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Wastewater Master Plan

Prepared for

City of Springfield, Oregon

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Glossary of Acronyms

AACE	American Association of Cost Engineering
CIP	capital improvement project
DEQ	Oregon Department of Environmental Quality
EDU	Equivalent Dwelling Unit
EPA	U.S. Environmental Protection Agency
E/S WPCF	Water Pollution Control Facility
GIS	geographic information system
gpad	gallons per acre per day
gpm	gallons per minute
gpd	gallons per day
HGL	Hydraulic grade line
I/I	Infiltration/inflow
LCOG	Lane Council of Governments
mgd	million gallons per day
MWMC	Metropolitan Wastewater Management Commission
MH	Manhole
NRCS	Natural Resources Conservation Service
NPDES	National Pollutant Discharge Elimination System
PFSP	Public Facilities and Services Plan
PVC	polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
RCP	reinforced concrete pipe
RDI/I	rainfall-derived infiltration and inflow
SAM	System Analysis Model
SDC	system development charge
SSMP	Sewer System Master Plan
SSO	sanitary sewer overflow
SSS	Sanitary Sewer Study
UBC	Uniform Building Code
UGB	urban growth boundary
WERF	Water Environment Research Foundation
WWFMP	Wet Weather Flow Management Plan

Executive Summary

Background

The City of Springfield provides wastewater collection and conveyance services using a system of pipelines and pump stations that it owns and operates. Along with the City of Eugene, Springfield discharges to a regional collection and treatment system owned by the Metropolitan Wastewater Management Commission (MWMC). Springfield's collection system discharges to the East Bank Interceptor, a MWMC facility. The master plan provides an assessment of existing and future needs for the City's collection system. Because the City's system contributes to the regional system, the master plan must consider and reflect results of the MWMC's Wet Weather Flow Management Plan (WWFMP) that identified improvements and activities for the wastewater collection and treatment facilities in the Eugene/Springfield (E/S) metropolitan area. That plan determined the most cost-effective and politically feasible solution for managing excessive wet weather wastewater flows acceptable to the MWMC and the Eugene and Springfield communities. Therefore, Springfield's plan provides a local solution for existing and future needs in the context of the regional solution. This is most evident in the level of I/I reduction achieved through pipeline rehabilitation which has been an ongoing system improvement activity following the WWFMP completion in 2001.

The Springfield Wastewater System Master Plan is intended to identify existing and future capacity constraints, determine capacity requirements and identify system improvements necessary to meet the city of Springfield's projected population and employment growth through the (2025) planning year. The hydraulic model used to develop Springfield's Wastewater Master Plan (WWMP) was developed with current inventory and land use data provided by the City. Wet Weather Flow Management Plan (WWFMP) results were considered, and based on additional monitoring data and updated modeling results, a refined solution for Springfield was developed.

Goals of this plan include:

- management of collection system flows and review of projected infiltration and inflow (I/I) removal requirements established in the WWFMP so as to not exceed the capacity of the MWMC Regional Wastewater Facilities currently being upgraded to meet projected flows and loads through 2025,
- providing continued public health and safety, and
- guidance to the development community.

Regulatory Drivers

DEQ has issued a NPDES (National Pollutant Discharge Elimination System) permit (#102486) for Springfield, Eugene and MWMC, which includes conditions under which treated wastewater can be discharged to the Willamette River. Included in those conditions is the requirement that Springfield, Eugene and MWMC fully implement the WWFMP, and that no discharges of untreated wastewater can be discharged to the waters of the state and US except under the following conditions; for flows greater than those occurring for the 24-hour duration, 1 in 5-year winter and 1 in 10-year summer storms. These conditions form the baseline assumptions for overflow avoidance in this plan and are consistent with the assumptions of the WWFMP. The Springfield/Eugene/MWMC NPDES permit will expire December 31, 2007 and DEQ is currently drafting a permit that will cover management of the wastewater system for the subsequent five years.

Public Process

Public Workshop

City staff facilitated a three hour open house/public workshop at City Hall, which allowed the public to explore the WWMP update in detail. The focus of the workshop was on the infrastructure improvements identified for both the existing wastewater system and the future expanded wastewater system. Copies of the plan were available for review, and staff answered questions from the public.

Outreach to the Engineering & Development Community

The WWMP was posted to the City's website for public review and comment. Staff conducted a mail-out notice to local engineering firms and developers, notifying them of both the public workshop and the web posting.

Public Hearing

In addition to City Council work sessions held during the WWMP update process, staff will facilitate a public hearing with the Springfield City Council for adoption of the WWMP. This hearing will be open to the public and allow for testimony prior to plan adoption.

Alternative Analysis

Deficiencies

The design storm was applied to the calibrated model to evaluate the existing (2007) pipeline system. System deficiencies were identified and are based on locations where the hydraulic grade line (simulated water surface) is within 2 feet or less than the ground surface elevation. This occurs at a number locations, therefore, sanitary sewer overflows are possible, particularly in the downtown area and in the eastern end of the Thurston trunk and connecting pipelines to the Main St. trunk.

Improvement Options

1. **Reduction Through Pipeline Rehabilitation** - Rehabilitation has the potential to reduce construction costs—larger pipes may not be necessary if peak flows due to I/I can be reduced. Consistent with the WWFMP, rehabilitation is assumed to consist of main lines and laterals within the public right-of-way ("public only").

The WWFMP includes recommendation for the Formulation/Definition and Implementation of a Voluntary Private Lateral Program. While the additional reduction due to private lateral replacement is not assumed in the solutions presented, it has been identified as a future program by the City and is described in Section 5.4.5 of the plan.

2. **Pipeline Replacement With Larger Pipes** – This option increases pipe diameters to create more capacity to convey peak flows. These improvements can also involve a pipe in parallel with the existing line, where the existing line is maintained and its capacity utilized.

3. **Diversion Pipelines –** This option involves installation of new pipes to divert flow from locations with limited capacity to those with available capacity.

4. **Pump stations** – When pump stations in collection system do not have capacity to convey the peak flow with the largest pump out of service, they are identified for improvement.

Storage was not considered a cost effective option. Infiltration and Inflow reduction, conveyance improvements, and additional treatment capacity consistent with the MWMC Facilities Plan were ultimately selected for implementation. In addition, storage was thought to be more of a problem with implementation and siting (being a good neighbor) than any public amenity opportunities (parks, etc.) it would offer.

Existing System Improvements

Gravity replacement pipes, parallel pipes, diversions and pump station upgrades, in addition to system rehabilitation are required to eliminate sanitary sewer overflows under existing conditions (see Figure ES-1). A diversion pipe proposed to convey flow from the Thurston trunk to the Main St. trunk will avoid more costly improvements along both trunk lines.

There are 6 manholes evaluated in the model where improvements do not eliminate hydraulic grade lines (HGLs) within 2 feet of the ground surface. There is no surface flooding at these locations and they are relatively isolated and distributed in the system. The HGL elevations are not the result of local pipeline capacity or high levels of I/I but are the result of the backwater produced by surcharge in pipelines downstream of these locations. As a result, the extent of additional improvements required to further reduce the HGL would likely be hundreds of feet of pipeline replacement to achieve HGL compliance at a relatively few manhole locations. The cost would be far greater than the recommended improvement to install water tight manhole covers at these limited number of manholes.

Future System Improvements

Future improvement projects are identified to eliminate system deficiencies observed when the future flows are applied to the system after improvements for existing conditions are made. The model indicates surface flooding at multiple downtown locations around the 21st and E pump station and at the eastern end of the Main St. trunk, which requires the identification of additional improvements. In most cases the future deficiencies require improvements in additional areas where no improvement has been identified for existing conditions.

Additional rehabilitation is included as part of the future improvements to meet 2001 WWFMP targeted peak flow reductions. One additional improvement along the Main St. trunk is necessary to address remaining deficiencies resulting from future land use. Table 5.5 lists the projects. These projects are separate and distinct from the projects identified from the existing conditions.

There are 4 manholes in addition to those identified for existing conditions, where improvements do not eliminate HGL's within 2 feet of the ground surface. For the same reasons as previously stated, the extent of additional improvements required to further reduce the HGL are greater than the recommended improvement to install water tight manhole covers at these limited number of manholes.

Expanding System to Meet Development Needs

Several areas have been identified for future development that are not served by the system as it existed in 2007. To plan for the needed infrastructure to service these areas, design peak flows were developed and the needed pipe locations, diameters and lengths were calculated as follows.

Ground elevations at locations along the probable pipe route were determined along with manhole depths and preliminary pipe slope. Based on the projected flow, the City's design standard, and calculated pipe slope, pipe diameters were calculated. To assist the City in future refinements to this master plan level of design, the expanded service pipes and manholes were entered into the hydraulic model based on estimated manhole depths. Pipe diameters for the expansion areas should be reviewed and adjusted as updated information becomes available.

With the exception of the Harbor Drive area, all areas are expected to be developed within the 20-year planning time frame (see Figure 5.5 of the plan).

CIP Recommendations

Shown on Figure ES-1 and listed in Table ES-1 is a complete listing of existing and future pipeline and pump station improvements. The table provides information in the following categories:

- Project location
- Comments on project characteristics
- Project to serve expansion areas
- Costs
- Priority provided by City of Springfield
- A proposed implementation year (or range of years)

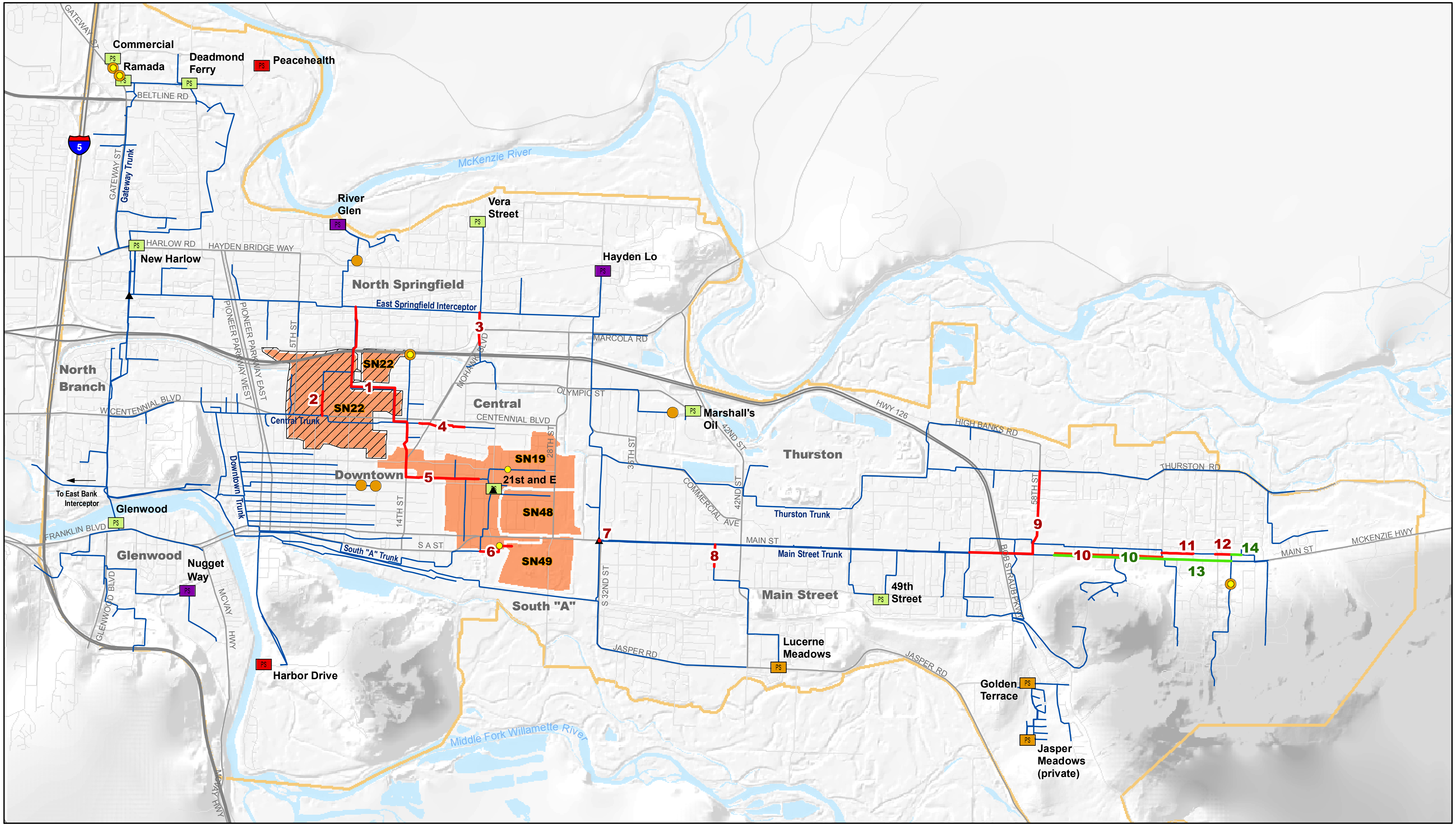
In the COMMENTS section of the CIP project listing, the diameter increase for existing pipelines that is required for future flow conditions is provided. For cases where an existing pipe needs to be upsized for both the existing and future conditions, the diameter required for both land use conditions is provided with the assumption that the diameter required for future land use will be installed.

Pipes for expanded (currently un-served) areas serving future development areas and their associated costs are also shown in the CIP section of the master plan.

The project priorities are based on a review of the projects by City staff and their understanding of other system drivers including health and safety, environmental impacts and development patterns. In addition, downstream to upstream logic, availability of monitor data in close proximity to improvement locations and basin boundaries, and quality of calibration were also considered. This results in recommendations for implementation and potential additional actions to refine project needs and associated characteristics that affect project costs.

SDC Allocations

In order to identify the relative contribution to the projects by land use condition, peak flows are provided for existing and future land use conditions for each project. Based on those peak flows a percentage of peak flow was calculated for existing and future land use.



Pump Stations

Existing Pump Station Improvements

Pump Stations to be Decommissioned

Future Pump Stations

Weir/Diversion

Existing Water Tight Manhole Improvements

Future Water Tight Manhole Improvements

Future Pipe Improvement

Existing Pipe Improvement

Existing Major Wastewater System Pipes

SN22 Future Basin Rehabilitation (WWFMP Subbasin ID)

Existing Basin Rehabilitation

Urban Growth Boundary

N

0 2,000 4,000
Approximate scale in feet

FIGURE ES-1
Executive Summary

City of Springfield Wastewater Master Plan

CH2MHILL

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TABLE ES-1
Capital Improvement Project Listing
Springfield Wastewater Master Plan

Springfield Wastewater Collection System Improvements

Project ID	Purpose	Existing Dia (Inch)	Proposed Diameter (Inch) or Peak Rate (gpm)	No of MHs	Length (ft)	Description	Comments	Priority	Proposed Year	Construction Cost	Total Cost
1	Existing upgrade	--	24	22	6418	Parallel existing 24-inch pipe with new 24-inch pipe from MH10033730 d/s to MH10033409	Will require 300 ft auger bore (bore & jack) 36-steel casing $75,000 (at $250/ft) under Hwy 126	6	2009 - 2010	$2,539,000	$3,935,000
2	Existing upgrade	12	21	4	795	Replace existing 12-inch with 21-inch from MH10033284 u/s to MH10033293	Used to control simulated overflow at MH10033395. Downstream pipe segment from MH10033284 u/s to MH10033294 is upgraded to 27-inch for future improvements.	10	2010 - 2011	$307,000	$476,000
3	Existing upgrade	12	18	5	1112	Replace existing 12-inch with 18-inch from MH10034175 u/s to MH10034164		19	2013 - 2014	$398,000	$617,000
4	Existing upgrade	10	12	11	1538	Replace existing 10-inch with 12-inch from MH10033706 d/s to MH10033719	Crosses Mohawk Blvd	20	2103 - 2014	$477,000	$739,000
5	Existing upgrade	15	24	21	4161	Replace existing 15-inch with 24-inch pipe from MH10034054 d/s to MH10033730. ***Project not required if future rehabilitation is performed.***	Flow monitoring basins 83 and 84 just u/s of improvements. Calibration fair in this area.			$1,625,000	$2,519,000
6	Existing upgrade	10	15	6	1231	Replace existing 10-inch with 15-inch pipe from MH10033920 d/s to MH10033982. ***Project not required if future rehabilitation is performed.***	Flow monitoring suggested prior to preliminary design			$391,000	$606,000
7	Existing upgrade	27/36	--	--	--	Flow at vault on west d/s end of Main Street Interceptor reconfigured to prevent flow from going north. All flow is diverted south.	No construction assumed. Reconfiguration of flow achieved through valve or weir adjustments.			--	--
8	Existing upgrade	10	15	3	714	Replace existing 10-inch with 15-inch from MH10034589 u/s to MH10034519.	Lucerne Meadows LS is routed to the West. As of 2007, this LS discharged to the north through these pipe segments.			$224,000	$347,000
9	Existing upgrade	--	15	17	4837	New 15-inch wet weather bypass from MH10035662 d/s to MH10035367.	Bypass weir set at 496.0 ft elevation (COS) at MH10035662. Crosses Bob Straub Pkwy at start of I105.	8	2010 - 2011	$1,416,000	$2,195,000
10	Existing upgrade	15/18	21--existing, 24--future	11	3589	Replace existing 15-inch and 18-inch pipe with 24-inch from MH10035908 d/s to MH10035636.	A 21-inch is necessary for existing land use. For future land use, this project is upgraded to a 24-inch pipe. Flow monitoring is recommended prior to preliminary design.	11	2010 - 2011	$1,356,000	$2,102,000
11	Existing upgrade	12	15	9	1014	Replace existing 12-inch with 15-inch from MH10035903 d/s to MH10035835.	Flow monitoring is recommended prior to preliminary design	15	2012 - 2013	$348,000	$539,000
12	Existing upgrade	10	12	3	529	Replace existing 10-inch with 12-inch from MH10036187 d/s to MH10036186.	Flow monitoring is recommended prior to preliminary design	16	2012 - 2013	$159,000	$246,000
Rehabilitation for I/I Reduction	Existing Rehab	Varies	8-12	--	23,548	All rehab in basin SN 22. This completes the existing rehab listed in the 2001 WWFMP.	Review cost effectiveness relative to conventional conveyance improvements	5	2009 – 2010	$3,908,968	$7,573,000
Nugget Way PS	Existing upgrade	642 gpm (single pump) 898 gpm (pumps 1 &2)	911 peak wet weather	--	--	Upgrade 2 pump system with 911 gpm capacity each	Flow monitoring suggested prior to preliminary design	3	2008 - 2009	$769,417	$1,443,000
Hayden PS	Existing upgrade	380 gpm (single pump)	494 gpm existing peak, 494 gpm future peak	--	--	Upgrade 2 pump system with 494 gpm capacity each	Flow monitoring suggested prior to preliminary design	21	2013 - 2014	$560,379	$1,050,000
River Glen PS	Existing upgrade	379 gpm (single pump)	525 gpm existing peak, 664 gpm future peak	--	--	Upgrade 2 pump system with 664 gpm capacity each	Flow monitoring suggested prior to preliminary design	22	2014 - 2015	$653,152	$1,224,000
13	Future upgrade	12	18	6	2224	Replace existing 12-inch pipe with 18-inch pipe from MH10035908 u/s to MH10036270.		13	2011 - 2012	$739,000	$1,145,000
14	Future upgrade	10	12	3	325	Replace existing 10-inch pipe with a 12-inch pipe from MH10036195 d/s to MH10036187		17	2012 - 2013	$105,000	$163,000
Rehabilitation for I/I Reduction	Future rehab	Varies	8-12	--	31,211	22.6k ft in SN19, 7k feet in SN48, 1.5k feet in SN49. This plus reduction due to pipe improvements completes the future rehab listed in the 2001 WWFMP.	Review cost effectiveness relative to conventional conveyance improvements	SN19 - 1 SN48&49 - 9	2008-2009 2010-2011	$5,181,026	$10,038,000

Project ID	Purpose	Existing Dia (Inch)	Proposed Diameter (Inch) or Peak Rate (gpm)	No of MHs	Length (ft)	Description	Comments	Priority	Proposed Year	Construction Cost	Total Cost
Harbor Drive	System expansion	--	8 (gravity) and 5 (force main)	32	7818	Service requirements: 1) new "Harbor Drive" PS equipped with 2 pumps each with 145 gpm capacity. 2) 134 ft of 5-inch to extend existing "dry pipe" force main 3) 7684 ft of 8-inch pipe to service entire neighborhood.	Project evaluated if river crossing reduced cost. Most cost effective solution makes use of the existing "dry pipe' force main in place north of the neighborhood..	25	2017 -2018	$2,156,000	$3,342,000
Jasper Road	System expansion	--	10, 12, 21	89	22992	Extends system along Jasper Road to allow for the decommissioning of Lucerne Meadows and Golden Terrace PSs. Service requirements: 1) 2581 ft of 10-inch pipe, 2) 3395 ft of 12-inch pipe, and 3) 17016 ft of 21-inch pipe.		4	2008–2010	$7,496,000	$11,619,000
Franklin Blvd	System expansion	--	8, 15	27	6280	Extends the system from the existing 30-inch south along Franklin Blvd. Service requirements: 1) 2411 ft of 8-inch pipe, and 2) 3868 ft of 15-inch pipe.	Includes the 150 trailer parcels not originally contained in the GIS.	2	2008 - 2009	$1,934,000	$2,998,000
Thurston Rd	System expansion	--	8	17	3882	Extends the system from the existing 15-inch east along Thurston Road. Service requirements are 3882 ft of 8-inch pipe.		24	2016 - 2017	$949,000	$1,471,000
McKenzie Hwy	System expansion	--	10,12	17	3906	Extends the system from the existing 21-inch east along McKenzie Highway. Service requirements: 1) 1924 ft of 10-inch pipe, and 2) 1983 ft of 12-inch pipe.	Pipe extended east as far as grade supported gravity flow. Last manhole shown is at crest of hill.	14	2011 - 2012	$1,049,000	$1,626,000
Vera Area	System expansion	--	8, 12	39	9583	Services the development east of the new Vera pump station. Service requirements: 1924 ft of 10-inch pipe and 1983 ft of 12-inch pipe.		23	2014 - 2016	$2,570,000	$3,984,000
PeaceHealth/ Riverbend PS	System expansion	--				Pump station designed as part of the PeaceHealth/Riverbend Campus Development.	Basis for cost is the *Sanitary Sewer Study for Riverbend Subdivision (KPFF Consulting Engineeers, 2005). Costs adjusted to 2008 dollars.*	12	2011 - 2012	$2,232,930	$3,189,900
		--									
Existing Subtotal										$15,131,917	$25,611,000
Future Subtotal										$6,025,026	$11,346,000
System Expansion Subtotal										$18,386,930	$28,229,900
Total										$39,543,873	$65,186,900

1.0 Introduction and Background

1.1 Background and Goals

The City of Springfield provides wastewater collection and conveyance services using a system of pipelines and pump stations that it owns and operates. Along with the City of Eugene, Springfield discharges to a regional collection and treatment system owned by the Metropolitan Wastewater Management Commission (MWMC). Springfield's collection system discharges to the East Bank Interceptor, a MWMC facility. The master plan provides an assessment of existing and future needs for the City's collection system. Because the City's system contributes to the regional system, the master plan must consider and reflect results of the MWMC's Wet Weather Flow Management Plan (WWFMP) that identified improvements and activities for the wastewater collection and treatment facilities in the Eugene/Springfield (E/S) metropolitan area. That plan determined the most cost-effective and politically feasible solution for managing excessive wet weather wastewater flows acceptable to the MWMC and the Eugene and Springfield communities. Therefore, Springfield's plan provides a local solution for existing and future needs in the context of the regional solution. This is most evident in the level of I/I reduction achieved through pipeline rehabilitation which has been an ongoing system improvement activity following the WWFMP completion in 2001.

The Springfield Wastewater System Master Plan is intended to identify existing and future capacity constraints, determine capacity requirements and identify system improvements necessary to meet the city of Springfield's projected population and employment growth through the (2025) planning year. The hydraulic model used to develop Springfield's Wastewater Master Plan (WWMP) was developed with current inventory and land use data provided by the City. Wet Weather Flow Management Plan (WWFMP) results were considered, and based on additional monitoring data and updated modeling results, a refined solution for Springfield was developed.

Goals of this plan include:

- management of collection system flows and review of projected infiltration and inflow (I/I) removal requirements established in the WWFMP so as to not exceed the capacity of the MWMC Regional Wastewater Facilities currently being upgraded to meet projected flows and loads through 2025,
- providing continued public health and safety, and
- guidance to the development community.

1.2 Regulatory Requirements

Springfield's design, operation, maintenance and management of the wastewater collection system is regulated under Federal, State and local regulatory requirements.

1.2.1 Federal

The United States Environmental Protection Agency (EPA) has delegated permitting authority under the Clean Water Act to the Department of Environmental Quality (DEQ). However, compliance with Clean Water Act requirements is reviewed periodically by the EPA, which retains independent enforcement authority.

1.2.2 State of Oregon

DEQ has issued a NPDES (National Pollutant Discharge Elimination System) permit (#102486) for Springfield, Eugene and MWMC, which includes conditions under which treated wastewater can be discharged to the Willamette River. Included in those conditions is the requirement that Springfield, Eugene and MWMC fully implement the WWFMP, and that no discharges of untreated wastewater can be discharged to the waters of the state and US except under the following conditions; for flows greater than those occurring for the 24-hour duration, 1 in 5-year winter and 1 in 10-year summer storms. These conditions form the baseline assumptions for overflow avoidance in this plan and are consistent with the assumptions of the WWFMP. It should be noted that the EPA has not approved DEQ's 1 in 5-year and 1 in 10-year 24-hour storm exceptions and draft EPA policy on sanitary sewer overflows (SSO's) currently is undergoing interagency review. It should be noted that the Springfield/Eugene/MWMC NPDES permit expired December 31, 2007 and has been administratively extended pending DEQ's completions of a "renewed" discharge permit. In addition to existing permit conditions regarding collection system maintenance, the Cities will be specifically required to identify and eliminate all inflow sources. Additionally, inclusion of the 1 in 5 year and 1 in 10 year SSO exceptions will be dependent on EPA approval of an SSO rule that enables DEQ to maintain this standard.

After reviewing the total rainfall in 24 hours for the one in 5 year winter and one in 10 year summer, it was determined that the one in 5 year winter storm was greater. Because of the relatively wide range in historic 5-year, 24-hour rainfall totals, uncertainty about the methodologies used to establish the total depth, and the relative remoteness in time when the rainfall frequency analyses were conducted, a new frequency analysis was performed using Eugene Airport historic hourly rainfall data for the 1948 to 2005 period. The frequency analysis used wet season (not full year) annual maximums to calculate a 5-year, 24-hour rainfall of 3.83 inches compared to 3.9 inches used in the most recent planning studies. This revision is currently under review by DEQ.

1.2.3 Statewide Planning Goals

Statewide planning goals also govern local jurisdictions planning for key urban services and public facilities. Specifically, Statewide Planning Goal 11 requires 20 year public facilities plans. The Eugene-Springfield Metropolitan Area (Metro) General Plan and the Public Facilities and Services Plan (PFSP), a functional refinement of the Metro Plan, are acknowledged as compliant with Statewide planning Goal 11. The 2004 MWMC Facilities Plan adopted most recently, promulgated significant amendments to the Metro Plan and PFSP, and Springfield Collection System Master Plan and must not conflict with or result in internal inconsistencies. The Metro

Plan requirements include policies for provision of key urban services and the PFSP which compel the City to extend the system to support new development.

1.2.4 Pump Station Sizing Requirements

The state has design standards that must be met for pump stations. According to the DEQ Oregon Standards for Design and Construction of Wastewater Pump Stations, a pumping system consisting of multiple pumps, must include one spare pump sized for the largest series of same-capacity pumps to provide for system redundancy.

1.2.5 City of Springfield Development Code

Chapter 4.3-105 of the Springfield Development Code requires sanitary sewer systems to be installed with new developments in the City and requires new developments connect to existing mains. The Code requires new systems to be designed in conformance with the *Engineering Design Standards and Procedures Manual*.

2.0 Related Documents

2.1 Wet Weather Flow Management Plan (WWFMP)

In 1998, MWMC initiated a project to develop a comprehensive WWFMP for the local and regional wastewater collection and treatment facilities in the Eugene/Springfield metropolitan area. Developing the plan essentially consisted of evaluating four technologies for managing excess wet weather flow relative to performance (frequency of SSOs), cost, and political and community acceptance. The four technologies included: (1) system rehabilitation to control rainfall-derived infiltration and inflow (RDI/I); (2) in-line and off-line storage of peak flows; (3) additional conveyance (including greater pipe conveyance and pump station capacity); and (4) additional capacity to treat peak flows at the treatment plant. The objective of the plan was to develop and implement the most cost-effective set of solutions, looking at the locally owned and MWMC owned system as a whole. The resulting strategies, which were adopted in 2001 by MWMC, Eugene and Springfield, are outlined in Table 2.1 below.

TABLE 2.1
WWFMP Solutions for Existing Conditions
City of Springfield Wastewater Master Plan

Component of WWFMP	Description
Sub-Area Solution E24 (Springfield)	Public system rehabilitation in seven sub-basins
	Further investigation and remediation as necessary in Gateway area
	Upgrades to the Willakenzie Pump Station and potentially the Gateway Pump Station
	No storage
Sub-Area Solution W25 (Eugene)	Public system rehabilitation in 21 sub-basins
	Installation of valve at 14th and Tyler
	Upgrade to screw pumps at treatment plant
	No Storage
Strategy to Manage Excess Flow at Eugene/Springfield Water Pollution Control Facility (E/S WPCF) for Existing Conditions	Manage 100 percent of 82-mgd excess flow rate and 59.4-million-gallon excess volume by adding two primary treatment trains to E/S WPCF. Two additional primary treatment trains will increase primary treatment capacity to approximately 263 mgd, or 88 mgd beyond the current primary treatment capacity of 175 mgd.

2.2 MWMC Facilities Plan

The 2004 MWMC Facilities Plan is the result of a comprehensive evaluation of the regional wastewater treatment facilities serving the Eugene-Springfield metropolitan area. The Facilities Plan is a comprehensive update to the original "208 Plan," which was completed in 1977. The 208 Plan established the original projections, requirements, and projects needed to serve the Eugene-Springfield community through 2004. This Facilities Plan also builds on previous, targeted studies, including the 1997 MWMC Master Plan for the Eugene/Springfield Water

Pollution Control Facility (E/S WPCF), 1997 Biosolids Management Plan, 2001 Wet Weather Flow Management Plan and the 2003 Management Plan for a Dedicated Biosolids Land Application Site.

Both Eugene and Springfield have separate sewer systems that come together into a regional system of pipes. Over 800 miles of sewer pipes and 47 pump stations transport wastewater to the E/S WPCF. Most of the conveyance pipelines of 24 inches in diameter or greater and associated pumping facilities necessary to convey the region's wastewater to the regional facility were included in the facilities' original construction by regional and local resources. This new MWMC Facilities Plan identified facility enhancements and expansions that are needed to serve the community's wastewater needs through 2025 as described below.

Excess flow management (increasing from 175 mgd to 277 mgd--2025 projection) will be attained by implementing a peak flow management approach within the WPCF. The peak flow will be conveyed to the WPCF and the entire peak treated through preliminary treatment (screenings and grit removal). A portion of the preliminary effluent will then be routed to the existing four primary clarifiers; the remaining portion will be routed directly to the aeration basins. The primary effluent will then be diverted around secondary treatment and re-blended with the secondary effluent before being discharged to the Willamette River.

No additional primary clarifiers will be constructed but rather primary peak flow treatment capacity will be increased in these existing four tanks by retrofitting them with new energy dissipation inlets and baffling (in the range from 72 - 86 mgd existing capacity to 137 - 165 mgd after enhancements). Secondary treatment capacity will be expanded from approximately 103 mgd to 165 mgd by retrofitting 4 of the existing 8 aeration basin cells with step feed and anoxic selector technology, retrofitting/enhancing the existing 8 secondary clarifiers, and constructing two additional secondary clarifiers.

2.3 Public Facilities and Services Plan (PFSP)

This Eugene-Springfield Metropolitan Area Public Facilities and Services Plan (Public Facilities and Services Plan, December 2001) is a refinement plan of the Eugene-Springfield Metropolitan Area General Plan (Metro Plan). The plan evaluates public facility needs in the Eugene-Springfield metropolitan area, including estimated costs and timing of planned projects, and describes existing and alternative methods of financing public facilities and services.

A companion document, the Eugene-Springfield Metropolitan Area Public Facilities and Services Plan, Existing Conditions and Alternatives report (April 1999) serves as a technical background document to the Public Facilities and Services Plan and can be referenced for more detailed information on existing water, wastewater, stormwater, and electrical facilities, including alternative financing and service delivery options.

The PFSP was updated and amended in 2005 to include revised population and employment projections and associated regional wastewater facilities for a new PFSP planning horizon of 2025. Springfield's wastewater capital improvements will need to be consistent with the PFSP.

2.4 Engineering Design Standards and Procedures Manual

The City of Springfield Public Works Department updated the Engineering Design Standards and Procedures Manual for public infrastructure in 2006. The manual is intended to help the development community identify acceptable design options and standards, and to explain permitting procedures, requirements and schedules. For the purpose of this document the following engineering design standards are used:

- gravity and force main velocities
- minimum cover
- minimum slope

2.5 North Springfield Sewer Study

The City of Springfield recognized the need to plan for future sanitary sewer service for the unsewered areas north of I-105 in North Springfield where most homes were on individual septic systems. In 1991, CH2M HILL conducted an engineering study and developed a conceptual sewer layout for sewer service areas generally bounded by Gateway Street on the west, I-105 to the south, Mohawk Road to the east and the UGB to the north. The report summarizes the finding of the engineering study and includes discussion and recommendations pertinent of the facilities needed to expand the sewer system to serve North Springfield. Major elements of the report included:

1. Development sewage flows
2. Development of infiltration and inflow rates
3. Development of pipe sizes
4. Determined pump station sizes
5. Prepared sewer system maps
6. Prepared opinions of cost of proposed facilities
7. Modified existing System Analysis Model (SAM) program to reflect new sewer configurations
8. Ran modified SAM program to determine impacts on the existing North Springfield Interceptor.

2.6 SHN I&I Investigation

This report discusses sanitary sewer interceptor investigations performed by the SHN Consulting Engineers and Geologists for the City of Springfield on the Glenwood and Marcola interceptors. Findings and recommendations are presented which include conclusions about the potential causes of major defects, rehabilitation methodologies that could be employed to solve the deficiencies noted, and subsequent analyses to optimize the type of repair. A preliminary project description and budgetary cost estimate is presented to assist the City begin the process of planning and implementing critical I/I reduction improvements on the Marcola Interceptor.

The City of Springfield conducted an I&I and pipe defect investigation in the sanitary sewer collection systems located between Glenwood Blvd. and Franklin Blvd. (Study Area 1) and between Olympic Street and Marcola Road. (Study Area 2). Following rainfall events, the collection systems in both of these areas experience I/I induced flows that increase normal daily flow rates by as much as 8:1. Typically, a rainfall event that is greater than 0.5 inches in 24 hours is sufficient to create noticeable increases in the pipeline flows.

The major elements identified during the project study are summarized in Table 2.2 below.

Table 2.2
Inventory of Collection System in Study Area
City of Springfield Wastewater Master Plan

Description	Line Size	Estimated Footage or No.
Marcola Interceptor	42 -inch	5,682 Lineal Feet
Marcola Interceptor	Manholes	9
Glenwood Trunk Line	24-inch	3,399 Lineal Feet
Glenwood Trunk Line	18-inch	1,450 Lineal Feet
Glenwood Trunk Line	15-inch	203 Lineal Feet
Glenwood Trunk Line	12-inch	853 Lineal Feet
Glenwood Trunk Line	8-inch	93 Lineal Feet
Glenwood Trunk Line	Manholes	26
Total CCTV Footage		11,680 Lineal Feet
Total Manhole Inspections		35

2.7 Standard Construction Specifications

Springfield's Standard Construction Specifications were adopted in 1994, and have been updated periodically thereafter. Division 400 of the Standard Specifications provides guidance to contractors for standard construction practices for sewers, including construction techniques and materials.

2.8 Sanitary Sewer Study for RiverBend Subdivision

The Sanitary Sewer Study (SSS), prepared by KPFF Consulting Engineers, is a supplemental report submitted in March 2005 in support of PeaceHealth's RiverBend Master Plan and Subdivision Tentative Plan applications. It provides the framework for the sanitary sewer study approach and also describes the sanitary sewer service available to the RiverBend Subdivision campus and proposed the conceptual layout necessary to serve the campus, including the site of the Sacred Heart Medical Center. The site of the study is generally bounded by Deadmond Ferry Road and a residential area to the north, the McKenzie River to the east, South Game Farm Road to the west, and a residential neighborhood to the south.

2.9 Eugene-Springfield Metropolitan Area General Plan

Modifications to the Springfield sanitary system are required to be consistent with the overall policy framework and planning and land use designations set forth in the Eugene-Springfield Metropolitan Area General Plan 2004 Update (Metro Plan; 2004). The Metro Plan is the official long-range comprehensive plan (public policy document) of metropolitan Lane County and the cities of Eugene and Springfield. The Metro Plan sets forth general planning policies and land use allocations and serves as the basis for the coordinated development of programs concerning the use and conservation of physical resources, furtherance of assets, and development or redevelopment of the metropolitan area.

The Public Facilities and Services element of the Metro Plan provides direction for the future provision of wastewater collection and treatment infrastructure as "key urban services" to planned land uses within the Metro Plan, Plan Boundary.

3.0 Study Area Characteristics

This chapter describes the location, physical environment, land uses and zoning, and other general characteristics of the study area that affect this facilities planning effort.

3.1 Study Area

The Springfield metropolitan area is located in the heart of Lane County, Oregon, and is situated in the southern Willamette Valley between the Willamette and McKenzie rivers. When combined with Eugene, it makes up Oregon's second largest metropolitan area. Interstate 5 divides the metropolitan area; Eugene is located on the west side, and Springfield is located on the east side of Interstate 5. MWMC provides regional wastewater conveyance and treatment services for Springfield. The current Springfield service area is shown in Figure 3.1 (the urban growth boundary (UGB) of Springfield serves as the boundaries of service). The UGB defines the area where Springfield will continue to provide wastewater collection services to a growing metropolitan area over the next 20 years.

3.2 Physical Environment

3.2.1 Temperature

The average winter temperature is approximately 42 degrees F with an average daily minimum temperature of 35 degrees. The lowest temperature occurred on December 8, 1972, and registered –12 degrees F. In summer, the average temperature is 64 degrees F and the average daily maximum temperature is about 76 degrees F (NRCS, 1977). Additional temperature data are shown in Table 3.1 and Figure 3.2.

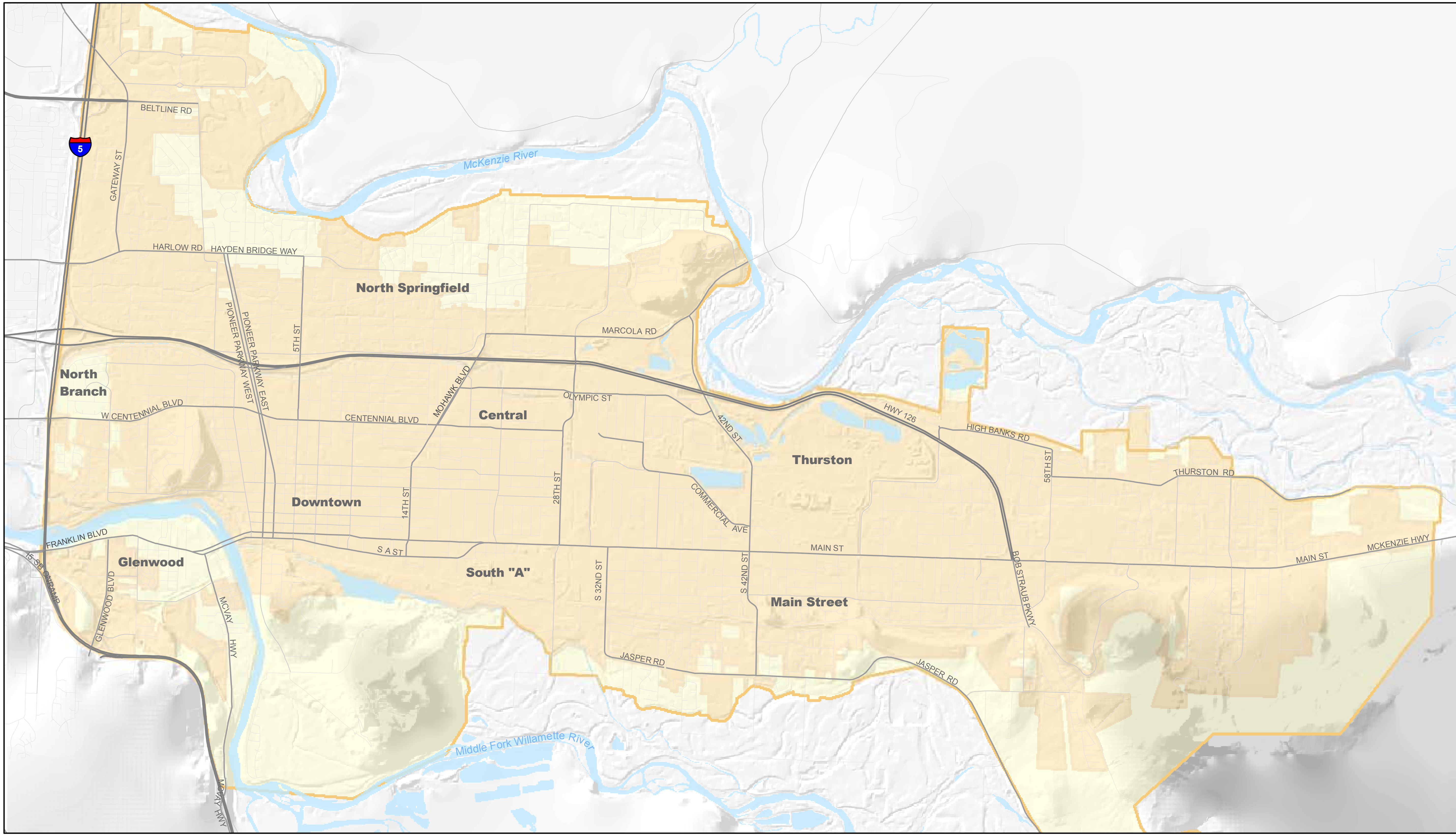
3.2.2 Precipitation Patterns

The City of Springfield website documents an average annual rainfall of 46 inches. Almost fifty percent of this precipitation occurs during the wet season spanning November to January. The dry months of July and August receive less than 1 inch of rainfall. Monthly precipitation data are shown in Table 3.1 and Figure 3.3.

3.2.3 Groundwater

The stages of both the McKenzie and the Willamette rivers rise and fall with the wet and dry seasons and with releases and storage from upstream dams. The groundwater level generally stays constant during the dry season, normally 10 feet to 20 feet below grade. However, groundwater level can experience a 7-foot increase during the wet season.

Table 3.1 and Figures 3.2 and 3.3 provide monthly temperature and precipitation data.



LEGEND

Urban Growth Boundary

City Limits

FIGURE 3.1
Study Area

City of Springfield Wastewater Master Plan

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TABLE 3.1
Average Temperature and Precipitation in Springfield
City of Springfield Wastewater Master Plan

Month	Average Temperature (%F)	(%F)	Average Precipitation (in)
January	46	33	7.5
February	52	35	5.5
March	55	36	5.1
April	61	39	2.8
May	67	43	2
June	74	48	1.3
July	82	51	0.4
August	81	51	0.8
September	76	47	1.5
October	64	42	3.7
November	53	38	7.5
December	47	35	7.9
Total			46.0

Source: http://www.ci.springfield.or.us/stats.htm

Figure 3.2

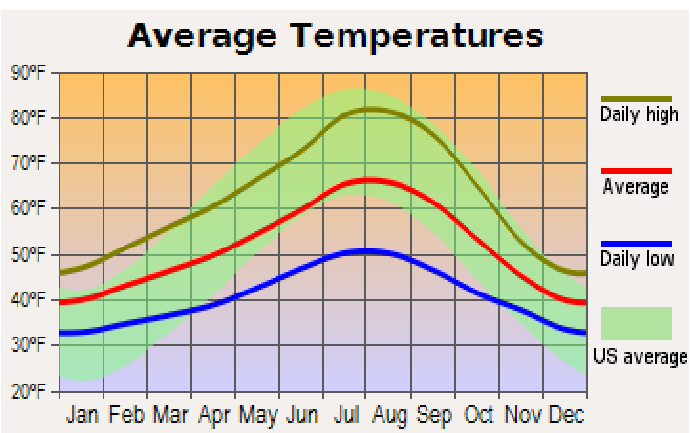
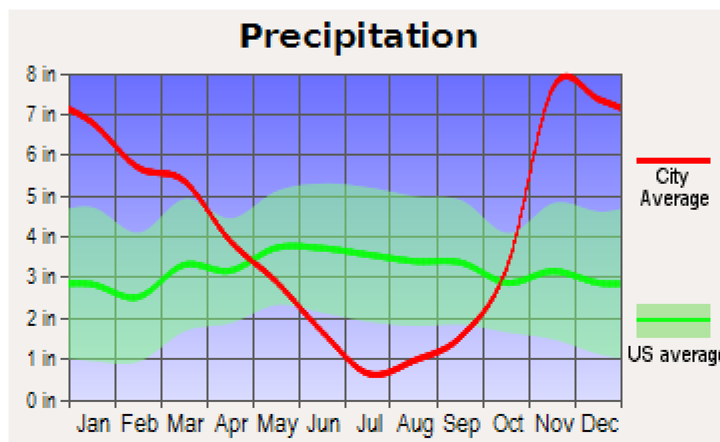


Figure 3.3



Source: http://www.city-data.com/city/Springfield-Oregon.html

3.3 Socioeconomic Environment

3.3.1 Historical Population

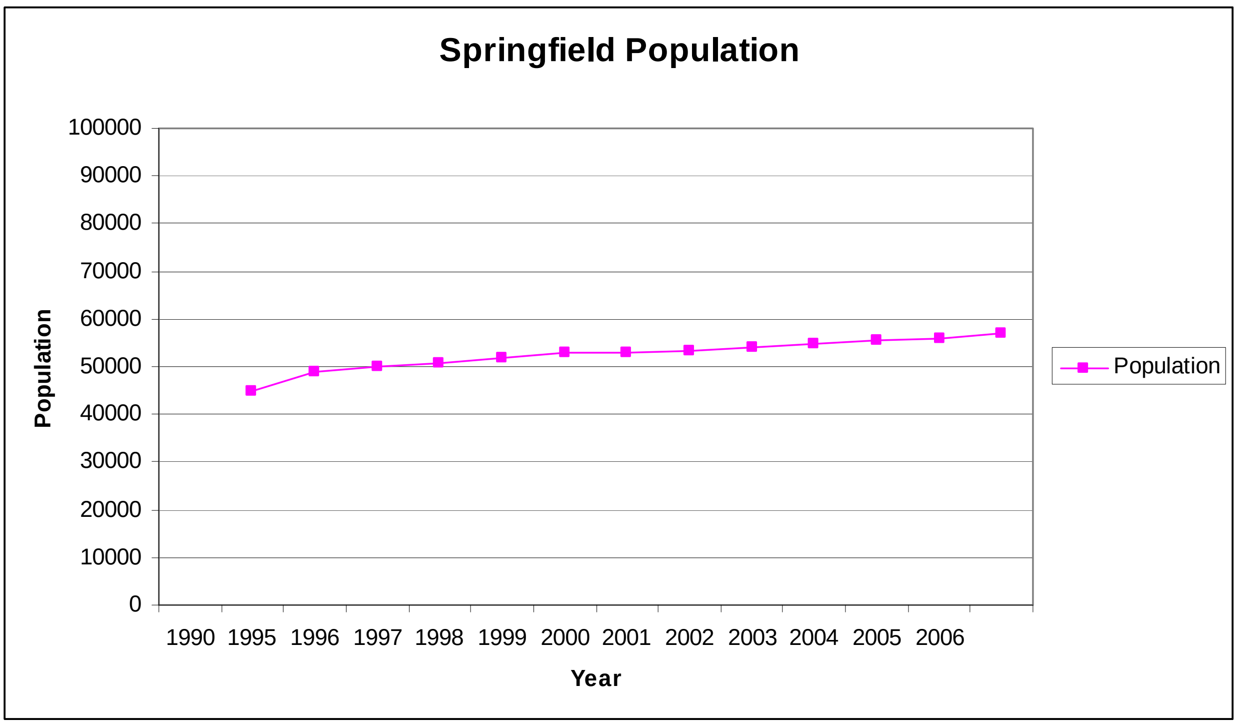
Historical population data obtained from the Lane Council of Governments (LCOG) for both Eugene and Springfield were collected for years 1990 and 1995 through 2002 (Figure 3.4). Historical population data have been summarized and presented in Table 3.2.

TABLE 3.2

Historical Population Data for Springfield, 1990-2006
City of Springfield Wastewater Master Plan

Year	Springfield Population
1990	44,683
1995	49,005
1996	50,140
1997	50,670
1998	51,700
1999	52,945
2000	53,005
2001	53,483
2002	53,946
2003	54,720
2004	55,350
2005	55,860
2006	57,065

FIGURE 3.4
Historical Population for Springfield



3.3.2 Population Growth Projections

The following population projections were obtained from the City's web site and are based on Lane County growth trends. The values assume Springfield=16% of Lane County. The year and estimated population is provided below:

- 2010: 60,960
- 2015: 66,130
- 2020: 71,216

3.4 Land Use Regulations

3.4.1 Springfield Facilities Located Within the Urban Growth Boundary

For planning and coordination of services within the urban growth boundary (UGB), the Public Facilities and Services Plan identifies jurisdictional responsibility for the provision of wastewater services, describes respective service areas and existing and planned wastewater facilities, and contains planned facilities maps for these services.

Springfield's development will remain consistent with Metro Plan policies by using planned facilities maps of the Public Facilities and Services Plan to guide the general wastewater projects in the metropolitan area. In addition, Springfield will use refinement plans and ordinances as the guide for detailed planning and project implementation.

3.4.2 Zoning Designations

The Springfield sanitary system is situated in numerous zoning designations within the UGB. However, to describe all of the various zoning designations occupied by Springfield's infrastructure would be overly complex and beyond the scope of this discussion. Therefore, to simplify the description, the existing and future land use zoning is shown in Figures 3.5 and 3.6 and Tables 3.3 and 3.4.

3.4.3 Land Use

The Eugene-Springfield metropolitan area has undergone a 50 percent to 70 percent growth in land area during the past two decades. It encompasses a total of 48,898 acres in the UGB. Currently, approximately 39,683 acres are served by MWMC. Of this area, 36 percent is classified residential, 15 percent is commercial, 3 percent is industrial, and the remaining 46 percent is either government, water, right-of-way, open space, or vacant. A certain portion of this total acreage does not contribute to the wastewater collection system or is known to be undeveloped. Examples include areas served by septic tanks, wetland areas, and areas with steep slopes. The steep slope areas were identified by City staff in a geographic information system (GIS) layer to estimate areas undevelopable due to steep slopes. For the purposes of wastewater planning, all of these areas (approximate total of 2,065 acres) are considered noncontributing and are not included in the flow analysis. The total noncontributing areas for Eugene and Springfield are 1,778 and 283 acres, respectively. The total area contributing to the wastewater collection system is composed of 67 percent residential, 28 percent commercial, and 5 percent industrial. Tables 3.3 and 3.4 list the Equivalent Dwelling Units (EDUs) and area served within each flow monitoring basin for existing and future land use conditions respectively. The land use type within each flow monitoring basin is shown in Figures 3.5 for existing conditions and in 3.6 for future conditions.

3.5 Vertical Datum used for Model

The elevations used in the hydraulic model developed for this Springfield wastewater master plan are in the City of Springfield vertical datum. The following is provided for reference only for coordination between City of Springfield and MWMC hydraulic models and projects.

The City of Eugene uses the NGVD29 vertical datum, except at the airport where it is NAVD 88 (source: Mike Miller January 10, 2007 email). NGVD29 is 3.5 feet lower than NAVD88 and the City of Springfield uses a datum that is 0.35 feet lower than NGVD29 in elevation (source: David Starns January 19, 2007 email). The City of Springfield is in the process of converting to NAVD 88, but the City of Eugene is intending to stay at NGVD1929. The final MWMC datum will be NGVD1929.The adjustment to bring City of Springfield vertical datum to equal the NGVD29 datum used by the City of Eugene is to add 0.35 feet to all elevation data used in the Springfield hydraulic model which was based on GIS and as-builts.

TABLE 3.3
Existing Land Use
City of Springfield Wastewater Master Plan

Basin ID	Land Use Category	EDU	Acres
5173	Commercial	3843	332.6
5173	Industrial	993	224.9
5173	Residential	17590	2366.3
F70	Commercial	1047	45.6
F70	Industrial	350	66.0
F70	Residential	700	60.6
F72	Commercial	79	3.6
F72	Industrial	3	0.5
F72	Residential	1056	119.7
F74	Commercial	453	26.6
F74	Industrial	690	146.5
F74	Residential	1068	213.7
F77	Residential	658	73.1
F81	Commercial	98	17.2
F81	Industrial	179	48.1
F81	Residential	65	45.3
F83	Commercial	90	9.7
F83	Industrial	81	7.6
F83	Residential	228	35.5
F84	Commercial	24	0.9
F84	Industrial	5	0.7
F84	Residential	287	40.8
F85	Commercial	262	6.7
F85	Industrial	3	0.01
F85	Residential	358	45.3
F86	Commercial	40	2.9
F86	Residential	219	34.7
F87	Commercial	17	0.4
F87	Residential	298	21.8
F88	Commercial	276	15.1
F88	Industrial	1008	400.4
F88	Residential	585	97.7
F89	Industrial	7	4.5
F89	Residential	2831	425.4
F90	Commercial	227	12.3
F90	Industrial	63	0.6
F90	Residential	1122	154.9
TOTAL		**36,902**	**5,108**

TABLE 3.4
Future Land Use
City of Springfield Wastewater Master Plan

Basin ID	Land Use Category	EDU	Acres
5173	Commercial	4529	491.4
5173	Industrial	1862	613.1
5173	Residential	28496	4335.6
F70	Commercial	1077	55.9
F70	Industrial	570	244.6
F70	Residential	1775	160.8
F72	Commercial	79	3.6
F72	Industrial	3	0.5
F72	Residential	1056	119.7
F74	Commercial	453	26.6
F74	Industrial	1002	391.8
F74	Residential	1088	215.8
F77	Residential	658	73.1
F81	Commercial	152	23.8
F81	Industrial	222	59.9
F81	Residential	113	64.6
F83	Commercial	90	9.7
F83	Industrial	81	7.6
F83	Residential	228	35.5
F84	Commercial	24	0.9
F84	Industrial	5	0.7
F84	Residential	287	40.8
F85	Commercial	262	6.7
F85	Industrial	3	0.0
F85	Residential	358	45.3
F86	Commercial	40	2.9
F86	Residential	219	34.7
F87	Commercial	17	0.4
F87	Residential	298	21.8
F88	Commercial	276	15.1
F88	Industrial	1319	482.6
F88	Residential	585	97.7
F89	Industrial	7	4.5
F89	Residential	2996	509.1
F90	Commercial	227	12.3
F90	Industrial	63	0.6
F90	Residential	1122	154.9
TOTAL		**51,642**	**8,365**

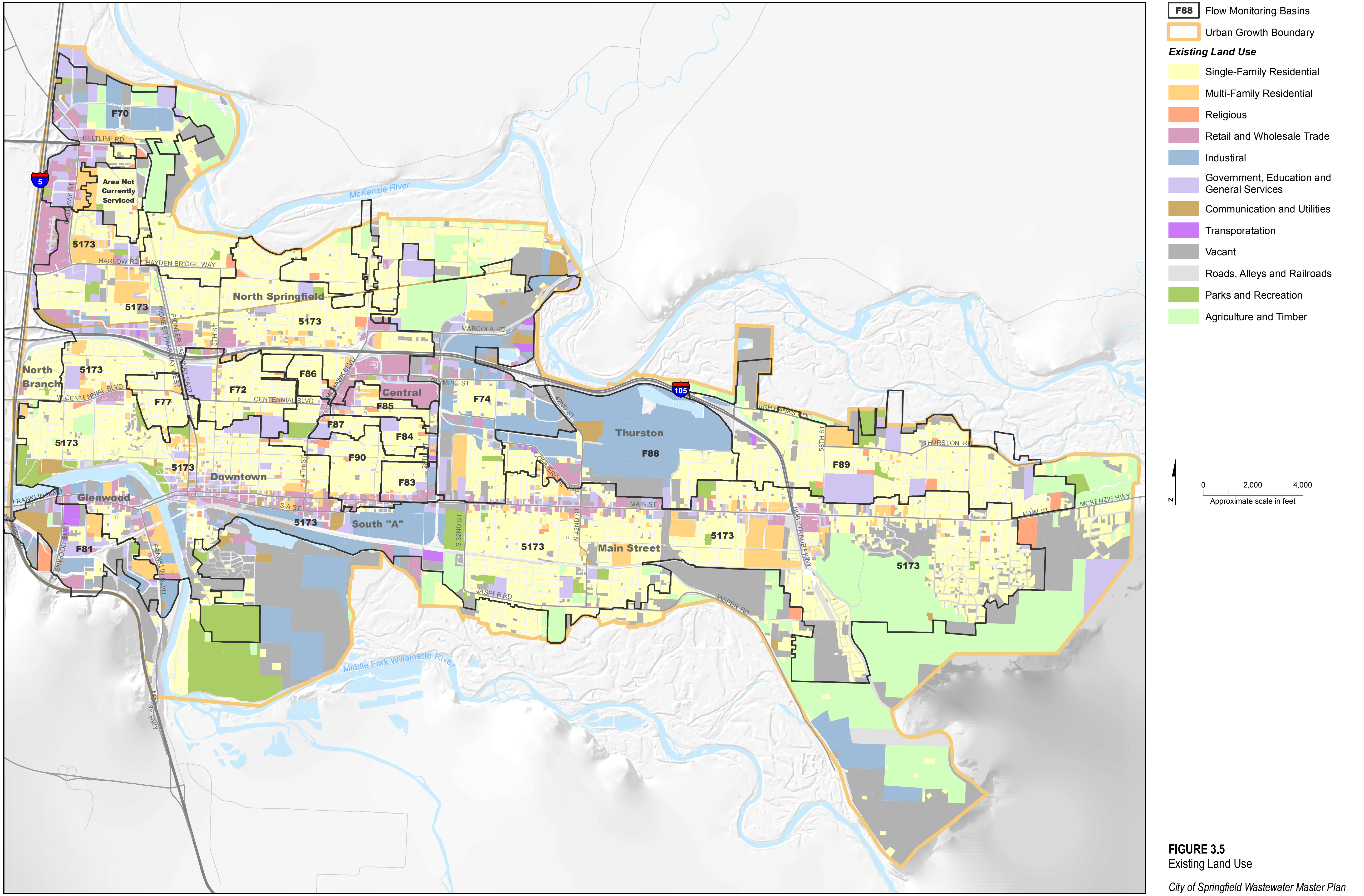


FIGURE 3.5
Existing Land Use

City of Springfield Wastewater Master Plan

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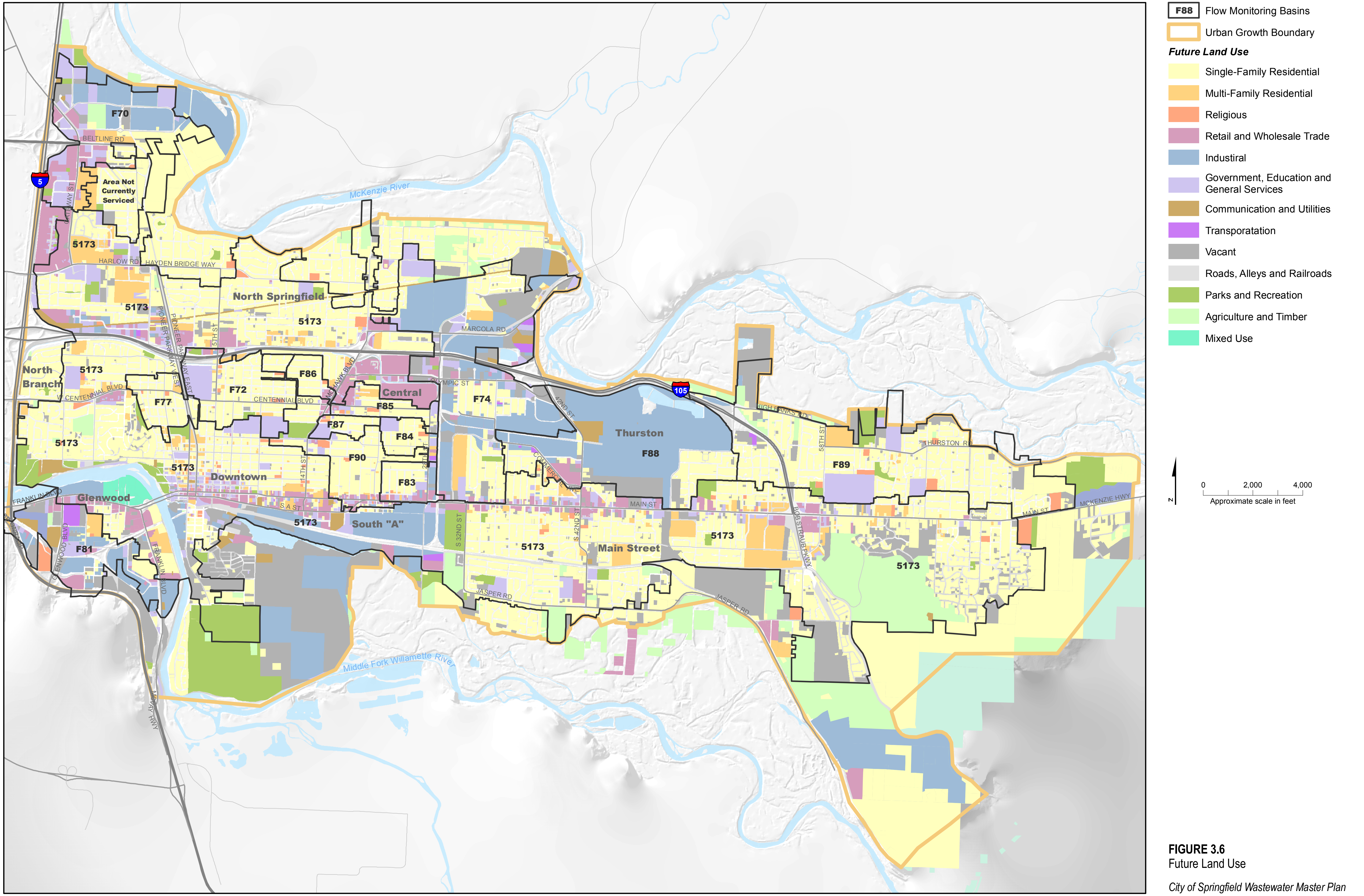

FIGURE 3.6
Future Land Use

City of Springfield Wastewater Master Plan

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4.0 Existing Wastewater Collection System

4.1 Inventory of Existing System

The City of Springfield's wastewater system consists of seven major interceptors and trunk sewers serving various sectors of the service area. Gravity lines follow local topographic features, generally flowing from east to west. All sewage flows are conveyed to the East Bank Interceptor near I-5 and the Willamette River. Sewage flows are then routed to the Eugene/Springfield WPCF through the Willakenzie Pump Station.

4.1.1 Springfield Wastewater Collection System

The Springfield collection system includes approximately 229 miles of pipelines.
The major trunk systems in Springfield are Gateway, Thurston, Main Street, East Springfield Interceptor (a MWMC owned and maintained pipeline), South Springfield Interceptors, Central and Downtown. Springfield's existing collection system consists of approximately 28 miles of interceptor and trunk sewers 10-inches in diameter and larger. Of this, 1,546 pipe segments (75.7 miles) and 1,548 nodes representing 34 percent of the system are included in the system model developed to project flows and capacity requirements of the system. Based on information on the City's web site there are 16,720 service connections.

Table 4.1 summarizes the pipeline lengths by flow monitor basin for existing pipelines in the Springfield sewerage system. A detailed break down of pipe diameters and lengths by flow monitoring basin is shown in Appendix F.

The basis for developing the physical system in the hydraulic model was the City's geographical information system (GIS) data supplemented with as-built and survey data.

TABLE 4.1
Summary of the System per Flow Monitoring Basin
City of Springfield Wastewater Master Plan

Flow Monitor Basin	No of Pipes	Length (ft)	Area (Acres)
5173	3,932	762,476	5,779
F70	186	32,728	433
F72	109	30,416	251
F74	397	84,859	928
F77	76	18,965	109
F81	71	17,995	324
F83	46	10,320	84
F84	45	9,543	69
F85	73	14,137	88
F86	32	9,393	53
F87	30	6,585	43
F88	208	46,105	704
F89	652	120,110	924
F90	179	46,366	258
Total	**6,036**	**1,209,998**	**10,048**

The original downtown basin is the oldest portion of the Springfield collection system. Constructed before World War I, it was designed to carry and discharge both stormwater and sanitary flows to the Willamette River. In the 1950's, the City constructed a wastewater treatment plant. Wastewater flows remained in the existing conduits, but new conveyance facilities were built to transport stormwater to the Willamette River.

The remainder of the system was developed around the downtown core as the City expanded. The original East Springfield Interceptor was constructed in 1962; the South Springfield Interceptor was construction in 1997. Table 4.2 summarizes the collection system by age.

TABLE 4.2
Summary of Collection System Age
City of Springfield Wastewater Master Plan

Date Constructed	Length of Pipe (miles)	Percent (%)
1987-2007	41.3	20.3
1966-1986	86.3	42.4
1945-1965	76.05	37.3

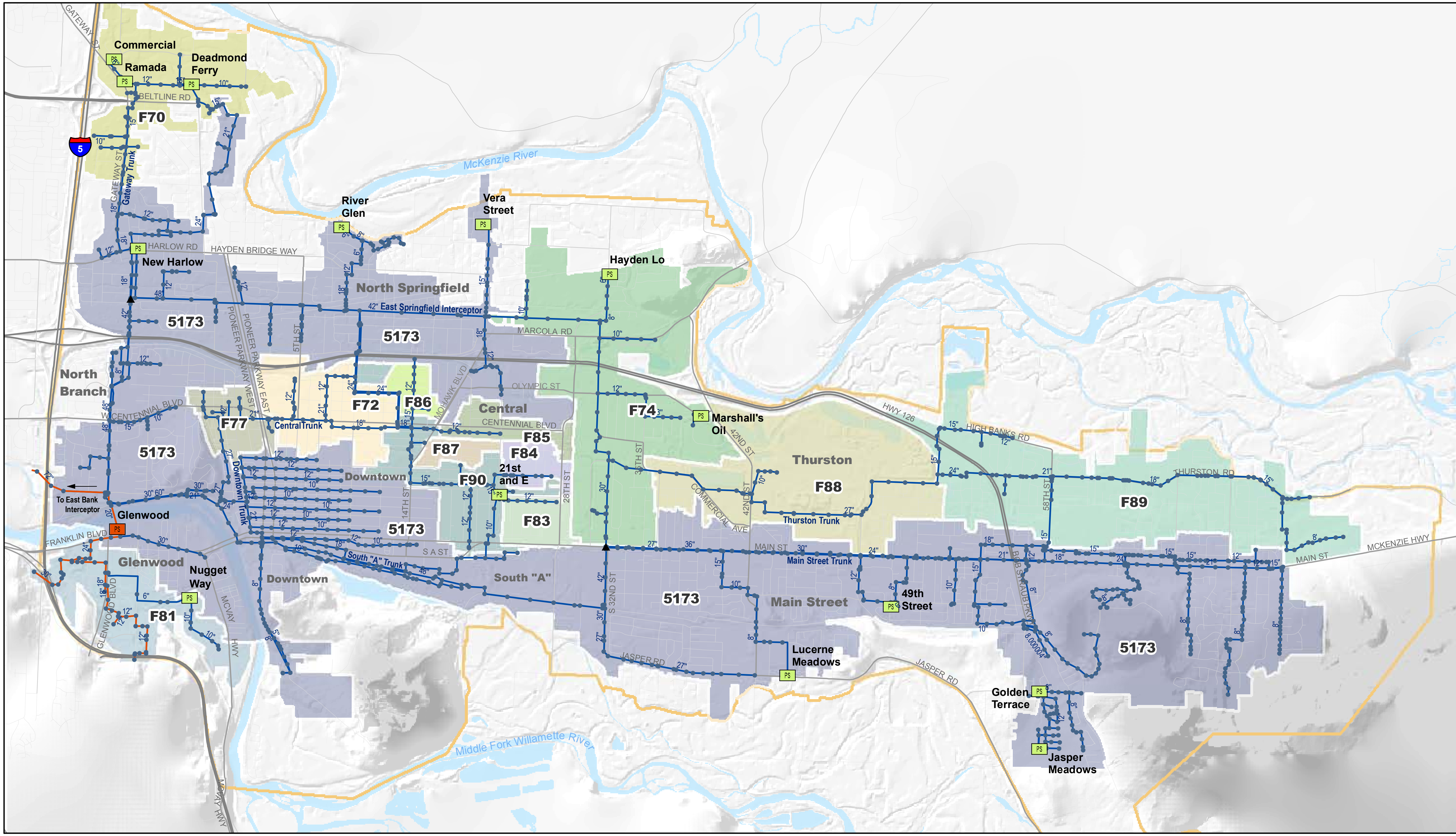
The existing Springfield wastewater service area is divided into seven major areas which are generally defined by topographic and demographic features. These areas are individually discussed as follows and shown in Figure 4.1.

North Springfield/North Branch: The North Springfield/North Branch areas are served by the East Springfield Interceptor. Constructed in 1962 following the annexation of East Springfield (1960), this interceptor consists of 2 miles of 48-inch diameter reinforced concrete pipe running from the connection to the East Bank Interceptor north and east upstream to Laura Street. The North Springfield area is generally bounded by the north city limits, highway 126 to the south, the head of the East Springfield Interceptor to the east, the intersection of Lochaven and Don Streets to the west. The North Branch Basin is generally described as a rectangle bounded by I-5, Belt Line Road, the Willamette River and an imaginary north/south line running through Kelly Butte.

Typical pipe depth varies from 10- to 18-feet (ground surface to pipe invert), with an average slope of approximately 0.001 feet/ft. From Laura Street to its head near the railroad spur line service 32nd street, the line is 42-inches in diameter, having an average depth of about 12- to 13-feet with a typical slope of 0.001 to 0.0015 feet/ft.

All sanitary sewage generated east of 32nd Street enters the East Springfield Interceptor via the Thurston or Main Street trunk sewers. Other major tributary lines served by this interceptor include the City Center relief sewer and the Gateway Street trunk sewer.

Thurston Road: This is located in the extreme easterly portion of the City. The Thurston trunk sewer ranges in size from 15-inches near Thurston School to 27-inches at the confluence with East Springfield Interceptor. Pipe depths and slopes vary widely as slightly higher relief in the eastern sector allows for shallow trenches and smaller pipes with moderate gradients. West of Highway 126, pipe depths and slopes are deeper with less gradient, respectively, which is more characteristic of the low relief alluvial plains.



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- Pump Stations
- Weir/Diversion
- Manholes
- Existing Major Wastewater System Pipes

MWMC Facilities

- Glenwood Pump Station
- Existing Major Wastewater System Pipes

- Flow Monitoring Basins
- Urban Growth Boundary

N

0 2,000 4,000
Approximate scale in feet

FIGURE 4-1
Existing Wastewater Collection System

City of Springfield Wastewater Master Plan

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Main Street: This basin currently drains southeast Springfield. The Main Street trunk sewer ranges in size from 1-inch near 71st Street to 30-inches at the confluence with the Thurston and East Springfield Interceptor.

Downtown: The downtown trunk system collects sewage flows generated in the older downtown core area. The total area served is generally bounded by Mill Street to the west, 16th Street to the east, North "G" Street to the north and South "A" Street to the south.

The original downtown system was constructed prior to World War I. Sewers collected both sanitary wastes as well as storm wastewaters, and were discharged directly into the Willamette River. The sanitary and storm sewer systems were separated in the early 1950's when the City constructed the sewage treatment plant. The sanitary system remained in the older, formerly combined sewers with the storm sewer system routed into new pipelines.

Central: The Central Basin encloses the Downtown Basin on all sides except the south. The central trunk system, combined with the Downtown trunk, serves the entire area east of Prescott Street, west of 28th Street, south of Highway 126 and north of South "A" and Main Streets. The Central trunk sewer was constructed in conjunction with the Downtown trunk.

Two diversion structures remove excessive storm flows from the Central Basin. A 24-inch relief sewer near 13th and Centennial Boulevard routes flow to the East Springfield Interceptor. A pump station located at "E" and 21st Streets diverts flow to the South "A" trunk line, reliving the overloaded upper reaches of the Central trunk.

South "A": This basin primarily consists of industrial lands adjacent to South "A" Street. The South "A" trunk also provides some relief capacity for the Central Basin.

Glenwood: The Glenwood Basin is bound to the south and west by the Willamette River and to the east by Interstate 5. The Glenwood Pump station (an MWMC owned and operated facility) collects all flows from the Glenwood Basin and pumps them across the Willamette River to the East Bank Interceptor. Additional flows from the Riverview-Augusta and Laurel Hills area in Eugene contribute to the flows at the pump station.

The Glenwood Trunk sewer, a 30 inch line, serves a major portion of the Glenwood basin, and extends east from the Glenwood Pump station in Franklin Boulevard to the intersection of Franklin Blvd. and McVey Highway.

4.1.2 Pump Stations

Springfield's location on nearly flat alluvial plains makes gravity conveyance of wastewater sewage to the East Bank Interceptor difficult from several sectors of the City. Thirteen City-owned pump stations augment gravity lines either by lifting flows from low-lying areas into major interceptors or by diverting flows from overloaded lines to pipelines with available capacity. These are listed in Table 4.3 and also shown on Figure 4.1.

TABLE 4.3
Summary of Stations Modeled and No. of Pumps
City of Springfield Wastewater Master Plan

Pump Station	Total Number of Pumps
Golden Terrace	2
Lucerne Meadows	2
Harlow (new)	3
Hayden	2
Deadmond Ferry	2
Commercial	2
21^{st} E St	2
Nugget Way	2
49^{th} St	2
Ramada	2
Glenwood	2
Marshall Oil	2
River Glen	2

Additional information regarding current and future land use pump station requirements is presented in Table 5.2.

5.0 Sewer System Evaluation

5.1 Planning Scenarios

Three land use conditions were identified and used to evaluate the ability of the collection system to meet wet weather flow conveyance requirements:

- 20 year plan consistent with the PFSP and state-wide planning goals,
- existing land use (corresponding to the December 2005/January 2006 monitoring period, and
- build-out land use condition used for sizing pipeline improvements

The basis for these scenarios are GIS land use data provided by City staff and estimates for development within the future 20-year planning horizon also provided by the City. Residential Equivalent Dwelling Units (EDU) counts were developed based on parcel data within the UGB and identification of the parcels that are served currently and in the future. The development and area served for the 20-year PFSP was assumed for the purpose of the analysis but is dependent on future growth rates.

The characteristics of the existing and building out land use conditions were summarized in Sections 3.5 and 3.6.

5.2 Design Storm Selection

In the WWFMP, a 5-year design event with a total rainfall of 3.9 inches over 24-hours was used as the basis for identifying deficiencies and developing improvements. CH2M HILL updated the rainfall frequency analysis resulting in 5.99 inches over 72 hours (including 3.83 over 24 hours) as the 5-year design storm. This was applied to the Springfield model and the MWMC WWFMP model also updated in 2007. To ensure the design storm was applied consistently with the initial conditions developed from calibration, the design storm was inserted within the precipitation time series on December 25, 2005 (peak rainfall intensity occurs at noon on December 27, 2005). The storm is applied uniformly across the City in the model. Appendix C provides a detailed description of the rainfall analysis and selection of the design storm.

5.3 Model Development

To predict system performance under wet weather flow conditions a hydraulic model was used. Initially an expansion of the MWMC model was considered but given the amount of new data that was made available by the City of Springfield it was determined that creating a new model from the most current inventory data was preferable. The MIKEURBAN model from DHI Software had already been selected and used for the MWMC model, and it was used for Springfield. This includes the use of the RDII module to develop wet weather flow contribution, incorporating impacts of antecedent rain on an urban watershed. In general, pipes 10-inches and larger were modeled.

Once the model data input was accomplished, area hydrologic elements were input (basin area, imperviousness, time of concentration, percentage of catchment area contributing to RDI runoff, soils data) to estimate both dry and wet weather flows. Finally, flow prediction accuracy is produced through a calibration process where flow monitoring data gathered during the December 2005, January 2006 wet weather season is used to adjust the model's flow generation variables. Once the model is able to generate flow rates that occurred (using rainfall during the monitoring period), that generally match the flow measured at the flow monitors, the model is considered ready to predict flows for other wet weather periods such as the 5-year design storm. The Springfield model appears to accurately independently predict peak flows measured at the flow monitors.

However, when the design storm was input to the model and flows predicted from the model they were determined to initially be too high based on other prediction methods such as linear regression estimation and City staff's observations. Therefore, an adjustment factor was applied to hydrologic variables in the model resulting in reduced flow rates for more than half of the contributing area. The resulting model was then used to identify hydraulic deficiencies and associated improvements. Details of this process is provided in Appendix A.

5.4 Collection System Capacity Analysis

5.4.1 Deficiency Definition

5.4.1.1 Pipelines

The DEQ requirement is that no overflows occur other than during periods where rainfall is equal to or greater than the design storm event. Therefore a deficiency is defined by the water surface elevation in manholes predicted by the hydraulic model relative to the ground surface. As a result, pipelines are allowed to surcharge or pressurize for short durations during peak flow periods. From the 2001 Wet Weather Flow Management Plan, each improvement must meet the criterion of keeping maximum water surface elevations in manholes lower than critical elevations. These critical elevations include 3 feet above pipe crown elevations in the manhole in areas where there are basements. In areas without basements, the water surface elevation must be 2 feet below the ground surface. For the Springfield Master Plan, all locations where the modeled water surface reaches the ground surface an improvement is recommended to lower the water surface to meet the 2 foot criterion.

For pipe improvements, pipe slopes consistent with existing pipes are used. The minimum diameter needed to convey the peak wet-weather flow rates is based on the need to maintain the maximum water level below the 2 foot criterion.

For new pipes needed to service areas of future (buildout = 20 year planning horizon) development, pipe sizing is based on the projected flows associated with buildout land use conditions and the 2000 gallons per acre per day (gpad) infiltration allowance established in the 2001 WWFMP. Where possible, 2 feet per second minimum velocity is maintained during dry-weather. In most cases new pipe gravity capacity is equal to or greater than the peak flow rate. However, some new pipes are surcharged at acceptable levels based on backwater from downstream conditions.

5.4.1.2 Pump Stations

The state also has design standards that must be met for pump stations. According to the DEQ Oregon Standards for Design and Construction of Wastewater Pump Stations, a pumping system consisting of multiple pumps, must include one spare pump sized for the largest series of same-capacity pumps to provide for system redundancy.

Pump station capacity requirements are provided for existing and future flow rates in Table 5.1.

5.4.2 Existing Deficiencies

The design storm was applied to the calibrated model to evaluate the existing (2007) pipeline system. System deficiencies based on hydraulic gradeline elevation criteria are shown in Figure 5.1. There are a number locations where surface flooding is indicated by the model, particularly in the downtown area and in the eastern end of the Thurston trunk and connecting pipelines to the Main St. trunk.

Table 5.1 lists the pump stations evaluated. A field drawdown test was used to determine pump station capacity. Existing and future flows are compared to the capacity which identified three capacity deficiencies.

5.4.3 System Improvement Options

1. **Reduction Through Pipeline Rehabilitation -** Rehabilitation has the potential to reduce construction costs—larger pipes may not be necessary if peak flows due to I/I can be reduced. The WWFMP documents a review of the available data relating RDI/I reduction to system rehabilitation. These data represented local experience (four sub-basins in Eugene and one in Springfield) and experience of other agencies in Oregon and elsewhere. A relationship between the amounts and type of system rehabilitation performed and the amounts of RDI/I consequently reduced was developed.

   Consistent with the WWFMP, rehabilitation is assumed to consist of main lines and laterals within the public right-of-way ("public only"). Table 5.2 is a summary of the status of the rehabilitation program as identified in WWFMP.

   Section A.2 in Appendix A provides the results of the flow monitoring data analysis that is the basis for selection of basins where I/I reduction will have the greatest benefit.

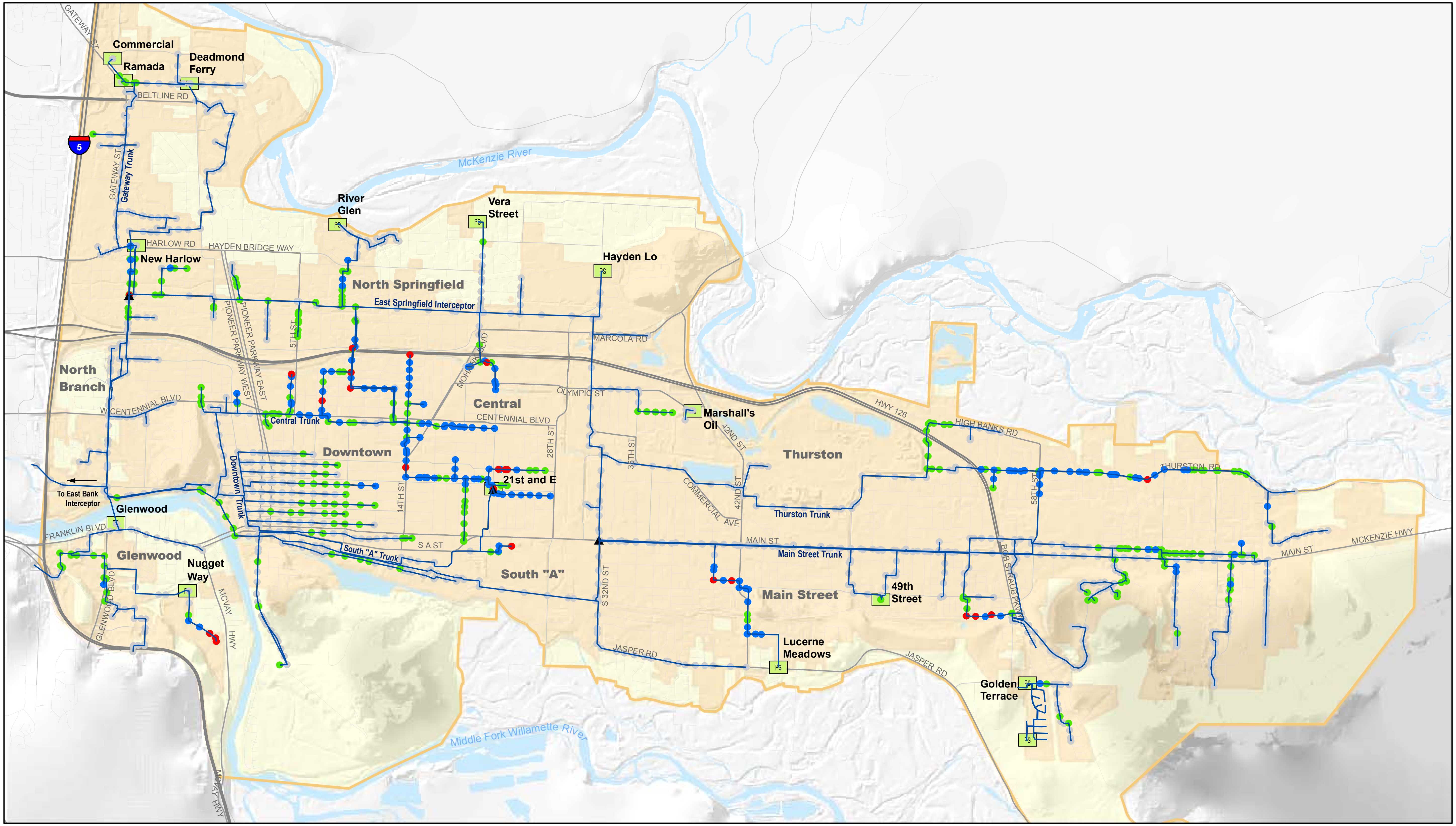
2. **Pipeline Replacement With Larger Pipes** – This option increases diameters to create more capacity to convey peak flows. These improvements can also involve a pipe in parallel with the existing line, where the existing line is maintained and its capacity utilized.

3. **Diversion Pipelines –** This option involves installation of new pipes to divert flow from locations with limited capacity to those with available capacity.

TABLE 5.1
Pump Station Needs
City of Springfield Wastewater Master Plan

Pump ID	Firm Capacity[1] (gpm)	Existing Number of Pumps	Existing Land use (gpm)	Future Land use (gpm)	Improvement Need [2,3]	Comment
Golden Terrace	225	2	316	--	None	PS to be decommissioned. Flow routed west as part of Jasper Road Extension Project
Lucerne Meadows	186	2	260	461	None	PS to be decommissioned. Flow routed west as part of Jasper Road Extension Project
New Harlow	--	3	2729	3694	None	No improvement needed. Pumps designed at 3500 gpm/each.
Hayden Lo	380	2	494	494	PS capacity increase for existing land use	Add capacity to 494 gpm firm capacity.
Deadmond Ferry	1010	2	232	503	None	Force main recently rerouted south.
Commercial	274	2	215	218	None	
21st & E Street	954	2	785	898	None	Wet weather pump station
Nugget Way	642	2	911	911	PS capacity increase required for existing land use	Significant source detection performed and sources of inflow/infiltration were removed. Therefore, additional flow monitoring is recommended prior to improvement. An alternative to a PS capacity increase has been developed by others to build gravity pipelines to convey flow to lines in McVay Highway.
49th Street	288	2	269	274	None	
Ramada	120	2	16	16	None	
Glenwood (MWMC Facility)	4,300	2	5489	5889	PS capacity required for existing land use	Space for two additional pumps is available. 12" and 20" force mains are existing. Firm capacity based on using both. No project improvement is included in the CIP because it is not a City facility.
Marshall Oil	230	2	224	224	None	
River Glen	379	2	525	664	PS capacity increase	Add capacity to 664 gpm firm capacity.
Vera (Constructed in 2007)	--	2	--	405	None	Pump capacity is estimated at 500 gpm based on pump curves and elevation data.

1. Defined as the capacity with the largest pump not operating based on 2005 single pump drawdown tests.
2. Pump station capacity improvements are sized to meet future land use flow rates given that the development is expected to occur within the 20 –year planning period.
3. Flow monitoring recommended at all improvement locations prior to improvement design



LEGEND

Depth to Water Level from Manhole Rim (feet)

- 0
- 0-2
- 2-5
- > 5

- Pump Stations
- Weir/Diversion
- Existing Major Wastewater System Pipes
- Urban Growth Boundary
- City Limits

N

0 2,000 4,000
Approximate scale in feet

FIGURE 5.1
Hydraulic Gradeline Elevations for 5-Year Event, Existing Land Use Conditions

City of Springfield Wastewater Master Plan

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4. **Storage** – This option is not considered. The WWFMP does not identify storage as a cost-effective solution. Rather, I/I reduction, conveyance improvements, and additional treatment capacity were ultimately selected for implementation. In addition, storage was thought to be more of a problem with implementation and siting (being a good neighbor) than any public amenity opportunities (parks, etc.) it would offer.

5. **Pump stations –** When pump stations in collection systems do not have capacity to convey the peak flow with the largest pump out of service, they are identified for improvement.

TABLE 5.2
Status of Rehabilitation
City of Springfield Wastewater Master Plan

SN Basin ID	Existing Planned Rehab (ft)	Future Planned Rehab (ft)	Rehab Completed	Remaining Existing	Remaining Future	Original RDII Reduction Estimate	Remaining RDII Reduction Estimate*
SN-08	3,419		2,725	694		13.8%	2.8%
SN-10	6,799		6,373	426		13.8%	0.9%
SN-23	11,449		7,466	3,983		43.3%	15.1%
SN-50	1,223			1,223		34.9%	34.9%
SN-18	7,749			7,749		40.5%	40.5%
SN-21	6,332		8,326	-		43.3%	0.0%
SN-20	10,000		10,000	-		45.7%	0.0%
SN-07		11,379			11,379	32.5%	32.5%
SN-11		4,358			4,358	15.4%	15.4%
SN-49		1,534			1,534	37.0%	37.0%
SN-48		7,048			7,048	43.3%	43.3%
SN-19		22,629			22,629	42.0%	42.0%
TOTAL	46,971	46,948	34,890	14,075	46,948		

*** shaded is reduction for "existing", non-shaded is reduction for "future"**

5.4.4 Description of Improvement Methodology

The Springfield Master Plan must consider multiple goals when developing solutions to identified deficiencies:

- Eliminate overflows for the 5-year design storm
- Maintain general consistency with the improvement approach identified in the 2001 WWFMP, and updated for the 2003 MWMC Facilities Plan.

As a result of these goals the following approach was utilized for the identification of I/I reduction and conveyance improvement projects:

1) <u>Existing System Rehabilitation:</u> Since the 2001 adoption of the WWFMP, Springfield has been systematically implementing a sanitary sewer rehabilitation program to address the basins identified as having high I/I. Of the WWFMP planned rehabilitation work about 14,000 feet of pipe rehabilitation in the public system remains to be performed. Based on the updated modeling of the Springfield system, as well as review of actual

flow monitoring data, this Plan identifies 14,463 feet of public rehabilitation to address existing conditions and identifies basin SN22 as the basin projected to have the greatest impact on the I/I problem. As SN22 is predicted to have a greater impact on peak flow reduction and elimination of downstream deficiencies than the remaining WWFMP identified basins (SN8, 10, 23, 50 and 18), the city may wish to consider some re-prioritization, consistent with WWFMP guidance. After the 14,463 feet was applied to the model, there continued to be deficiencies downstream of the rehabilitation. Because additional rehabilitation is identified in the WWFMP for future conditions, an additional 9,473 feet of public system rehabilitation was added to SN22 shown on Figure 5.2 for a total of 23,548 feet. This resulted in the elimination of downstream deficiencies and need for associated improvements.

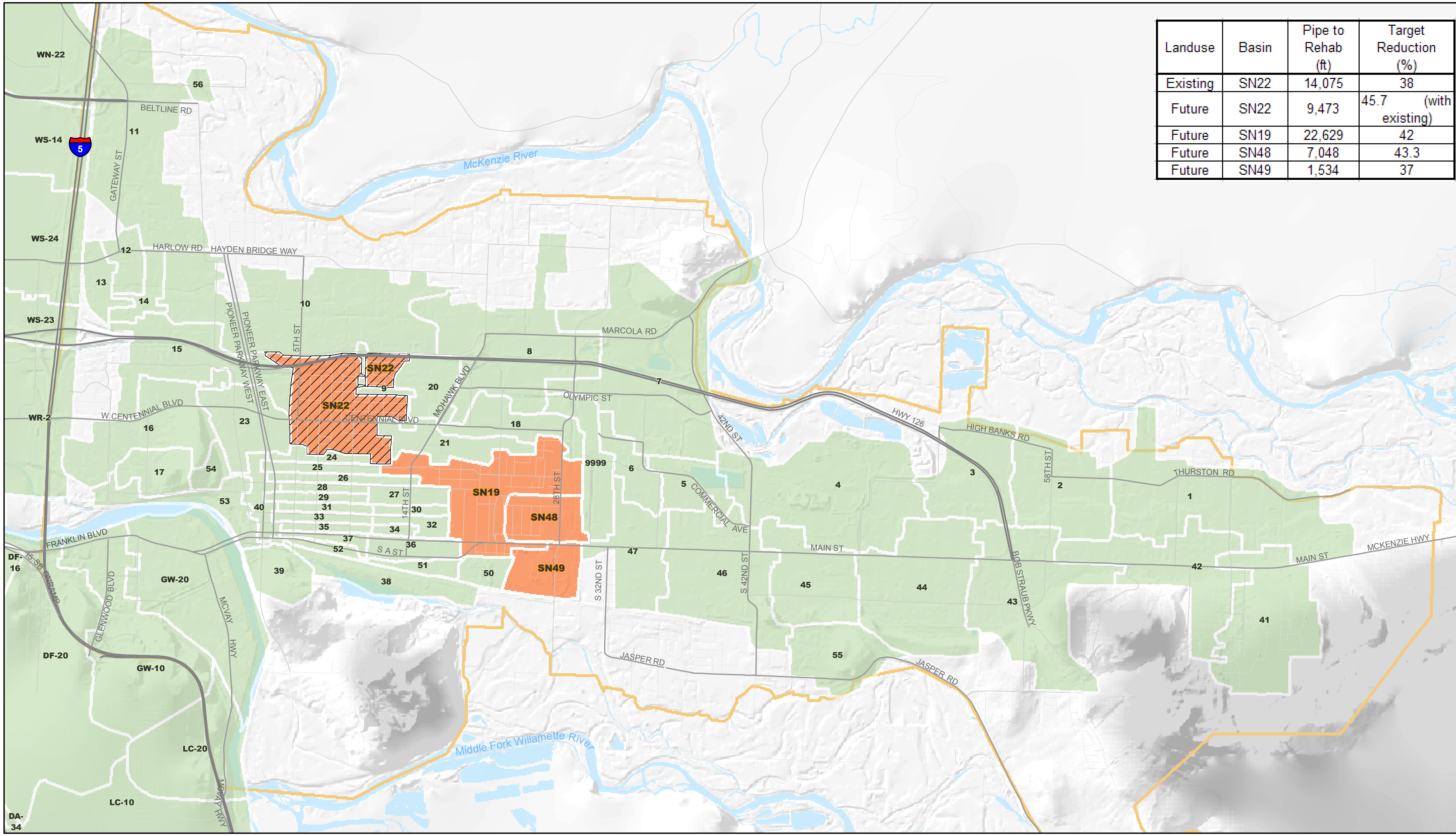
Given that the WWFMP obligation for rehabilitation is projected to be met for existing conditions by the work to be completed in SN22, the remaining deficiencies for existing conditions are proposed to be addressed through pipeline replacement and pump station upgrades. These improvements appear to have lower costs than additional public system rehabilitation.

2) Future Conditions: Based on the amount of public system rehabilitation performed for existing conditions and the WWFMP requirement for peak flow reduction, additional public system rehabilitation locations have been identified. Similar to the existing condition locations of high I/I that are upstream of system deficiencies, additional basins have been identified for rehabilitation. Basins SN 19, 48 and 49 from the WWFMP are shown on Figure 5.2 and identified with a total rehabilitation length of 31,211 feet, to help meet WWFMP requirements. After applying this rehabilitation only two additional projects (projects 13 and 14) to improve existing pipelines are needed to convey the peak flows. In addition, projects 5 and 6 (See Figure 5.3) that had been identified for existing conditions are no longer required due to the peak flow reduction resulting from the public system rehabilitation.

This approach is consistent with the WWFMP plan that used rehabilitation of the publicly owned system to achieve I/I reduction.

5.4.5 Private Lateral Program

The WWFMP includes recommendation for the Formulation/Definition and Implementation of a Voluntary Private Lateral Program. While the additional reduction due to private lateral replacement is not assumed in the solutions presented, it has been identified as a future program by the City.



Landuse	Basin	Pipe to Rehab (ft)	Target Reduction (%)
Existing	SN22	14,075	38
Future	SN22	9,473	45.7 (with existing)
Future	SN19	22,629	42
Future	SN48	7,048	43.3
Future	SN49	1,534	37

LEGEND

- Existing Basin Rehabilitation
- Urban Growth Boundary
- Future Basin Rehabilitation
- Basins

N

0 2,000 4,000
Approximate scale in feet

FIGURE 5.2
Rehabilitation

City of Springfield Wastewater Master Plan

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5.4.5.1 Definition of Private Lateral Program

The intention of a private lateral rehabilitation program is to achieve more I/I reduction than with rehabilitation of the public sewer system only, and build a higher confidence for achieving reduction targets in the long term. Industry findings are that public system rehabilitation alone isn't as effective as a public and private rehabilitation program given that: 1) a public only program doesn't address the I/I from the private laterals and 2) because I/I can migrate to locations in the private system where defects allow I/I to enter the system. As a result, the most effective program includes a combination of public and private system rehabilitation.

A private lateral rehabilitation program requires new processes and associated administration including the following elements:

- Increased public involvement
- Regulation/Ordinance
- Payment options
- Enforcement
- Inspection

5.4.5.2 Experience from Other Communities

According to a 2006 Water Environment Research Foundation (WERF) report, entitled, *Methods for Cost-Effective Rehabilitation of Private Lateral Sewers*, most municipalities have problems with I/I and want to know to what degree laterals are responsible. The survey revealed that 45% of the 58 participating agencies had analyzed how much private sewer laterals contribute to total I/I in their wastewater systems and that the average of the estimates was in the range of 40% with one estimate as high as 80%. Such estimates are valuable as an indication of the magnitude of the problem, not as absolute measured values given the difficulty in directly quantifying the I/I contributions due to laterals alone. More information on this report (#02-CT-S5) can be found at wef.org.

The City has several implementation options to evaluate based on the experience of other municipalities. Cities and/or Agencies in Oregon include Clean Water Services and the Cities of Salem and McMinnville. Rehabilitation programs for these agencies that included both public and private portions of the system resulted in 60% to 92% reduction in sewer basins where 100% of the system was rehabilitated. Some cities have budgeted the replacement of private laterals in their CIP or O&M programs, some have budgeted funds to reimburse qualifying property owners for replacing laterals on their own property, and some have simply required property owners to replace deficient laterals at the property owner's cost. Some do a combination of the above. Incentives and penalties for complying or failing to comply with the program are also included in some programs.

Value of a Private Lateral Program

The WERF study mentioned above derived several conclusions from their case-study analyses:

- Projects that included rehabilitation of private sewers from the right-of-way to the house achieved 50-70% peak-hour RDII flow reductions in the basins where the work was performed.
- Public sewer rehabilitation may beneficially reduce overall RDII volume. Reductions in peak 24-hour average RDII volumes ranged from 2-30%. Reductions in peak monthly average flows ranged from 2-65%. Reduction in the total volume of RDII, but not the peak, suggests that infiltration from the groundwater entering public sewers can be reduced significantly under certain conditions (depending on the overall groundwater conditions). Reductions in peak-day and peak-month RDII volumes benefit wastewater treatment facilities, but do not necessarily benefit the conveyance system.

Reduction Estimates

As a part of a 2003 WERF study titled, *"Reducing Peak Rainfall-Derived Inflow and Infiltration Flow Rates"*, 44 utilities were contacted regarding their programs and a detailed analysis of 12 projects for six utilities was performed. Several conclusions were derived from the case study analyses:

- Rehabilitation of only the sewers in the public-right-of-way may provide little reduction in peak-hour RDII flows. One study found a 17% reduction in peak-hour flows when the portion of building laterals in the public right-of-way was replaced. The other projects of this type found 5% or less reduction.
- As a corollary to the above, projects that addressed private sewers from the right-of-way to the house achieved 50-70% peak-hour RDII flow reductions.
- Public sewer rehabilitation may beneficially reduce overall RDII volume. Reductions in peak 24-hour average RDII volumes ranged from 2-30%. Reductions in peak monthly average flows ranged from 2-65%. Reduction in the total volume of RDII, but not the peak, suggests that infiltration from the groundwater entering public sewers can be reduced significantly under certain conditions (depending on the overall groundwater conditions). Reductions in peak-day and peak-month RDII volumes benefit wastewater treatment facilities, but do not necessarily benefit the conveyance system.
- The exception to the rule described above was a manhole rehabilitation project in Milwaukee, WI, that apparently achieved a 45% reduction in peak RDII flows through manhole rehabilitation only. The circumstances suggest that attention to manholes as inflow sources in instances where ground conditions reduce the impact of groundwater may produce significant results. Manhole rehabilitation in other case studies, however, did not achieve the same results.

More information on this study (#99-WW-F8) can be found at wef.org.

Reduction Estimates for City Planning

Because private laterals have not been included in local rehabilitation projects, no local data are available to assist the City in development of a relationship between RDII reduction and system rehabilitation that included upper/private property laterals. Through research performed as part of the 2001 WWFMP, reduction was estimated from agencies that included private laterals in their rehabilitation projects. A number of other agencies have data representing 100% rehabilitation that included upper/private laterals. Some agencies reported that subsequent to rehabilitating 100% of the public-owned portions of their systems, they were able to increase RDII reduction rates by 50% to 70% by rehabilitating the privately owned portions of their system, i.e., the upper laterals.

Monitoring data from other agencies were typically obtained within a few years of completing system rehabilitation projects so the data was not necessarily representative of RDII reduction over the long term.

The results from other agencies vary widely, probably because of the range of techniques, protocols, and quality control methods employed. If, however, a high standard of care is assumed, it is reasonable to expect that 100% system rehabilitation should yield RDII reduction greater than 50%. Taking other agency data only from sub-basins yielding greater than 50% RDII reduction in association with full system rehabilitation (including privately owned upper laterals), the average RDII percent reduction is approximately 70%. This represents a reduction amount that is 40% greater than the public system curve developed for the WWFMP (without privately owned upper laterals) assuming 100% basin rehabilitation. This increase is similar for rehabilitation amounts from 30% of a given basins pipelines through 100% of the pipelines.

5.4.5.3 Private Lateral Program Implementation

Many options exist for a private lateral program, including the use of monetary incentives, phased implementation (where at some point in the future defective lateral replacement becomes mandatory), and initial program implementation only in basins targeted for public system rehabilitation versus a citywide program.

The following benefits of a private lateral program have been identified:

1. Increases probability of achieving long-term flow reduction as a part of system rehabilitation efforts.
2. Reduces undesired flows into the system at their source rather than having to building additional piping and treatment downstream in the system.
3. Is consistent with the system-wide efforts to maintain, rehabilitate, and /or replace elements of the sanitary sewer infrastructure.
4. Produces additional reductions in I/I that allow for greater available capacity in downstream portions of the system.
5. Reduces potential for migration of infiltration,

The following items should be considered in program development and implementation:

- Inspection of private laterals, roof drains, and foundation drains (continued field verification program to identify problem areas).
- Notice of defects and required corrections (mailers to affected property owners identifying the problem and the required action).
- Repair of defects (addresses the repair or replacement of the defective lines).
- Enforcement (policy developed to address noncompliance by property owner).
- Who Pays? Identification of payment policy based on the alternatives stated above.
- Incentives for completion (identification of any incentives to the property owner to complete the repair work in a timely manner).

Provided below is a summary of program characteristics and options for implementation.

Program Participation

Private lateral replacement is a system-wide issue. However, specific drainage basins in the system have been identified through flow monitoring as contributing more I/I than other basins. The rehabilitation program could target one or both of the following groups:

- Property owners whose laterals are determined to be defective through inspection as part of a public rehabilitation project.
- Anyone whose lateral fails or is determined to be defective independent of its location (relative to public rehabilitation projects).

Incentive Options for Participation

A program that includes some financial incentives would be desired given the disruption to private property caused by private lateral replacement. Several options to consider individually or in combination are as follows:

- Pay lateral replacement in part or in whole through rates (by cities).
- Reduce the property owner's sewer bill.
- Add a surcharge to the bills of property owners who do not comply with a replacement directive.
- Provide financial assistance to qualifying low-income property owners.
- Incorporate deferred payment options into the program.

Voluntary vs. Mandatory

Two options to consider include:

- Implement the program as a long-term, voluntary program.

- Incorporate a phased approach, where initial participation in the program developed is voluntary but would become required at some point in the future. An example would be to provide incentives for voluntary replacement during public rehabilitation projects but make inspection and potential replacement mandatory at the time of ownership transfer.

Timing of Participation

Participation could be required for one or more of the following conditions:

- When public rehabilitation is being performed in that lateral's basin.
- When the lateral fails, independent of public rehabilitation activities.
- When property ownership is transferred.

Total or Partial Lateral Rehabilitation

Consider the following rules for determining when the property owner is responsible for rehabilitating only the privately owned portion of the lateral or the entire lateral:

- If the mainline in the public right-of-way is not being rehabilitated private lateral replacement includes the entire lateral to the public mainline.
- If the mainline in the public right-of-way is being rehabilitated, private lateral replacement includes the lateral to the property line.

5.4.5.4 Rehabilitation Methods

A variety of methods are available for agencies to rehabilitate sewer laterals. The *"Methods for Cost-Effective Rehabilitation of Private Lateral Sewers"*, WERF survey showed that most popular trenchless methods are pipe bursting and CIP relining and that almost every other agency has used one or both of these methods on sewer laterals. Other already proven methods include chemical grouting, flood grouting, and robotic repairs, whereas a new method just being introduced is slug grouting. The WERF report provides detailed data about currently available technologies in the U.S. market, which was provided by manufacturers. The research did not involve any field or laboratory testing of methods/technologies, so relevant assessments of these technologies were sought from municipalities or other independent sources.

5.4.5.5 Drivers for Program Implementation

Through the master and facility planning efforts that have occurred since the 2001 WWFMP plan it can be concluded that the total flow contribution from Springfield of 100 mgd estimated at build-out land use, is at best constant and likely increasing. The master plan identifies improvements to control overflows for the design storm for Springfield's collection system. Improvements must also control the contribution to the treatment plant where the peak flow limitation is 277 mgd from all sources. Peak flow exceedences up to and including the design storm condition that cause overflows at the plant are not permitted.

While the City has implemented many of the “public-only” rehabilitation projects identified in the WWFMP, the combination of growth and changes in RDII contributions have the potential to exceed this 100 mgd target. To limit the RDII contribution and create a wet weather flow management plan that increases the likelihood of greater and longer term flow reduction, the implementation of a private lateral rehabilitation program is warranted.

Future updates to the WWFMP will refine the peak flow targets from the contributors to the regional system. However, the results of Springfield’s Master Plan support an RDII reduction program that maximizes the amount and duration of wet weather flow reduction. A RDII program that includes private laterals will best achieve this program goal.

5.4.6 Existing System Improvements

Listed in Table 5.3 are the public system rehabilitation improvements proposed to reduce existing deficiencies. The targeted RDI reduction and the associated percentage of pipelines to rehabilitate was developed as part of the WWFMP to minimize downstream pipeline improvements and reduce peak flows at the E/S WPCF. The target RDI reduction summarized in Table 5.4 were consistent with the WWFMP, however, the subbasins selected for future rehabilitation were selected based on the results of the hydraulic modeling and flow monitoring. Varying levels of RDI reduction and locations were incorporated into the model to mitigate the system capacity upgrades through improvement projects. The final combination of alternatives was a blend of rehabilitation and system improvement upgrades.

Figure 5.3 and Table 5.4 show the gravity replacement pipes, parallel pipes, diversions and pump stations that need to be upgraded to correct the existing hydraulic deficiencies. These projects are necessary with the rehabilitation described above to eliminate sanitary sewer overflows under existing conditions. Project 9 is a diversion proposed to convey flow from the Thurston trunk to the Main St. trunk to avoid more costly improvements along both trunk lines. Provided in the table is the existing diameter and a description of the project. Project 10 must be increased in diameter when future land use is incorporated in the analysis.

There are approximately 6 manholes where improvements do not eliminate HGL’s within 2 feet of the ground surface. The extent of additional improvements required to further reduce the HGL are greater than the recommended improvement to install water tight manhole covers at these limited number of manholes.

TABLE 5.3
Subbasins Targeted For Rehabilitation
City of Springfield Wastewater Master Plan

Flow Monitor Basin	SN Basin	Catchment ID	Total Area (Acres)	Land Use	Target RDI Reduction (%)	Total Length of Pipes in Basin (ft)	% of pipes to rehab – Based on length of pipe	Total length of pipes for rehab, ft
72	SN22	10033374	12.671	Existing	45.7%	33640	70%	23548
		10033395	16.123					
		10033002	21.372					
		10033021	40.633					
		10033266	8.784					
		10033275	32.709					
		10033284	17.507					
		10033289	38.061					
		10033295	52.856					
90	SN19	10033565	26.664	Future	42.0%	41144	55%	22629
		10033642	27.363					
		10033650	28.983					
		10033696	11.446					
		10033734	53.29					
		10033991	14.879					
		10033995	9.952					
		10034008	10.525					
		10034054	25.256					
		10034065	20.826					
84		10034030	10.555					
		10034033	18.627					
		10034045	28.487					
		10034063	6.84					
83	SN48	10033997	8.612	Future	43.3%	11747	60%	7048[1]
		10033999	9.805					
		10034001	23.014					
		10034013	42.17					
5173	SN49	10033920	69.1	Future	37.0%	3835	40%	1534
Totals						**90,366**		**54,759**

[1] Rehabilitation completed.

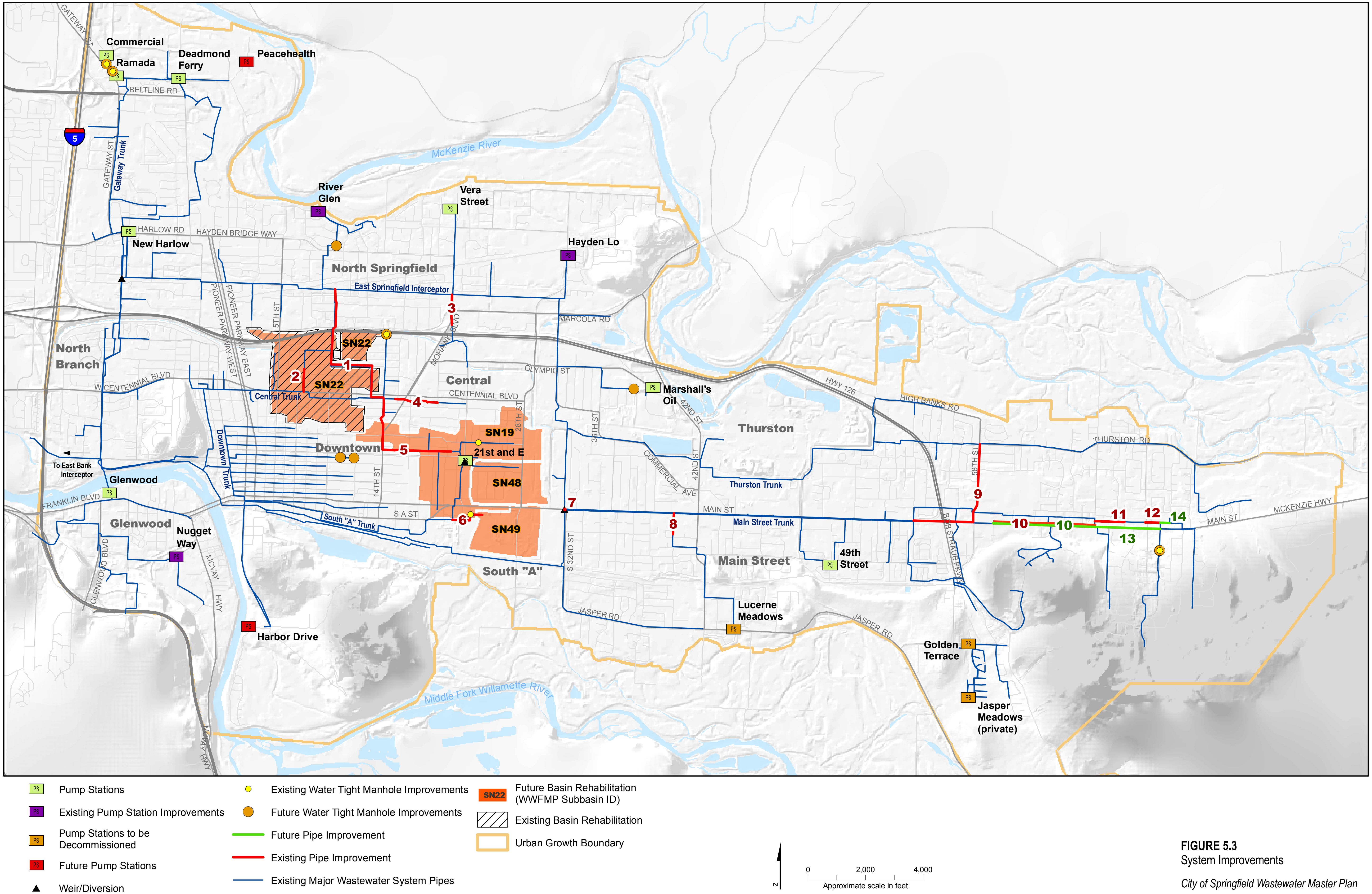

FIGURE 5.3
System Improvements

City of Springfield Wastewater Master Plan

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TABLE 5.4
Pipeline Improvements for Existing Land Use – (See Figure 5.3)
City of Springfield Wastewater Master Plan

Project ID	Purpose	Existing Dia (Inch)	Proposed Diameter (Inch) or Peak Rate (gpm)	No of MHs	Length (ft)	Description
1	Existing upgrade	--	24	22	6418	Parallel existing 24-inch pipe with new 24-inch pipe from MH10033730 d/s to MH10033409
2	Existing upgrade	12	21	4	795	Replace existing 12-inch with 21-inch from MH10033284 u/s to MH10033293
3	Existing upgrade	12	18	5	1112	Replace existing 12-inch with 18-inch from MH10034175 u/s to MH10034164
4	Existing upgrade	10	12	11	1538	Replace existing 10-inch with 12-inch from MH10033706 d/s to MH10033719
5	Existing upgrade	15	24	21	4161	Replace existing 15-inch with 24-inch pipe from MH10034054 d/s to MH10033730. ***Project not required if future rehabilitation is performed.***
6	Existing upgrade	10	15	6	1231	Replace existing 10-inch with 15-inch pipe from MH10033920 d/s to MH10033982. ***Project not required if future rehabilitation is performed.***
7	Existing upgrade	27/36	--	--	--	Flow at vault on west d/s end of Main Street Interceptor reconfigured to prevent flow from going north. All flow is diverted south.
8	Existing upgrade	10	15	3	714	Replace existing 10-inch with 15-inch from MH10034589 u/s to MH10034519.
9	Existing upgrade	--	15	17	4837	New 15-inch wet weather bypass from MH10035662 d/s to MH10035367.
10	Existing upgrade	15/18	21--existing, 24--future	11	3589	Replace existing 15-inch and 18-inch pipe with 24-inch from MH10035908 d/s to MH10035636.
11	Existing upgrade	12	15	9	1014	Replace existing 12-inch with 15-inch from MH10035903 d/s to MH10035835.
12	Existing upgrade	10	12	3	529	Replace existing 10-inch with 12-inch from MH10036187 d/s to MH10036186.
Rehabilitation for I/I Reduction	Existing Rehab	Varies	8-12	--	23,548	All rehab in basin SN 22. This completes the existing rehab listed in the 2001 WWFMP.
Nugget Way PS	Existing upgrade	642 gpm (single pump) 898 gpm (pumps 1 &2)	911 peak wet weather	--	--	Upgrade 2 pump system with 911 gpm capacity each
Hayden PS	Existing upgrade	380 gpm (single pump)	494 gpm existing peak, 494 gpm future peak	--	--	Upgrade 2 pump system with 494 gpm capacity each
River Glen PS	Existing upgrade	379 gpm (single pump)	525 gpm existing peak, 664 gpm future peak	--	--	Upgrade 2 pump system with 664 gpm capacity each

5.4.7 Future System Improvements

Future improvement projects are identified to eliminate system deficiencies observed when the future flows are applied to the system after improvements for existing conditions are made. Figure 5.4 shows the potential water level for this condition. As shown, multiple downtown locations around the 21st and E pump station and at the eastern end of the Main St. trunk indicate surface flooding which requires the identification of additional improvements. In most cases the future deficiencies require improvements in additional areas where no improvement has been identified for existing conditions. Improvements identified for existing conditions have been reviewed to determine if pipe size increases are required. Only one of the improvements identified for existing conditions, project 10 has been required upsizing to meet future conditions.

As stated in Section 5.4.4, additional rehabilitation is included as part of the future improvements to meet 2001 WWFMP targeted peak flow reductions. One additional improvement along the Main St. trunk is necessary to address remaining deficiencies resulting from future land use. Table 5.5 lists the projects. These projects are separate and distinct from the projects identified from the existing conditions.

There are approximately 4 manholes (See Figure 5.3) in addition to those identified for existing conditions, where improvements do not eliminate HGL's within 2 feet of the ground surface. The extent of additional improvements required to further reduce the HGL are greater than the recommended improvement to install water tight manhole covers at these limited number of manholes.

TABLE 5.5
Collection System Improvements for Future Land Use – (See Figure 5.3)
City of Springfield Wastewater Master Plan

Project ID	Purpose	Existing Dia (Inch)	Proposed Diameter (Inch) or Peak Rate (gpm)	No of MHs	Length (ft)	Description
13	Future upgrade	12	18	6	2224	Replace existing 12-inch pipe with 18-inch pipe from MH10035908 u/s to MH10036270.
14	Future upgrade	10	12	3	325	Replace existing 10-inch pipe with a 12-inch pipe from MH10036195 d/s to MH10036187
Rehabilitation for I/I Reduction	Future rehab	Varies	8-12	--	31,211	22.6k ft in SN19, 7k feet in SN48, 1.5k feet in SN49. This plus reduction due to pipe improvements completes the future rehab listed in the 2001 WWFMP.
PeaceHealth/ Riverbend PS	System expansion	--				Pump station designed as part of the PeaceHealth/Riverbend Campus Development.

Note: Expansion areas listed in Table 5.7

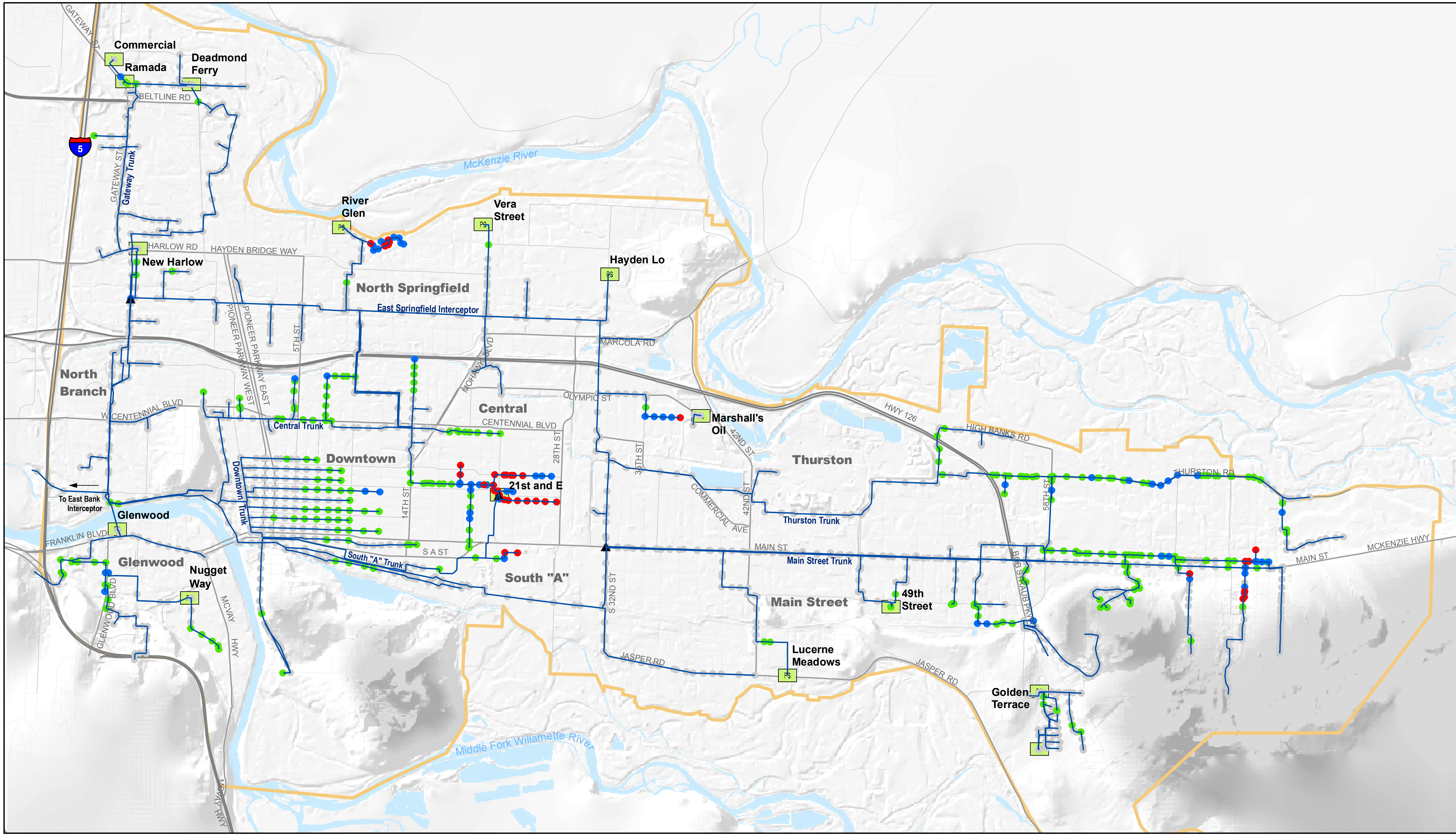
The routed peak flows for existing and future land use conditions with the proposed improvements in place are listed in Table 5.6

TABLE 5.6

Existing and Future Peak Flows with Proposed Improvements, Diversions and I/I Reduction in Place

City of Springfield Wastewater Master Plan

	Existing Land Use Peak Flow (mgd)	**Future Land Use Peak Flow (mgd)**
Thurston Trunk east of 32nd Street	8.4	8.2
Main St. Trunk east of 32nd Street	22.0	23.7
Glenwood—into lift station	7.9	8.5
E. Springfield Interceptor – downstream of Gateway Trunk	40.4	40.9
Downtown/Central Trunks—north of river and south of D Street	13.5	13.4
Total Flow to E. Springfield Interceptor	99.5	101.7



LEGEND

Depth to Water Level from Manhole Rim (feet)

- 0
- 0-2
- 2-5
- > 5

- Pump Stations
- Weir/Diversion
- Existing Major Wastewater System Pipes
- Urban Growth Boundary

N

0 2,000 4,000
Approximate scale in feet

FIGURE 5.4
Future Deficiencies with Existing Improvements in Place

City of Springfield Wastewater Master Plan

CH2MHILL

5.4.8 Expanding System to Meet Development Needs

Several areas have been identified for future development that are not served by the system as it existed in 2007. To plan for the needed infrastructure to service these areas, design peak flows were developed and the needed pipe locations, diameters and lengths were calculated as follows.

Ground elevations at locations along the probable pipe route were determined along with manhole depths and preliminary pipe slope. Based on the projected flow, the City's design standard, and calculated pipe slope, pipe diameters were calculated. To assist the City in future refinements to this master plan level of design, the expanded service pipes and manholes were entered into the hydraulic model based on estimated manhole depths. Pipe diameters for the expansion areas should be reviewed and adjusted as updated information becomes available.

The areas shown in Figure 5.5 and listed in Table 5.7 were identified for expansion of the 2007 system. With the exception of the Harbor Drive area, all areas are expected to be developed within the 20-year planning time frame. A brief description of the expansion areas and associated improvements are provided below.

Harbor Drive

The Harbor Drive, Dorris Ranch, Inland Way area consists of single family residential parcels currently with septic tanks. The City recognizes the potential impact to the Willamette River bordering this area due to possible tank discharges and plans to extend wastewater service to reduce the impact to water quality. The City has constructed a 5-inch force main terminating near the intersection of Dorris Street and Harbor Drive. In the northern portion of the area, 7,684 ft of 8-inch diameter pipe and a 150 gpm pump station is needed to service the existing and planned development.

An evaluation of a river crossing and pumping wastewater into the Franklin Blvd. system was performed. This approach requires approximately 1300 feet of additional force main (across the river) compared to 134 feet if flow is directed north to the existing force main. Pumping west to Franklin Blvd. does create lower power and maintenance costs due to elevations. However, the horizontal drilling and additional force main results in a less cost effective approach than the Harbor Dr. route to the north. It is recommended the City pump the wastewater north along South 2nd Street.

McVay Highway

In Southwest Springfield, 6,280 feet of 8 and 15-inch diameter pipe are recommended to extend service to the parcels identified for future development on the southern portion of McVay Highway. The proposed pipes will connect to the existing 30-inch diameter pipe near intersection of McVay Highway and Franklin Blvd. The future parcels include industrial land use and new residential development south of E 19th Avenue. The pipe size for future service was developed assuming existing flow would not be diverted from Nugget Way PS. During preliminary engineering, the alternative to deepen the existing line in order to decommission the Nugget Way PS should be evaluated as alternatives are developed. The flow was loaded based on the projected land use. This loading may be revised in the future based on the development from near the Lane Community College and Bloomberg Road Basin areas. Following improvement definition an additional 588 EDUs were identified for a total of 1194 EDUs in this location and should be included in future analyses.

TABLE 5.7
Summary of Expansion Projects
City of Springfield Wastewater Master Plan

Area of Future Service	Area (acre)	EDU	Avg Sanitary Flow (mgd)	Peak Wet Weather (mgd)	Total Flow (mgd)	Diameter (inch)	Pipe Length (ft)	Comment
Harbor Drive	72.2	128	0.04	0.01	0.22	8" (gravity)	7684	Includes a pump station to connect to existing force main along S. 2nd Street.
						5" (force main)	134	
McVay Highway	212	606	0.14	0.25	0.49	8"	2411	Includes 150 trailer park parcels. Following improvement definition an additional 588 EDUs were identified for a total of 1194 EDUs in this location and should be included in future analyses.
						15"	3868	
Main Street Extension	546	1308	0.31	1.09	1.63	10"	1924	Following improvement definition an additional 1252 EDUs were identified for a total of 2560 EDUs in this location and should be included in future analyses.
						12"	1983	
Thurston Road Extension	40	60	0.01	0.08	0.11	8"	3882	Following improvement definition an additional 520 EDUs were identified for a total of 580 EDUs in this location and should be included in future analyses.
Jasper Road	1233	3447	0.81	2.47	3.85	10"	2581	Includes Jasper Meadow and Brand S Rd. stubouts. Construction timing may impact capacity needs at Golden Terrace. Following improvement definition an additional 318 EDUs were identified for a total of 3765 EDUs in this location and should be included in future analyses.
						12"	3395	
						21"	17016	
Vera	185	532	0.13	0.37	0.58	8"	1703	

Main Street Extension

Also located at the east end of the City along the McKenzie Highway, 1308 EDUs are identified for future development. A total of 3,902 feet of 10- and 12-inch pipe is recommended to extend east as far as elevations support gravity flow into the system. However, there are portions of parcels at the east end of this area that may require lift stations. Following improvement definition an additional 1252 EDUs were identified for a total of 2560 EDUs in this location and should be included in future analyses.

Thurston Extension

Located at the east end of the City on Thurston Rd., approximately 60 EDUs have been included in the model for future development. As of 2007, the system terminates with a 15-inch diameter pipe just east of Weaver Road on Thurston Road. To service these future parcels, 3,882 feet of 8-inch diameter pipe is recommended. Following improvement definition an additional 520 EDUs were identified for a total of 580 EDUs in this location and should be included in future analyses.

Jasper Road

The City has planned for the extension of the pipeline along Jasper Road in the southeast portion of the City, ultimately connecting to existing 27-inch diameter pipe at South 42nd Street and Jasper Road. As a result, Lucerne Meadows and Golden Terrace pump stations can be decommissioned. A peak flow of 3.85 mgd was estimated from the Jasper Road expansion area served by a 21-inch line. Two "stubouts" are included in the expansion area: 1) 12-inch line to service the 0.78 mgd Jasper Meadows area from the temporary existing private Jasper Meadows pump station, and 2) 12-inch line to service the 2.78 mgd flow from the southern Jasper Road extension area placed along the Brand S Road. This alignment was selected due to proximity to the proposed future parcels and natural drainage in the area. Following improvement definition an additional 318 EDUs were identified for a total of 3765 EDUs in this location and should be included in future analyses.

Vera

The Vera Street pump station in North Springfield was constructed in 2007 in anticipation of servicing the Hayden Bridge and Yolanda Avenue neighborhoods. The area consists of predominantly single family residential units. The peak flow was estimated to be 0.58 mgd versus a revised single pump capacity, of approximately 0.72 mgd based on pump curve and elevation data. This is adequately sized to convey the future peak flow.
The natural drainage of the neighborhood indicates that wastewater will flow north to Hayden Bridge Rd where 8- and 12-inch diameter pipes are recommended.

PeaceHealth/Riverbend PS

The RiverBend Subdivision planned for the northwest corner of the City near Deadmond Ferry Road and Baldy View Lane includes a wastewater pump stations in coordination with the PeaceHealth hospital. The *Sanitary Sewer Study for RiverBend Subdivision* (KPFF Consulting Engineers, March 2005) indicates the pump station will have a peak capacity of 0.52 mgd. Cost of the pump station is included in the CIP listing in Section 6.

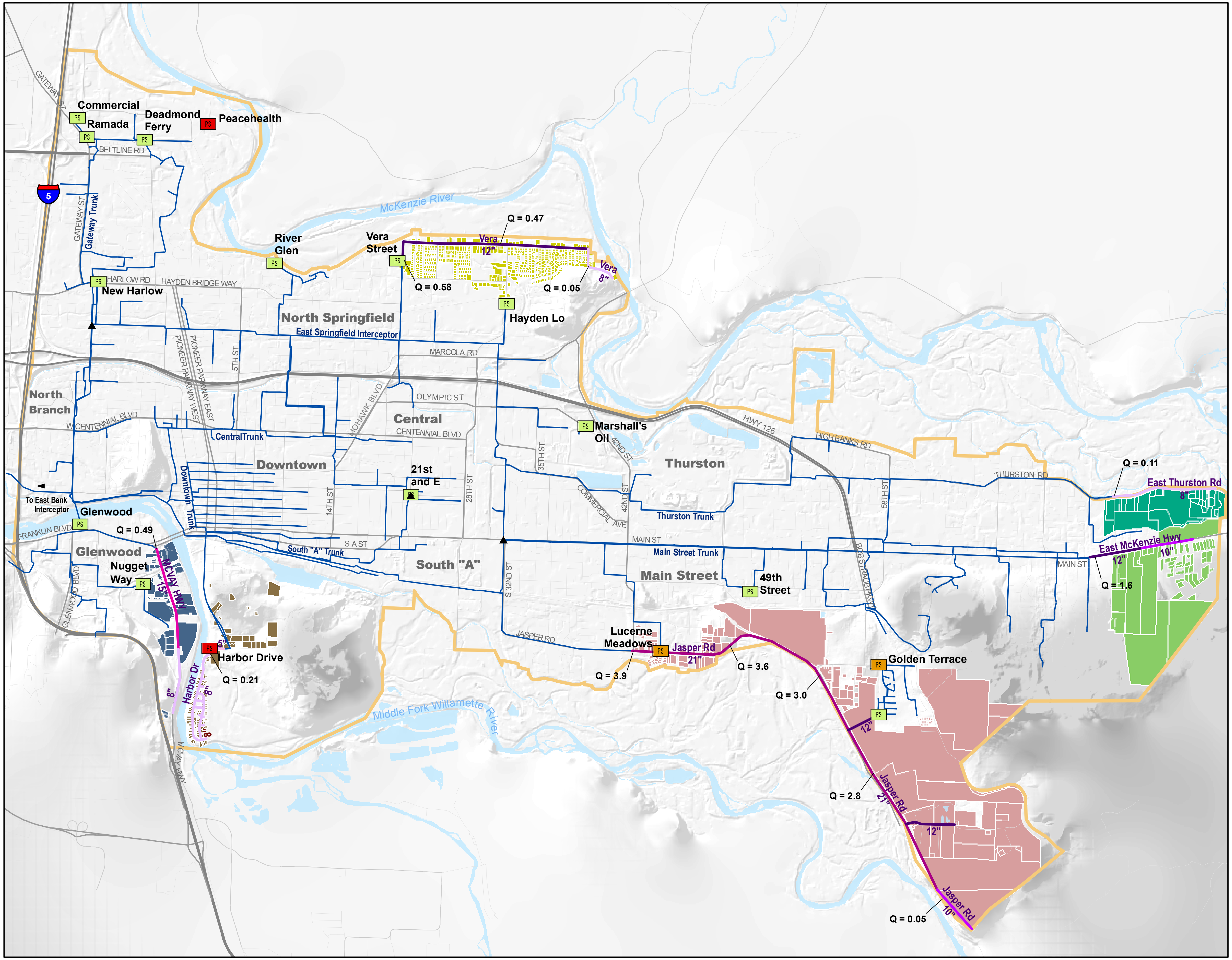


FIGURE 5.5
Expanded Service Pipes

City of Springfield Wastewater Master Plan

6.0 Capital Improvements Program

6.1 Cost Estimate Development

The costs prepared are order of magnitude, Class 5 estimates as defined by the American Association of Cost Engineers (AACE). Typically, Class 5 estimates are planning level estimates based on a limited amount of information. Because of this, the accuracy of these estimates typically can range from –20 to –50 percent on the low side and from +30 to +100 percent on the high side. Class 5 estimates are prepared for many different strategic business planning purposes, including but not limited to, market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs, budgeting, and long-range capital planning.

The cost basis for these Class 5 estimates is unit costs based on bid tabulations from municipal projects in the Northwest. These bid costs have been adjusted to current (2008) dollars and averaged to create a database of unit prices that serve as the basis for calculating capital improvement project costs. If a bid tabulation was not available, costs were developed using appropriate material costs, crews, and production rates from cost references, vendor input, and the professional judgment of the estimator. Unique items and repair technologies for which bid tabulations do not exist are priced individually using quotations and detailed cost breakdowns.

For rehabilitation projects bid tabs were reviewed from City of Springfield rehabilitation projects. The unit cost of $166/foot was developed from these data.

The pumps station costs were based on pump station replacement using cost data originally produced in the City of Eugene's WWMP, adjusted using the ENR index for use in the WWFMP and then adjusted again for the Springfield MP using an October 2007 ENR index value of 8045. For the pump station improvements the peak future flow rate was multiplied by two, assuming a two pump system and the DEQ redundancy requirement that the peak flow must be conveyed with the largest pump out.

The costs presented in this Plan have been developed as guidance for evaluating the projects. The costs are based on currently available information and are presented in 2008 dollars, which have not been adjusted for future escalation. Costs for potential discovery and remediation of contaminated materials have not been included.

The final project costs will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other variable factors. Because of these other factors, final costs will vary from the costs presented in this Plan; therefore, funding needs must be carefully reviewed before making specific financial decisions or establishing final budgets.

Project markups include the following:

- Contingency at 25 percent, included as a direct cost to account for unknown construction costs

Indirect costs include:
- Engineering, legal, administration, and coordination at 30 percent
- Services during construction at 15 percent
- Environmental mitigation at 5 percent
- Easements and right-of-way acquisition where needed at 5 percent

Other assumptions include:
- PVC for pipes 15” and less
- RCP for pipe diameters greater than 15 inches
- 8 foot depth for all pipe diameters up to 30-inches, 8.5 for 36-inches

Appendix G provides supporting documentation for capital improvement project costs.

6.2 Capital Improvements Projects

Table 6.1 provides a complete listing of existing and future pipeline and pump station improvements including:
- Expansion areas with costs
- A project description
- Comments
- Priority provided by City of Springfield
- A proposed implementation year (or range of years)

The project priorities are based on a combination of downstream to upstream logic, availability of monitor data in close proximity to improvement locations and basin boundaries, and quality of calibration. This results in recommendations for implementation and potential additional actions to refine project needs and associated characteristics that affect project costs. The priorities do not incorporate the impacts resulting from improvement project financing.

6.3 SDC Allocations

Table 6.2 repeats the list of projects for existing, future and system expansion areas. In order to identify the relative contribution to the projects by land use condition, peak flows are provided for existing and future land use conditions for each project. Based on those peak flows a percentage of peak flow was calculated for existing and future land use.

Pipes for expanded (currently unserved) areas serving future development areas and their associated costs are shown in the CIP section of the master plan. In the COMMENTS section of the CIP project listing, the increase in pipe size required for future flow conditions is provided. For cases where an existing pipe needs to be upsized for both the existing and future conditions, the diameter required for both land used conditions is provided with the assumption that the diameter required for future land use will be installed.

TABLE 6.1
Capital Improvement Project Listing
Springfield Wastewater Master Plan

Springfield Wastewater Collection System Improvements

Project ID	Purpose	Existing Dia (Inch)	Proposed Diameter (Inch) or Peak Rate (gpm)	No of MHs	Length (ft)	Description	Comments	Priority	Proposed Year	Construction Cost	Total Cost
1	Existing upgrade	--	24	22	6418	Parallel existing 24-inch pipe with new 24-inch pipe from MH10033730 d/s to MH10033409	Will require 300 ft auger bore (bore & jack) 36-steel casing $75,000 (at $250/ft) under Hwy 126	6	2009 - 2010	$2,539,000	$3,935,000
2	Existing upgrade	12	21	4	795	Replace existing 12-inch with 21-inch from MH10033284 u/s to MH10033293	Used to control simulated overflow at MH10033395. Downstream pipe segment from MH10033284 u/s to MH10033294 is upgraded to 27-inch for future improvements.	10	2010 - 2011	$307,000	$476,000
3	Existing upgrade	12	18	5	1112	Replace existing 12-inch with 18-inch from MH10034175 u/s to MH10034164		19	2013 - 2014	$398,000	$617,000
4	Existing upgrade	10	12	11	1538	Replace existing 10-inch with 12-inch from MH10033706 d/s to MH10033719	Crosses Mohawk Blvd	20	2103 - 2014	$477,000	$739,000
5	Existing upgrade	15	24	21	4161	Replace existing 15-inch with 24-inch pipe from MH10034054 d/s to MH10033730. ***Project not required if future rehabilitation is performed.***	Flow monitoring basins 83 and 84 just u/s of improvements. Calibration fair in this area.			$1,625,000	$2,519,000
6	Existing upgrade	10	15	6	1231	Replace existing 10-inch with 15-inch pipe from MH10033920 d/s to MH10033982. ***Project not required if future rehabilitation is performed.***	Flow monitoring suggested prior to preliminary design			$391,000	$606,000
7	Existing upgrade	27/36	--	--	--	Flow at vault on west d/s end of Main Street Interceptor reconfigured to prevent flow from going north. All flow is diverted south.	No construction assumed. Reconfiguration of flow achieved through valve or weir adjustments.			--	--
8	Existing upgrade	10	15	3	714	Replace existing 10-inch with 15-inch from MH10034589 u/s to MH10034519.	Lucerne Meadows LS is routed to the West. As of 2007, this LS discharged to the north through these pipe segments.			$224,000	$347,000
9	Existing upgrade	--	15	17	4837	New 15-inch wet weather bypass from MH10035662 d/s to MH10035367.	Bypass weir set at 496.0 ft elevation (COS) at MH10035662. Crosses Bob Straub Pkwy at start of I105.	8	2010 - 2011	$1,416,000	$2,195,000
10	Existing upgrade	15/18	21--existing, 24--future	11	3589	Replace existing 15-inch and 18-inch pipe with 24-inch from MH10035908 d/s to MH10035636.	A 21-inch is necessary for existing land use. For future land use, this project is upgraded to a 24-inch pipe. Flow monitoring is recommended prior to preliminary design.	11	2010 - 2011	$1,356,000	$2,102,000
11	Existing upgrade	12	15	9	1014	Replace existing 12-inch with 15-inch from MH10035903 d/s to MH10035835.	Flow monitoring is recommended prior to preliminary design	15	2012 - 2013	$348,000	$539,000
12	Existing upgrade	10	12	3	529	Replace existing 10-inch with 12-inch from MH10036187 d/s to MH10036186.	Flow monitoring is recommended prior to preliminary design	16	2012 - 2013	$159,000	$246,000
Rehabilitation for I/I Reduction	Existing Rehab	Varies	8-12	--	23,548	All rehab in basin SN 22. This completes the existing rehab listed in the 2001 WWFMP.	Review cost effectiveness relative to conventional conveyance improvements	5	2009 – 2010	$3,908,968	$7,573,000
Nugget Way PS	Existing upgrade	642 gpm (single pump) 898 gpm (pumps 1 &2)	911 peak wet weather	--	--	Upgrade 2 pump system with 911 gpm capacity each	Flow monitoring suggested prior to preliminary design	3	2008 - 2009	$769,417	$1,443,000
Hayden PS	Existing upgrade	380 gpm (single pump)	494 gpm existing peak, 494 gpm future peak	--	--	Upgrade 2 pump system with 494 gpm capacity each	Flow monitoring suggested prior to preliminary design	21	2013 - 2014	$560,379	$1,050,000
River Glen PS	Existing upgrade	379 gpm (single pump)	525 gpm existing peak, 664 gpm future peak	--	--	Upgrade 2 pump system with 664 gpm capacity each	Flow monitoring suggested prior to preliminary design	22	2014 - 2015	$653,152	$1,224,000
13	Future upgrade	12	18	6	2224	Replace existing 12-inch pipe with 18-inch pipe from MH10035908 u/s to MH10036270.		13	2011 - 2012	$739,000	$1,145,000
14	Future upgrade	10	12	3	325	Replace existing 10-inch pipe with a 12-inch pipe from MH10036195 d/s to MH10036187		17	2012 - 2013	$105,000	$163,000
Rehabilitation for I/I Reduction	Future rehab	Varies	8-12	--	31,211	22.6k ft in SN19, 7k feet in SN48, 1.5k feet in SN49. This plus reduction due to pipe improvements completes the future rehab listed in the 2001 WWFMP.	Review cost effectiveness relative to conventional conveyance improvements	SN19 - 1 SN48&49 - 9	2008-2009 2010-2011	$5,181,026	$10,038,000

Project ID	Purpose	Existing Dia (Inch)	Proposed Diameter (Inch) or Peak Rate (gpm)	No of MHs	Length (ft)	Description	Comments	Priority	Proposed Year	Construction Cost	Total Cost
Harbor Drive	System expansion	--	8 (gravity) and 5 (force main)	32	7818	Service requirements: 1) new "Harbor Drive" PS equipped with 2 pumps each with 145 gpm capacity. 2) 134 ft of 5-inch to extend existing "dry pipe" force main 3) 7684 ft of 8-inch pipe to service entire neighborhood.	Project evaluated if river crossing reduced cost. Most cost effective solution makes use of the existing "dry pipe' force main in place north of the neighborhood..	25	2017 -2018	$2,156,000	$3,342,000
Jasper Road	System expansion	--	10, 12, 21	89	22992	Extends system along Jasper Road to allow for the decommissioning of Lucerne Meadows and Golden Terrace PSs. Service requirements: 1) 2581 ft of 10-inch pipe, 2) 3395 ft of 12-inch pipe, and 3) 17016 ft of 21-inch pipe.		4	2008–2010	$7,496,000	$11,619,000
Franklin Blvd	System expansion	--	8, 15	27	6280	Extends the system from the existing 30-inch south along Franklin Blvd. Service requirements: 1) 2411 ft of 8-inch pipe, and 2) 3868 ft of 15-inch pipe.	Includes the 150 trailer parcels not originally contained in the GIS.	2	2008 - 2009	$1,934,000	$2,998,000
Thurston Rd	System expansion	--	8	17	3882	Extends the system from the existing 15-inch east along Thurston Road. Service requirements are 3882 ft of 8-inch pipe.		24	2016 - 2017	$949,000	$1,471,000
McKenzie Hwy	System expansion	--	10,12	17	3906	Extends the system from the existing 21-inch east along McKenzie Highway. Service requirements: 1) 1924 ft of 10-inch pipe, and 2) 1983 ft of 12-inch pipe.	Pipe extended east as far as grade supported gravity flow. Last manhole shown is at crest of hill.	14	2011 - 2012	$1,049,000	$1,626,000
Vera Area	System expansion	--	8, 12	39	9583	Services the development east of the new Vera pump station. Service requirements: 1924 ft of 10-inch pipe and 1983 ft of 12-inch pipe.		23	2014 - 2016	$2,570,000	$3,984,000
PeaceHealth/ Riverbend PS	System expansion	--				Pump station designed as part of the PeaceHealth/Riverbend Campus Development.	Basis for cost is the *Sanitary Sewer Study for Riverbend Subdivision (KPFF Consulting Engineeers, 2005). Costs adjusted to 2008 dollars.*	12	2011 - 2012	$2,232,930	$3,189,900
		--									
Existing Subtotal										$15,131,917	$25,611,000
Future Subtotal										$6,025,026	$11,346,000
System Expansion Subtotal										$18,386,930	$28,229,900
Total										$39,543,873	$65,186,900

TABLE 6.2
Peak Flows for SDC Allocation
Springfield Wastewater Collection System Improvements

Project Identification Number	Peak Flow (mgd) in Most Downstream Pipe Section--Existing Land Use[1,2]	Peak Flow (mgd) in Most Downstream Pipe Section--Future Land Use[1,2]	Percent of Flow From Existing/Future Sources
Projects required for existing land use conditions			
1	8.3	8.4	100% Existing/0% Future
2	1.8	1.8	100% Existing/0% Future
3	2.1	2.1	100% Existing/0% Future
4	1.3	1.3	100% Existing/0% Future
5	2.5	2.5	100% Existing/0% Future
6	1.1	1.1	100% Existing/0% Future
7	22.0	23.7	93% Existing/7% Future
8	1.5	1.5	100% Existing/0% Future
9	1.3	1.4	88% Existing/12% Future
10	4.3	5.4	80% Existing/20% Future
11	1.3	1.8	65% Existing/35% Future
12	1.0	1.5	70% Existing/30% Future
Rehabilitation for I/I Reduction	Varies	Varies	100% Existing/0% Future
Nugget Way Pump Station[3]	911 gpm	911 gpm	100% Existing/0% Future
Hayden Lo Pump Station[3]	494 gpm	494 gpm	100% Existing/0% Future
River Glen Pump Station[3]	525 gpm	664 gpm	79% Existing/21% Future
Projects required for future land use conditions			
13	2.4	3.2	75% Existing/25% Future
14	1.0	1.6	60% Existing/40% Future
Rehabilitation for I/I Reduction	varies	varies	flows from future development are 9.0% of the total future flow
Projects required for system expansion areas[4]			
Harbor Drive	--	0.22	0% Existing/100% Future
Jasper Road	0.76	4.1	19% Existing/81% Future
McVey Hwy.	--	0.71	0% Existing/100% Future
E. Thurston Rd	--	0.5	0% Existing/100% Future
E. McKenzie Hwy	--	2.1	0% Existing/100% Future
Vera Pump Station Area	--	0.58	0% Existing/100% Future
PeaceHealth/ Riverbend PS[3]	--	360 gpm	0% Existing/100% Future

Notes:
1) All flows result from the peak 5-year winter storm event with all rehabilitation and system improvements in place.
2) Existing system rehabilitation and associated costs for future land use conditions reduce pipeline improvement requirements in the existing system as well as treatment costs.
3) Peak flow for all pump stations are in gallons per minute (gpm).
4) Peak flows are based on revised landuse projections and should be included in future analyses.

Appendix A – Modeling Development and Methodology

A.1 Model Development

A.1.1 Pipe and Manholes

The process to identify the modeled pipes and nodes started with identifying the "active" pipes with diameters of 10 inches and greater. To this dataset, some 8 inch diameter pipes were added for connectivity and City added 8-inch pipes most likely to be impacted by future development. The City provided the primary GIS dataset, but also provided separate datasets that were not yet included in the City's GIS. These additional areas included the Jasper Meadows and the Game Farm Road/Deadmond Ferry extensions.

Once the delineation of the model was complete, the system data was reviewed to ensure the data met the requirements of the model and project objectives. CH2M HILL performed data filling (interpolation) and used as-built data and additional survey to address the data inconsistencies. Examples of data flagged for correction include the following:

- Moved/inserted nodes to align with end of pipe segments
- Pipes below the invert of the manhole ("floating" manholes)
- Missing invert or ground elevations
- Invert elevations above the ground elevations (upside-down manholes)
- Inconsistent connectivity

The City early in the project expressed an interest in updating its GIS based on the final model elevations. For this reason, particular attention was made to track the changes from the original GIS dataset. CH2M HILL used the documenting processes available within the MIKEURBAN model to track the changes as the modeling progressed. For the City's convenience, CH2M HILL exported the model pipes and nodes from the model showing the system as it exists in September 2007 allowing the City to review the data in an ESRI shapefile format. See Appendix A for metadata on the model export shapefiles including codes used to track the changes.

A.1.2 Lift Stations

Operational and physical data on the lift stations were compiled and incorporated into the model. This data included wetwell dimensions and elevations, influent line data, start/stop elevations, and pump curves. As part of the calibration process, adjustments were made to the lift station configurations in the model so lift station peak flow rates matched the most recent drawdown tests (2005) results. Table A.1 lists the stations modeled and the number of pumps at each station.

TABLE A.1
Summary of Stations Modeled and No. of Pumps
City of Springfield Wastewater Master Plan

Pump ID	Total Number of Pumps
71_Golden Terrace	2
72_Lucerne Meadows	2
Exist Harlow	2
LS73 Hayden Lo	2
LS74 Deadmond Ferry	2
LS75 Commercial	2
LS76 21st & E Str	2
LS78 Nugget Way	2
LS80 49th Str	2
LS85 Ramada	2
LS86 Glenwood	2
LS8 Marshall Oil	2
LS88 River Glen	2

A.1.3 Weirs

There are two weirs included in the hydraulic model: 1) The wet-weather bypass weir diverting flow into the E Street Lift Station, and 2) The diversion structure on the parallel North-South Interceptor near the discharge from the new Harlow LS. Weir elevations and orientation were set based on as-built information.

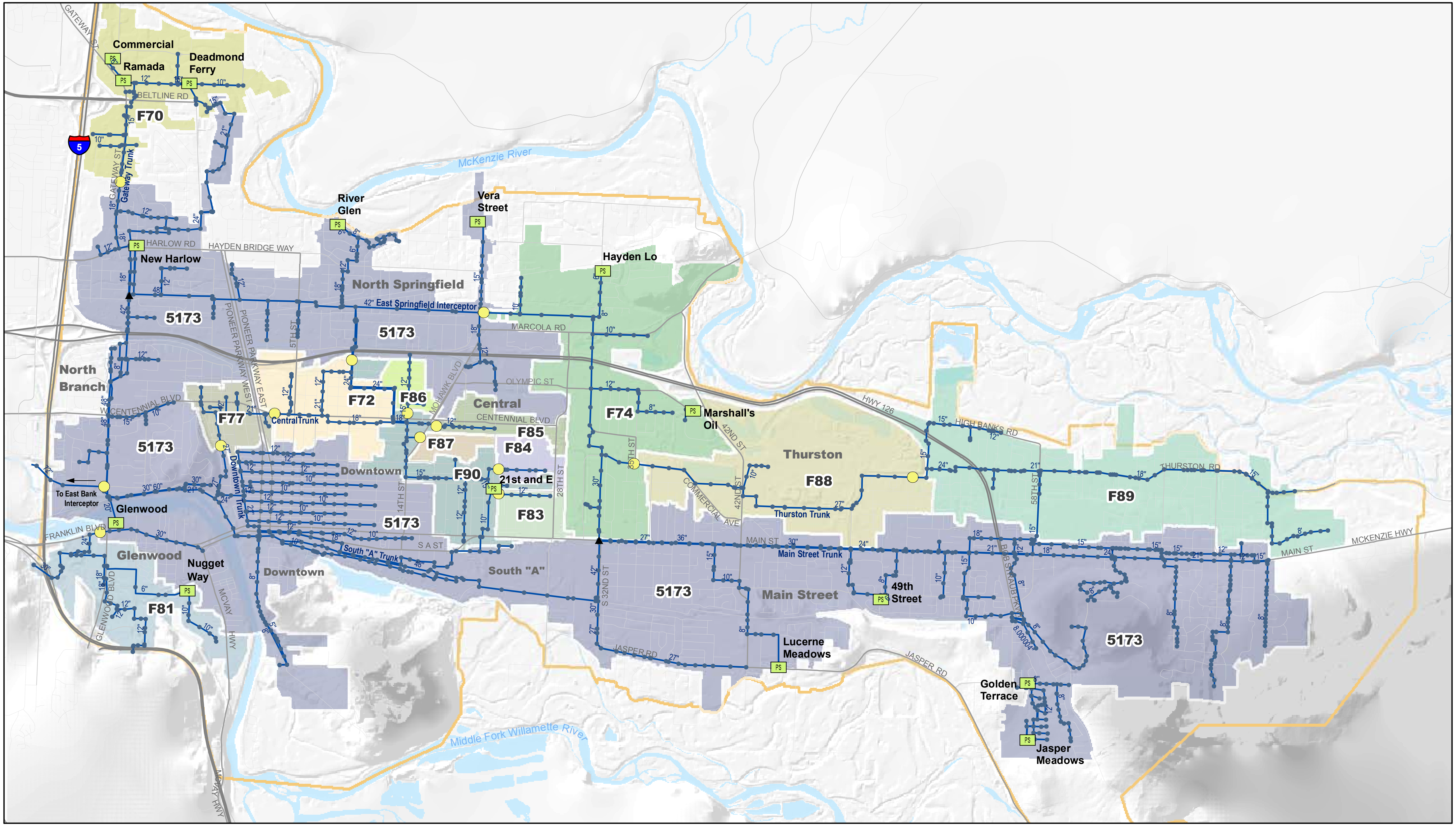
A.1.4 Near-term Projects

The calibration period of the model was December 2005 through January 2006. The system as it existed during this period was used to develop the calibrated model as is referenced as the "2006 system" in the model's *Scenario Manager*. After calibration and to reflect the system as it exists in 2007, the near term projects that were about to be constructed/ implemented by the City were incorporated and referenced as the "2007 System" in the *Scenario Manager*. The updates to the system are as follows:

- Jasper Meadows 12 inch line connecting at MH 10036735
- New Harlow Lift Station and force main
- Diversion at MH10035212 near 57th PL
- Deadmond Ferry reroute

A.2 Flow Monitoring and Data Analysis

Fourteen flow monitors were used to analyze dry and wet weather flow characteristics during the period of December 2005 to January 2006. Figure A.1 shows the flow monitor locations and Figure A.2 shows a schematic of the flow monitors to indicate up and downstream locations relative to one another. This allows for the appropriate subtraction of upstream monitor flows to isolate the contribution from the local monitor area.



LEGEND

- Pump Stations
- Weir/Diversion
- Manholes
- Flow Monitor
- Existing Major Wastewater System Pipes
- F77 Flow Monitoring Basins
- Urban Growth Boundary

N

0 2,000 4,000
Approximate scale in feet

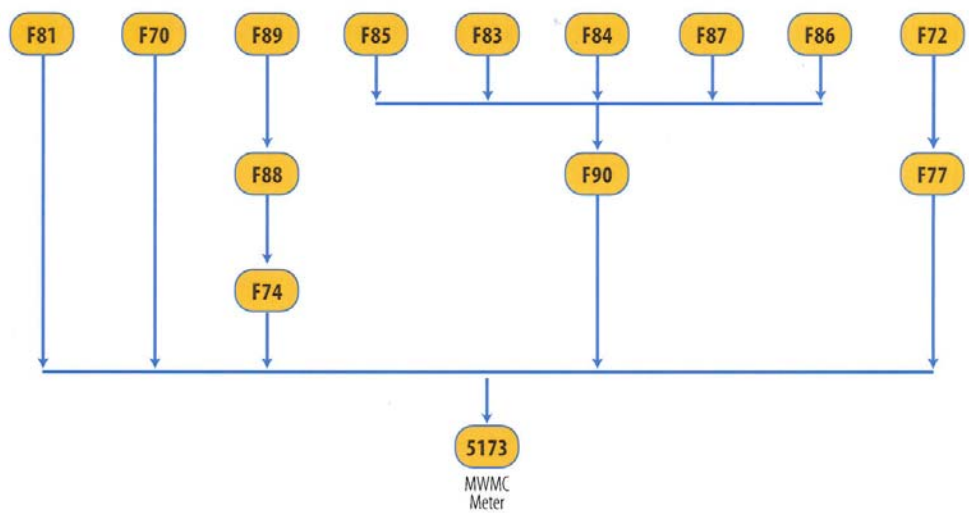
FIGURE A.1
Flow Monitoring Locations

City of Springfield Wastewater Master Plan

CH2MHILL

File Path: p:\SpringfieldOrCityOf\350467\GIS\Map_Documents\FlowModelingBasins.mxd, Date: March 31, 2008 10:24:44 AM

Figure A-2. Flow Monitoring Schematic



The monitor data was analyzed to identify dry weather flows as shown in Table A-2 as well as the absolute and relative contribution of wet weather flows in the collection system. Flow monitor data is used to calibrate the model and identify potential candidate basins for rehabilitation and associated I/I reduction. The following information was produced for each monitor basin:

- % of the volume of rainfall over the monitor basin measured at monitor location often call the "return" or "R" value.
- Peak flow rate per footage of pipe in the basin (peak gpm/ft)
- Total volume of I/I for a storm event per foot of pipe in the basin (Gallons/ft)
- Peak flow rate per contributing acre within the monitor basin (gpd/acre)

TABLE A.2
Average Dry Weather Flow Contributed from Each Monitor Basin
City of Springfield Wastewater Master Plan

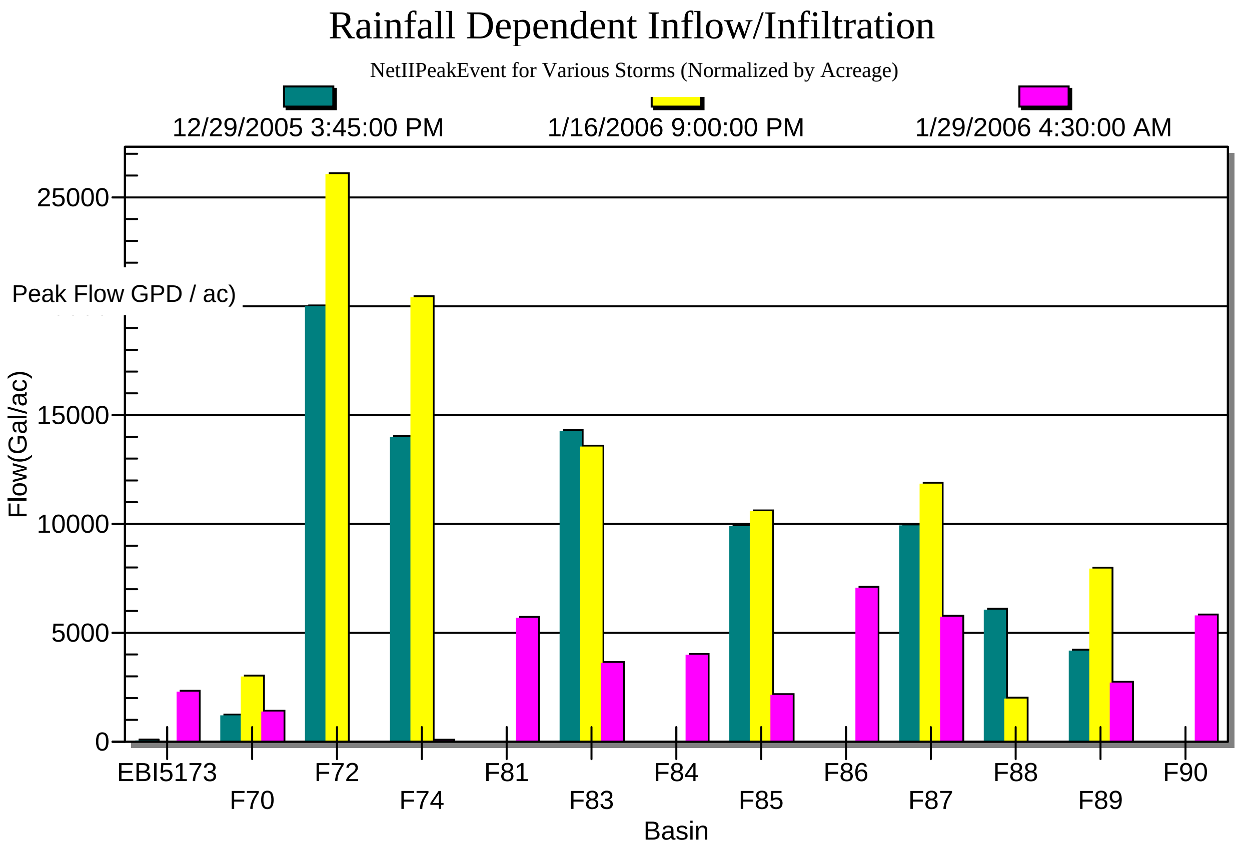
Flow Monitoring Basin	Acre (Acres)	Average Flow (mgd)
5173	5779	5.64
F70	433	0.27
F72	251	0.12
F74	928	1.30
F77	109	0.18
F81	324	0.20
F83	84	0.16
F84	69	0.04
F85	88	0.08
F86	53	0.03
F87	43	0.07
F88	704	0.44
F89	924	0.29
F90	258	0.28

Based on the review of these data, monitor basins upstream of deficiency areas with large I/I contributions relative to the other monitor basins and to other rates typically seen in municipal systems in the northwest where selected as rehabilitation basin candidates. The flow monitor basins selected correspond to the City's "SN" basins 19, 22, 48 and 49. The flow monitor basins that align with these SN basins are F72, 83, 84, 90 and 5173.

As shown in Figure A.3, the rate for peak gallons per day per acre of basin area in many of the basins is greater than 5,000 gpd/ac for most of the storm events recorded. 5,000 gpad corresponds to a peaking factors of 10.5 in F72, 8.6 in F84, 2.6 in F83, 4.6 in F90 and 5.1 in 5173 which is excess of the 3.5 peak flow factor included in the City's design standards for sizing new systems and therefore good candidate basins for I/I reduction.

Additional tables showing I/I characteristics in each monitoring basin is in Appendix B.

Figure A.3. Peak Gallons per Day per Acre Within Flow Monitoring Basins



A.3 Modeling Methodology

A.3.1 Hydraulic Model

Boundary conditions in hydraulic model are the hydrological and sanitary flow loads on the sewer system. For the City of Springfield hydraulic model, there are several types of boundary conditions used in the model:

- Sanitary flow loading
- Model outfall
- Evaporation
- Inflow/infiltration

Flow monitors installed and maintained by the City were the basis to quantify and distribute flow within the system.

A.3.1.1 Sanitary Flow Loading

Sanitary flow loads reflect the flows found in the system during periods not impacted by precipitation. To characterize the existing land use sanitary flow loading, CH2M HILL first identified the periods of repeatable dry-weather data. From this dataset, the monitor and net average flow rates and consistent diurnal pattern were calculated for each flow monitor.

To improve the accuracy of the flow distribution, the City provided CH2M HILL the largest water customers. A portion of the purchased water was assumed to be routed to the sewer as summarized in Table A.3.

TABLE A.3
Largest Water Customers
City of Springfield Wastewater Master Plan

SIU	Q Purchased (mgd)	% to Sewer	Q to Sewer (mgd)	Basin
Hexion Chemical (formerly Borden Chemical)	0.043	50%	0.022	5173
Lane County	0.040	85%	0.034	81
Weyerhaeuser Company	0.032	50%	0.016	88
Sierra Pine	0.028	85%	0.024	88
Weyerhaeuser Springfield Plywood	0.028	50%	0.014	88
McKenzie Forest Products	0.011	50%	0.006	5173
Pepsi Cola Bottling Company	0.010	50%	0.005	81
Rosboro Lumber Company	0.009	85%	0.008	5173
Dynea Corporation	0.006	85%	0.005	83
Voith Paper	0.004	50%	0.002	74
McKenzie Chrome	0.001	85%	0.001	74
MXR Services	0.000	85%	0.000	85
Quadra Chemical	0.000	50%	0.000	88

To distribute the average net flow within the basins, catchments were delineated. Catchments are smaller areas within each flow basin with one load point associated for each catchment. Using land use and parcel information, CH2M HILL calculated equivalent dwelling units (EDUs) for each parcel and then the total number of EDUs for each catchment and flow basin. CH2M HILL divided the total number of EDUs in each flow basin by the average dry-weather flow resulting in a per capita sanitary flow load. Groundwater infiltration was not determined separately so the sanitary flow load includes the groundwater infiltration component.

Table A.4 is a summary of the per EDU loading calculation used in the model for existing land use scenarios.

TABLE A.4
Existing Land Use Flow per EDU
City of Springfield Wastewater Master Plan

Basin	Total EDU[1]	Average Flow (mgd)	Less Industrial Sources (mgd)	Flow to Distribute (mgd)	Flow (gpd) per EDU[2]
5173	22,425	5.64	0.035	5.60	250
F70	2096	0.27		0.27	129
F72	1138	0.12		0.12	104
F74	2211	1.30	0.003	1.30	586
F77	658	0.18		0.18	273
F81	342	0.20	0.039	0.16	459
F83	399	0.16	0.005	0.16	395
F84	316	0.04		0.04	123
F85	623	0.08	0.001	0.08	124
F86	259	0.03		0.03	100
F87	315	0.07		0.07	207
F88	1870	0.44	0.054	0.384	205
F89	2838	0.29		0.292	103
F90	1412	0.28		.279	197
Total	36,902	9.08	0.137	8.94	--

Notes:
1) The number of EDUs per catchment is in the *Persons Equivalent (PE)* field in the hydraulic model's catchment editor.
2) The flow per EDU is used in the cyclic PE based "*Value"* field in each catchment's boundary item in the hydraulic model.
3) Higher flow values (>290 gpd based on City design standards for single family dwellings) are a direct result of actual flow monitor based measurements and may indicate either, 1) greater groundwater infiltration rates since average flows were developed for dry weather, but wet season conditions, or 2) basins containing higher flow generation sources other than the industries already identified.

A.3.1.2 System Outfall

The City of Springfield sewer system discharges into the East Bank Interceptor of the MWMC sewer system. This interceptor in the MWMC system was not included in the City's hydraulic model, but CH2M HILL used fixed water level as a boundary condition at the model outfall to account for potential hydraulic influence from the interceptor. Hydraulic simulations performed in the 2005 MWMC update were referenced to identify the peak wet-weather level resulting from the 5-year storm. From this analysis, a constant water level with an elevation of 404.81 feet is used. This water level equates to the discharge pipe being half full in the model.

A.3.1.3 Evaporation

Evaporation-transpiration data was compiled from City of Eugene airport meteorological data. The data was time series data from 2005 and 2006 and loaded as a catchment boundary load (see ET_LookoutPoint_estimated.dfs0 in the MIKEURBAN model). The evaporation data improves the accuracy of the model by causing the "infiltration limb" of the wet-weather response to return to typical system flows following a rain event at a faster rate.

A.3.1.4 Inflow/Infiltration

Inflow/infiltration (I/I) due to precipitation was accounted for in the model by using the Model A and RDI/I module hydrology models in MIKEURBAN. After importing the catchments into the model, the hydrology parameters were adjusted until the wet-weather response matched the flow monitoring data in terms of both peak rate and volume. The final calibrated hydrology parameters are available in the MIKEURBAN model.

The total area of each catchment results from the catchment delineation done in ArcGIS, but is not used by the hydrology runoff models, rather the model uses the "drainage" area in each catchment. For the City of Springfield model, the drainage area is the total area of the parcels identified as being connected to the sewer in January 2006.

A.3.1.5 Calibration

Calibration of the model was conducted first for dry weather and then for wet weather. The dry weather calibration was used to correct connectivity within the model. After completing the dry weather calibration, the rainfall that occurred during the flow monitoring period was loaded into the model. The wet weather calibration was an iterative process adjusting the hydrology models to correlate the peak flow rate, shape, and volume from the model to the monitored data. Figure A.5 below is shows the most downstream monitor in the system, Monitor 5173 located just upstream before discharging into the MWMC Eastbank interceptor. As seen in the figure, the model calibrated well to this monitor. Appendix D includes the calibration hydrographs from all the monitoring locations.

In addition to reviewing the accuracy of the model at the monitoring locations, CH2M HILL also reviewed the peak pumping capacities at each of the modeled lift stations. Initial simulations resulted in the model over predicting the pumping capacity at many of the lift stations. Drawdown tests for individual pumps were conducted in 2005 and were the basis for comparison. CH2M HILL adjusted pump curves to improve the accuracy of the model. Table A.5 below lists the capacity of the modeled lift stations established during the calibration process.

Figure A.5. Calibration of Monitor 5173

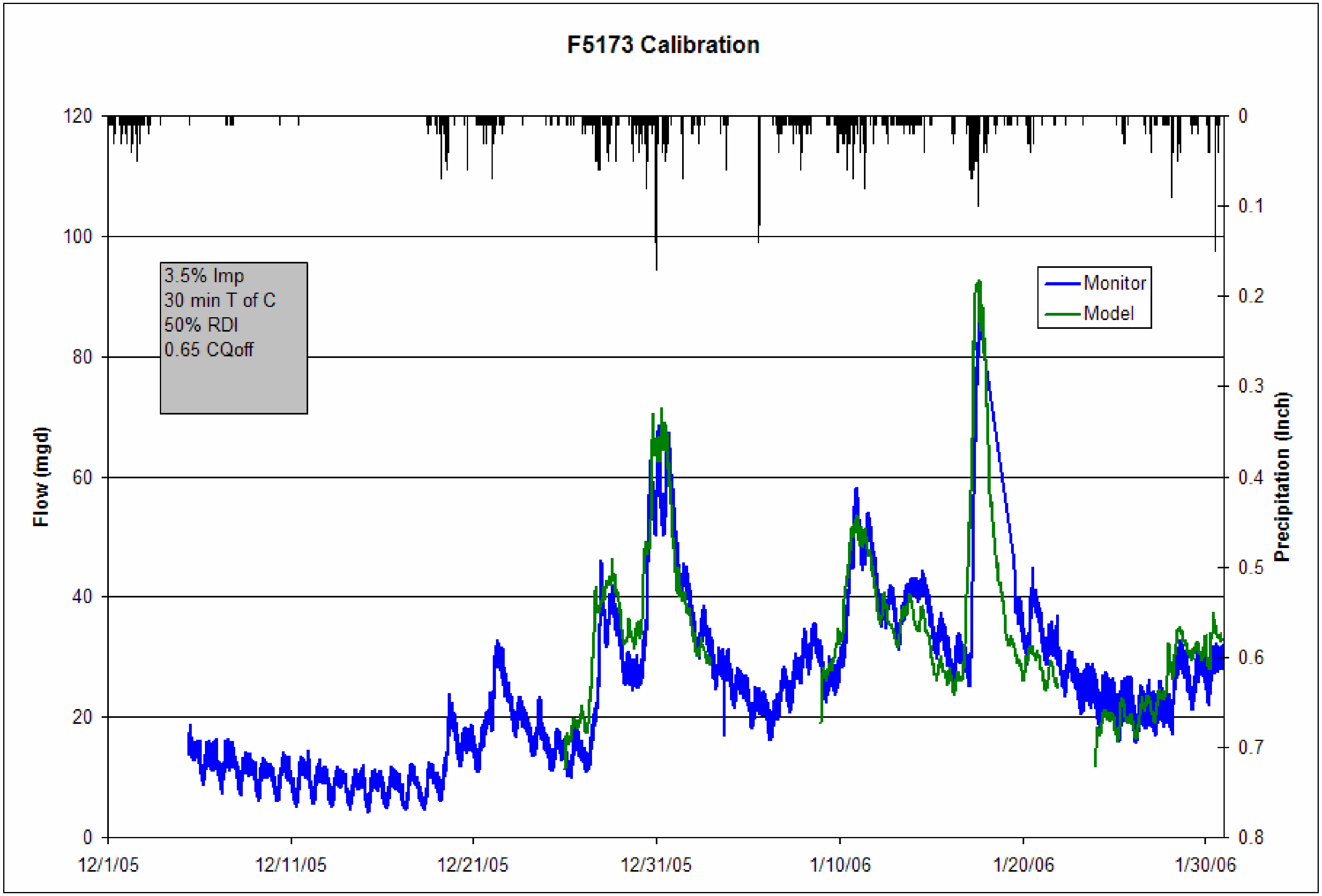


TABLE A.5
Lift Station Capacities based on Calibration Results
City of Springfield Wastewater Master Plan

Pump ID	2005 Drawdown Test (Single Pump)	Model Single Pump (gpm)	Model Lift Station Capacity (Combined Pumps)	Number of pumps operating for peak	Total Number of Pumps
71 Golden Terrace	225	225	316	2	2
72 Lucerne Meadows	186	186	260	2	2
Exist Harlow	1107	1104	2406	2	2
LS73 Hayden Lo	380	359	449	2	2
LS74 Deadmond Ferry	1010	1038	1038	1	2
LS75 Commercial	274	253	292	1	2
LS76 21st & E Street	954	902	1100	2	2
LS78 Nugget Way	642	642	898	2	2
LS80 49thStr	288	275	275	1	2
LS85 Ramada	120	120	120	1	2
LS86 Glenwood	--	4533	4533	1	2
LS87 Marshall Oil	230	230	230	1	2
LS88 River Glen	379	379	530	2	2

A.3.1.6 RDI/I Peak Flow Adjustments

As part of project's QA/QC of the initial model results, CH2M HILL compared the peak I/I rates resulting from the 5-year storm and compared this to the peak I/I rates determined by monitored storms. The peak I/I rates for the 5-year storm were estimated based on a regression analysis of the monitored data. The regression analysis produces a relationship between volume of rainfall measured at a flow monitoring location for multiple storms with the peak flow rate measured at that monitor location. By developing this relationship it allows for the prediction of peak flow rates given rainfall events that were not monitored such as a larger design event. Typically, the flows predicted for events larger than those measured at the monitor location either follow the regression trend line or may fall below the line as pipeline defects that allow I/I to enter the system reach capacity and the % of I/I that enters the system can decrease for larger rainfall events. This approach to estimate I/I is consistent with that described in the *Oregon Department of Environmental Quality Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon* as well as the approach applied in the 2001 WWFMP Plan (see Section 4.2.5.2).

The values produced through the regression analysis were compared to those resulting from the application of the RDII module utilized by the hydraulic model. In a majority of the basins the linear regression projections were less than the values predicted in the RDII module. The regression plots are included as Appendix E. A clear example of the difference between the regression results and the model results using the RDII module is for monitor 5173 which has the largest contributing area of all the monitored basins. The graph shows the peak flows relative to the storm volume for all the storms monitored at that location. The regression trend line is then established from those data points and extended to the 5-year storm volume for that basin. The peak flow rate predicted by the model using the RDII module to estimate I/I flows is also plotted. The regression trend line predicts 55.6 mgd as the peak 5-year flow rate versus the RDII module estimate of 106.4 mgd. As a result the model was adjusted to match the regression results for all basins where the regression values were less than the original model results. The results from the RDII module were used for monitor basins where the model predicted flows less than the regression equations. This is because this was the anticipated trend of flows predicted for the larger storm events as the capacity of pipe defects is reached and a decreasing amount of flow can enter the pipelines. No adjustment was applied to the flows from these basins. Although the regression based predictions should be valid for all basins in a majority of locations where the regression equation was not used, the monitor data did not support a quality predictive equation. This is shown in Table A.6 where low correlation coefficients are associated in most cases with basin values that were not adjusted.

In order to achieve the predicted flow rates an adjustment factor was applied to the impervious area. This model variable was selected because it will result in the same proportional adjustment desired in the RDII flow rate. Table A.6 provides the flow rates and adjustment factors for all monitor basins derived from the graphs in Appendix E.

TABLE A.6
Adjustment Factors
City of Springfield Wastewater Master Plan

Flow Monitor Basin	Regression RDII Peak Q (mgd)	Model RDII Peak Q (mgd)	Delta RDII Peak Q (mgd)	Adjustment Factor	Correlation Coefficient (R^2)
F70	1.17	1.93	0.76	0.61	0.40
F72	9.70	12.87	3.17	0.75	0.92
F74	22.56	6.59	-15.98	None	0.77
F77	13.17	2.19	-10.98	None	0.37
F81	18.64	8.28	-10.36	None	-0.86
F83	1.74	3.43	1.69	0.51	0.11
F84	1.25	3.48	2.23	0.36	0.96
F85	1.43	2.52	1.09	0.57	0.99
F86	10.90	2.60	-8.29	None	0.71
F87	0.63	1.01	0.38	0.63	0.76
F88	3.45	0.88	-2.57	None	0.33
F89	7.53	9.05	1.51	0.83	0.63
F90	4.85	1.71	-3.14	None	0.80
5173	55.60	106.44	50.84	0.52	0.96

A.3.2 Flow Development

A.3.2.1 Flow/EDU Development

To calibrate the model, the flow measured at the flow monitoring locations must be distributed upstream within the basins. To distribute the dry weather flow, equivalent dwelling units (EDUs) are assigned to the sewer parcels. The EDUs are used to weight the distribution of the flows based on the land use. The project team used available information in the taxlot, land use, and building shapefiles to assign EDUs to each parcel. This Section summarizes the EDU assignments.

For the single family and multiple density residential listed in the table, parcel areas were reviewed. For relatively large parcels (e.g., greater than 2 acres), it was assumed that additional units were on the parcel and a density of 1 unit (e.g., 1 quad) per 0.5 acres was applied.

For single family residential development, City Planning provided EDU density based on the slope. The average slope of each parcel was determined and assigned the appropriate residential density.

TABLE A.7
EDU Density Based on Slope
City of Springfield Wastewater Master Plan

EDUs/acre	Slope	Minimum lot size
5	General or otherwise unknown	--
4.4	15-25%	10,000 sq ft
2.2	25-35%	20,000 sq ft
1.1	Over 35%	40,000 sq ft

Many of the land use categories are based on area. Where building information was available, the number of floors times the building footprint was used to calculate area. If parcel information was the only area data available, it was assumed that only a portion of the parcel area contributed to sewer flow—between 25 and 50 percent of the parcel area.

Lastly, for the balance of parcels that are not addressed by the categories listed in Table A-8, an EDU assignment equivalent to the commercial assignment was used—1,100 gpd/parcel.

For the full development (build-out) scenarios, the City identified parcels that are expected to be ultimately connected to the sewer system in the future. Similar to the existing land use EDU estimates developed above, CH2M HILL used the *PlanDes* field in the land use data to estimate the future EDUs. For each future parcel, a sanitary flow loading of 236 gpd per EDU was assigned. This value was derived from updated census and LCOG 2006 data. Flow from 3,773 additional parcels (14,740 EDUs) is accounted for in the future development scenario. This equates to 3.4 mgd additional dry-weather flow each day. The sanitary flow component of the future parcels is incorporated in the catchment table editor identified with a “FU_.” prefix followed by a identification number based on the City's GIS 6-digit *Geofeat_ID* field (there were several duplicates where another "1" was added at the end to make it unique).

A.3.2.2 Future Development Loading

Future development areas were identified and based on the future land use of the parcels, equivalent dwelling units (EDU) were assigned. Projected maximum flow was identified for each of the areas that comprised both a sanitary flow (dry weather) and a wet weather component. The sanitary flow component was derived by using 236 gallon per day per EDU and multiplying this average sanitary flow by a diurnal fluctuation representative of residential development. An instantaneous factor of 1.7 is included in this diurnal pattern and was used to size the future service pipes. To this, a wet weather component of 2000 gpad based on the total area was added.

Based on information provided by the City, the future developed parcels have been assigned to a connection point in the existing system. This is reflected in the model.

A.3.2.3 RDI/I Rate for Future Conditions

For the future development scenarios, it was necessary to account for the wet-weather response the future parcels would have on the system. Consistent with the WWFMP, a wet-weather allocation of 2000 gpad was used. This was incorporated in the model as a *Network Load* using a unit hydrograph and a scaling factor. The shape of the unit hydrograph was taken from a monitored basin that represented more recent construction.

The 2000 gpad was established based on a "Total Area", not the drainage area described above. To ensure the 2000 gpad wet-weather allocation was consistently applied, the drainage area for each future parcel was divided by 0.789—this factor was derived by comparing the drainage area to the total area in flow monitoring basin 84 (a basin dominated by single residential parcels). A scaling factor applied to the unit hydrograph was then calculated based on the calculated total area of each parcel (see the *Scaling Factor* field in the model network load boundary item for future scenarios).

TABLE A.8

EDU Assignment

City of Springfield Wastewater Master Plan

Land Use Category	GIS FIELD (Attribute)	EDU Assignment (EDU/day)	Assumption	Source
Single Residential	LANDUSE: (1100, 1111, 1113, 1116, 1150) USECODE: (S)	1 EDU/parcel	--	Industry Standard
Duplex	LANDUSE: (1120)	2 EDU/parcel	--	Industry Standard
Apartments with 1 to 4 units	LANDUSE: (1131,1132)	4 EDU/parcel	--	Industry Standard
Apartments with 5 to 19	LANDUSE: (1133)	12 EDU/parcel	--	Project assumption
Apartments with more than 20 units	LANDUSE: (1134)	25 EDU/parcel	--	Project assumption
Hospital	McKenzie-Williamette Medical Center	0.66 EDU/bed (165 gpd/bed)	--	Metcalf & Eddy
Medical (clinic, dental)	LANDUSE: (6512, 6513, 6514, 6515, 6517, 6519)	2 EDU/1000 sq ft (500 gpd/1000 sq ft)	25 percent of parcel area contributes	WA Department of Ecology (WA DOE)
Dormitory/ Residence Hall	Building name	0.16 EDU/student (40 gpd/student)	100 student	Lin, Shun Water and Wastewater Calculations Manual
School	School name	0.1 EDU/student (25 gpd/student)	500 students	Metcalf & Eddy
Dwellings	Misc. (Community Center, Fire Stations)	0.4 EDU/occupant (100 gpd/occupant)	--	Industry Standard WA DOE
Airport	Mahlon Sweet Field Airport	0.012 EDU/passenger (3 gpd/passenger)	--	Metcalf & Eddy
Shopping Center Retail	USECODE: (R) FM_TYPE: (Shopping center)	1 EDU/1000 sq ft (250gal/1000 sq ft)	33 percent of parcel area contributes	WA DOE
Hotel/Motel	LANDUSE: (1510)	0.18 EDU/room (45 gpd/room)	100 rooms	Metcalf & Eddy
Restaurants/bars	LANDUSE: (5810)	0.25 EDU/seat (50 gpd/seat at 29 sq ft/seat)	50 percent of area is restaurant and 29 ft^2/seat	WA DOE
Auto Service Stations	LANDUSE: (6411)	2 EDU/parcel (12 gpd/car, assumed 50 cars/day)	50 cars/day	Metcalf & Eddy
Industrial	USECODE: (I)	10 EDU/parcel (1800 gpd/acre)	--	Lin, Shun *Water and Wastewater Calculations Manual* and consistent with CH2M HILL approach to similar land use
Commercial	PROPCL: (“Commercial”)	4 EDU/parcel (1150 gpd/acre)	--	Lin, Shun *Water and Wastewater Calculations Manual* and consistent with CH2M HILL approach to similar land use
Group Quarters (Fraternity, Sorority, Boarding Houses)	USECODE: (M)	20 EDU/parcel	50 occupants at 100 gpd/person	CH2M HILL assumption

Also, although the model was calibrated from flow monitoring data provided between December 2005 and January 2006, precipitation data was available from September 2005. The RDI/I module includes non-linear reservoirs to account for the effects of preceding precipitation. To ensure that these reservoirs were "filled" in the hydrology model and initial conditions were accurately accounted for in the model, the hydrology runoff model was run from September 2005 to January 2006.

A unit hydrograph was used in the model to account for the wet weather component of future parcels connected to the collection system. The shape of the unit hydrograph was based on the system response on a basin with relatively new construction. The peak of the unit hydrograph has a rate of 1 gpm. A scaling factor was applied in the model to account for a peak rate of 2000 gpad based on the total area of the future land use parcel. The peak of the unit hydrograph coincides with the peak flow rates observed in the system following the peak rainfall intensity.

To account for the antecedent soil conditions, the rainfall prior to the calibration period was included from September 2005 through January 2006. For this reason, it was necessary to insert zero precipitation before the unit hydrograph. This approach allows flexibility in the simulations performed by the model.

A public-only curve was developed that incorporated monitor data as well as the substantial experience and field observations developed by City of Eugene and Springfield staff. The curve was based on a logarithmic trend of four out of five data points that was further adjusted based on experience and knowledge of staff and to allow for a margin of error. The curve also represented the belief that about 5 percent of a sub-basin will need to be rehabilitated before any measurable RDII reduction can be achieved. The MWMC public-only curve that excludes the privately owned upper portions of the laterals is shown in Figure A.7.

The methodology to incorporate rehabilitation in the model is applied to the *ImpArea* field (Model A Time Area) and to the *RDIIArea (*RDI/I module) under the *Runoff Model* menu. For example, a review of rehabilitation progress recommended in the WWFMP indicated I/I in basin SN18 would be reduced by 40.5 percent. To incorporate in the model, the fields identified above were multiplied by a factor of 0.595 (1 – 0.405) reducing the peak I/I rates proportionally. This methodology can be applied by the City as rehabilitation progress is updated for future simulations.

Figure A.6. Unit Flow Hydrograph for Future I/I.

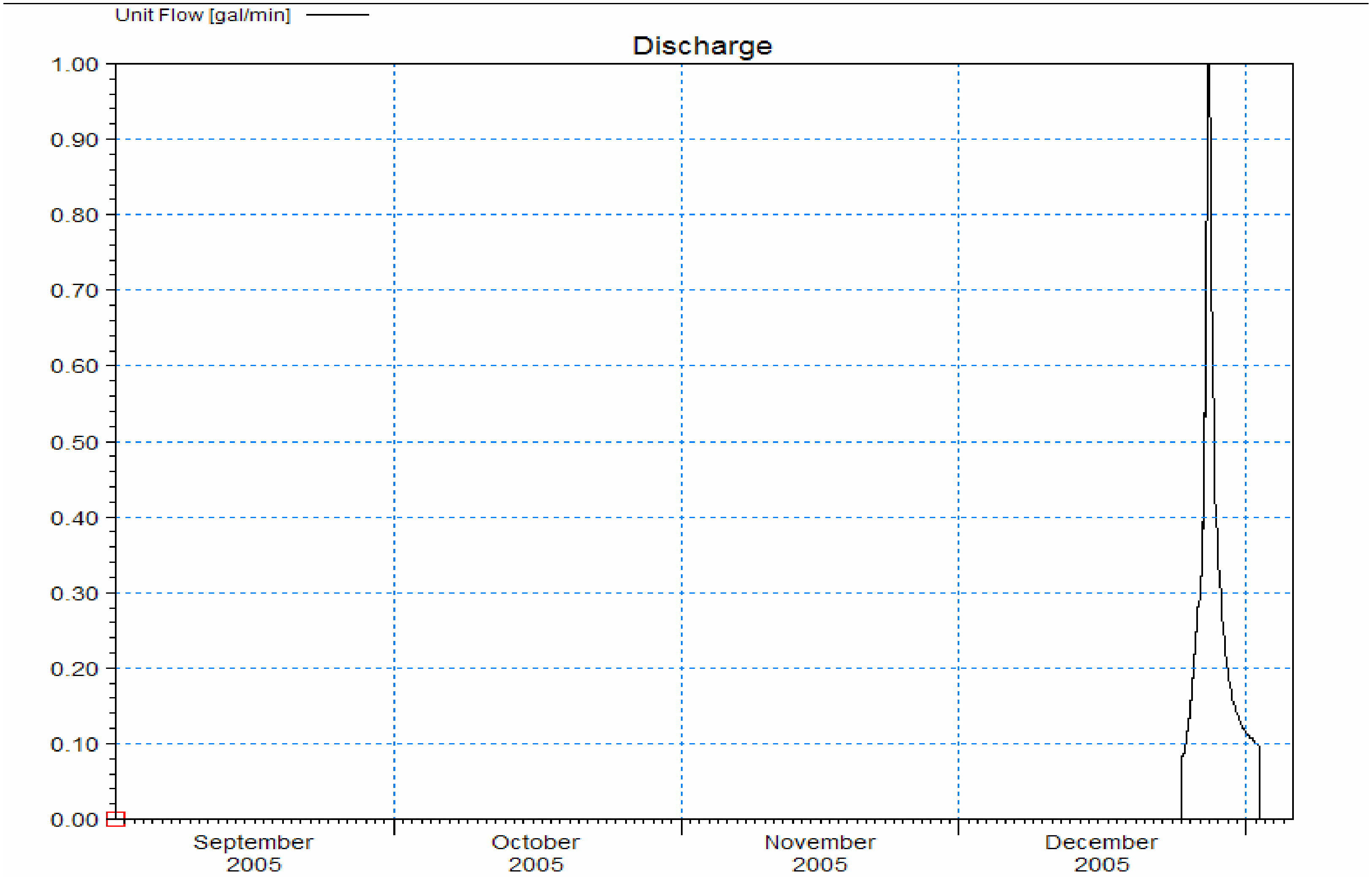
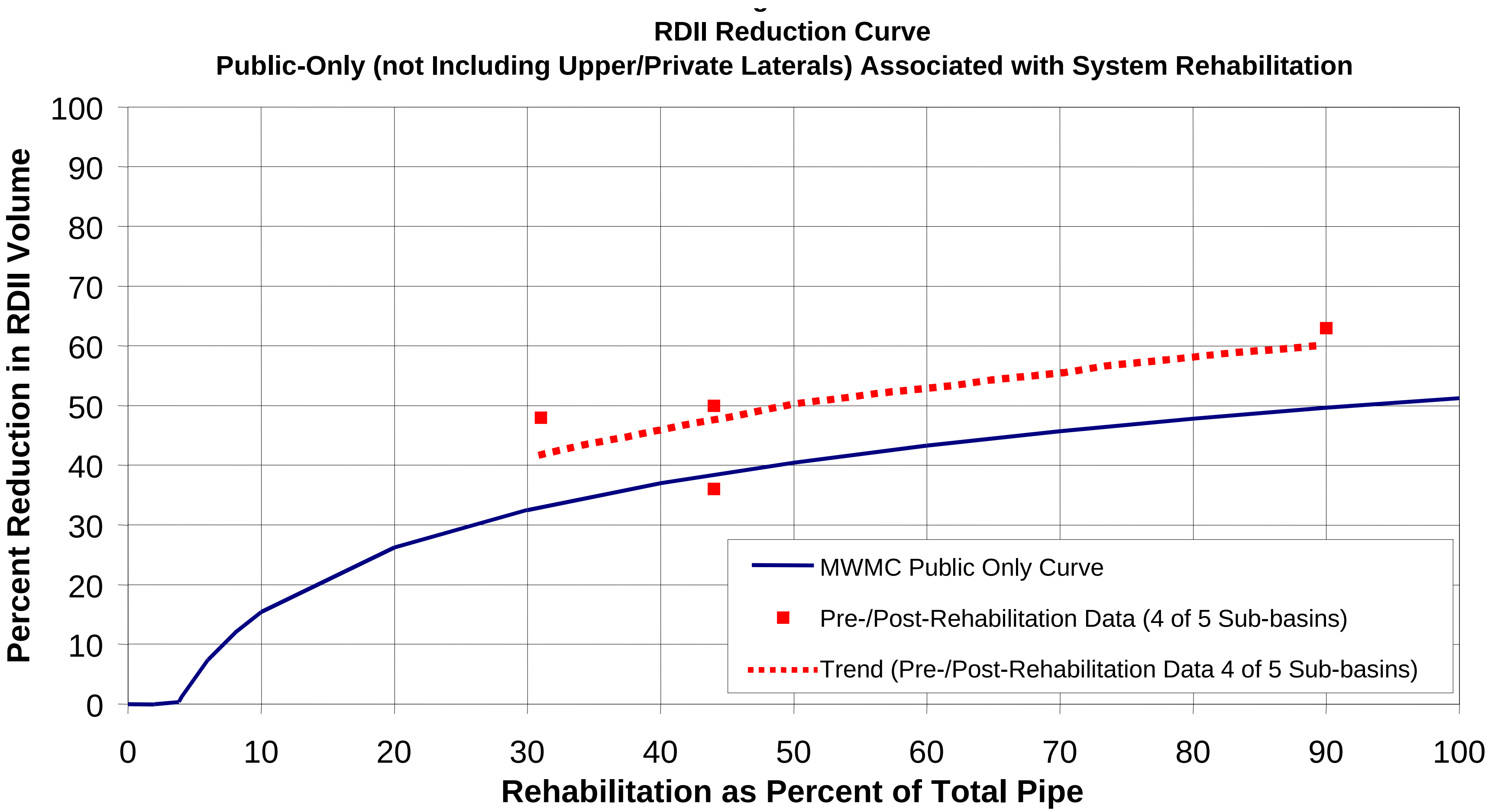


Figure A.7 Reduction Curve for Public-Only Rehabilitation



A.4 GIS Metadata and Reference Data

Scenario Manager:

The MIKEURBAN *Scenario Manager* was used to document the progression of modeling simulations, particularly in the "Comments" fields available in the scenario manager tool Within the tool, CH2M HILL used consistent naming conventions to document the progression of simulation alternatives and scenarios. The primary references are described as follows:

Scenarios

- Run #: A unique hydraulic simulation ID
- ADJ: indicates the peak wet-weather components were adjusted to fit the regression of the peak inflow/infiltration flow rates with precipitation for each monitored storm
- ExLU: Existing land use—used for simulations to incorporating calibration or current (as of January 2006) land use.
- FuLU: Future land use—Incorporates the ultimate buildout of the system for both wet- and dry-weather.
- 5Yr: Hydrology runoff model is linked to the 5-year design storm
- Norm: Nodes have been set to "normal"—allows ponding above the manhole and flow to enter the system as response to a storm recedes. Note, force main nodes and some manholes identified by City personnel as being bolted (e.g., those manholes just upstream of the Glenwood lift station in the vicinity of MH 10038011), are set as "sealed" in all the scenarios. The "normal" node cover setting is used for deficiency analyses.
- Spill: Nodes have been set to "spilling"—once the maximum water level (hydraulic grade line) reaches the ground surface of the node, flow is allowed to leave the system. Using spilling nodes more closely represents the hydraulic conditions of the system during a storm and used to for report figures.
- Imp: Documents that the run incorporates improvements (larger pipes, lift station capacities, or reduced inflow/infiltration due to planned rehabilitation).

Alternatives

On the right side of the "Scenario Manager" tool screen, the Alternatives are presented. These are classified per data type (network, boundary conditions, etc.) required in the model to perform a simulation. To view the applicable tables associated with each alternative, a "Right click" shows the model inputs corresponding to that alternative. Most are documented in the "comment" field or are self explanatory. A similar naming convention listed above for the scenarios was used in the alternatives.

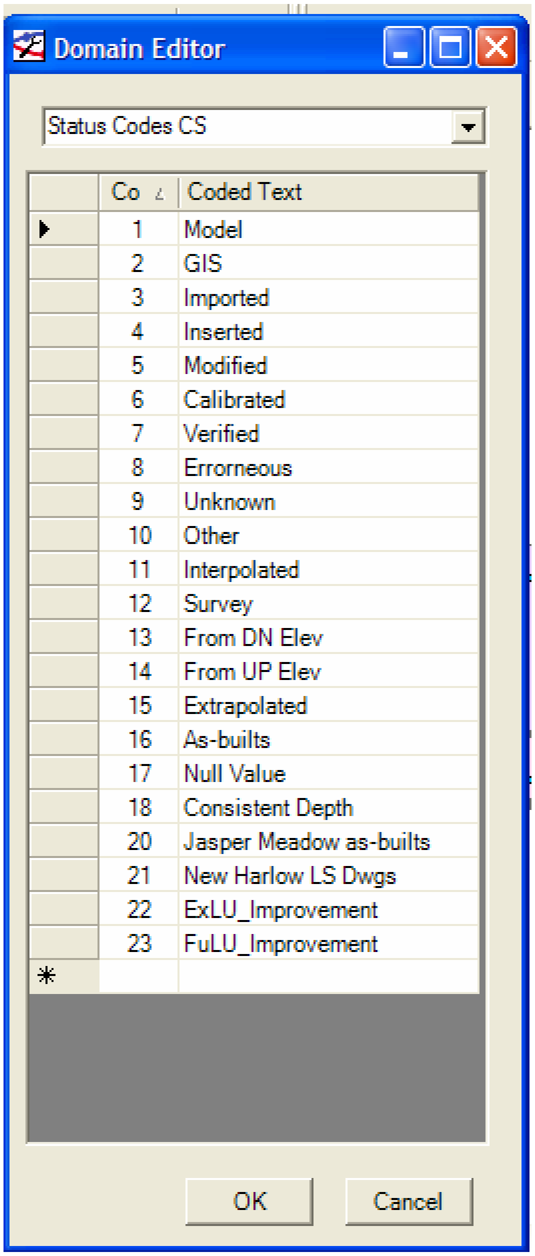
Model Nodes and Pipes Shapefiles

A model node and pipe shapefile were exported from the MIKEURBAN model for the City's convenience and possible source to update the City's GIS. These shapefiles incorporate all the data reviews and QA/QC efforts to clean the data in order for hydraulic simulations to be performed. This functionality to export shapefiles is built-in into the MIKEURBAN model, but is specific to the "Activated" scenario in the *Scenario Manager*. The modeling node and pipe shapefile provided to the City are of the "2007 System" with "Normal" nodes and represents the most current data source of the existing system as of September 2007.

The fields in the shapefiles match the field names used in the MIKEURBAN geodatabase and are each described extensively in the software documentation. To access this metadata documentation, browse to *.PDF file in the following path where MIKEURBAN is installed on the City computer: C:\Program Files\DHI\MIKE URBAN\Manuals*MIKE URBAN Tables.pdf*. See the documentation for the *msm_Node* and the *msm_Pipe* tables on pages 34 and 41 of the PDF file.

CH2M HILL documented whenever elevations were changed from the GIS within the MIKEURBAN model in the *Status, InvertLevel_S,* and the *GroundLevel_S* fields for nodes and *UpLevel_S* and *DwLevel_S* for pipes in their respective editors. A <*Null*> entry indicates the source of the data is the City's GIS. If referencing the exported model shapefiles, the fields are changed to *Element_S, InvertLE_1* and *GroundLe_1.*

The status codes shown in Figure A-1 detail where data fields were changed from the GIS. The codes shown in Figure A-1 are found in the MIKEURBAN model under the *Tools, Customize, Status Code* menus.



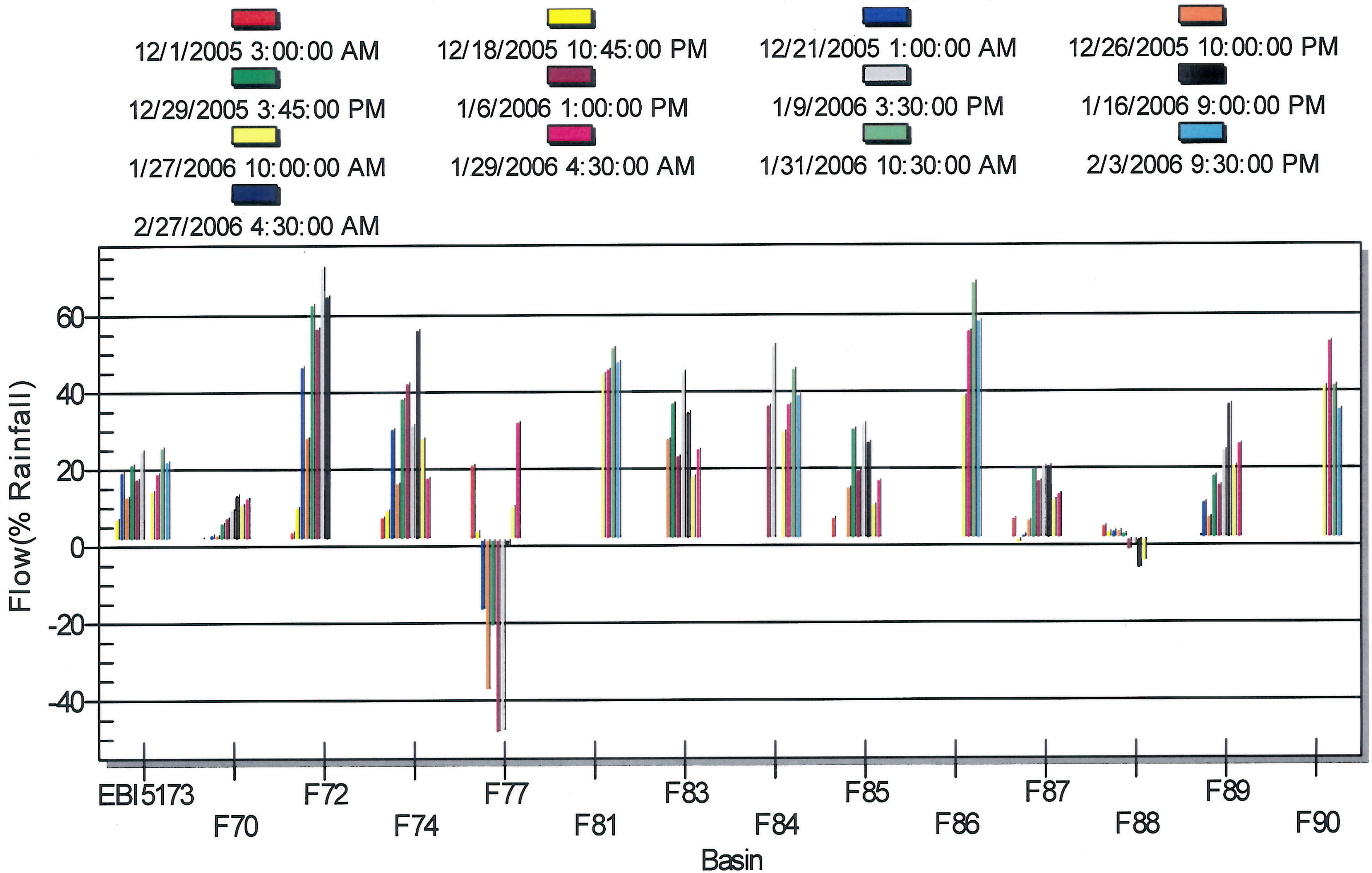
Co	Coded Text
1	Model
2	GIS
3	Imported
4	Inserted
5	Modified
6	Calibrated
7	Verified
8	Erroneous
9	Unknown
10	Other
11	Interpolated
12	Survey
13	From DN Elev
14	From UP Elev
15	Extrapolated
16	As-builts
17	Null Value
18	Consistent Depth
20	Jasper Meadow as-builts
21	New Harlow LS Dwgs
22	ExLU_Improvement
23	FuLU_Improvement

Status codes to denote data changes

Appendix B – I/I Characteristics for Monitor Basins

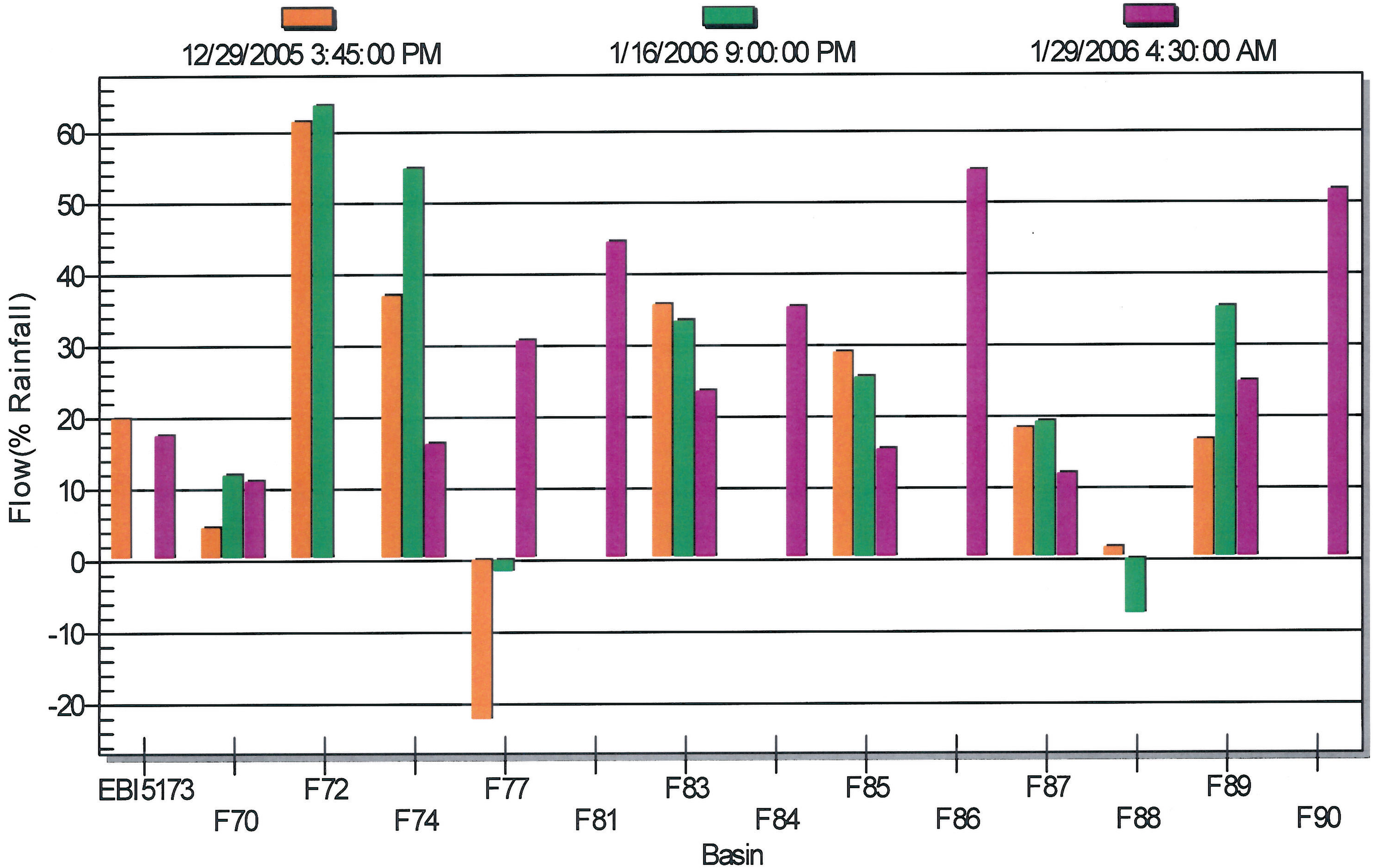
Rainfall Dependent Inflow/Infiltration

NetII Volume Event for Various Storms (Normalized by Acreage)



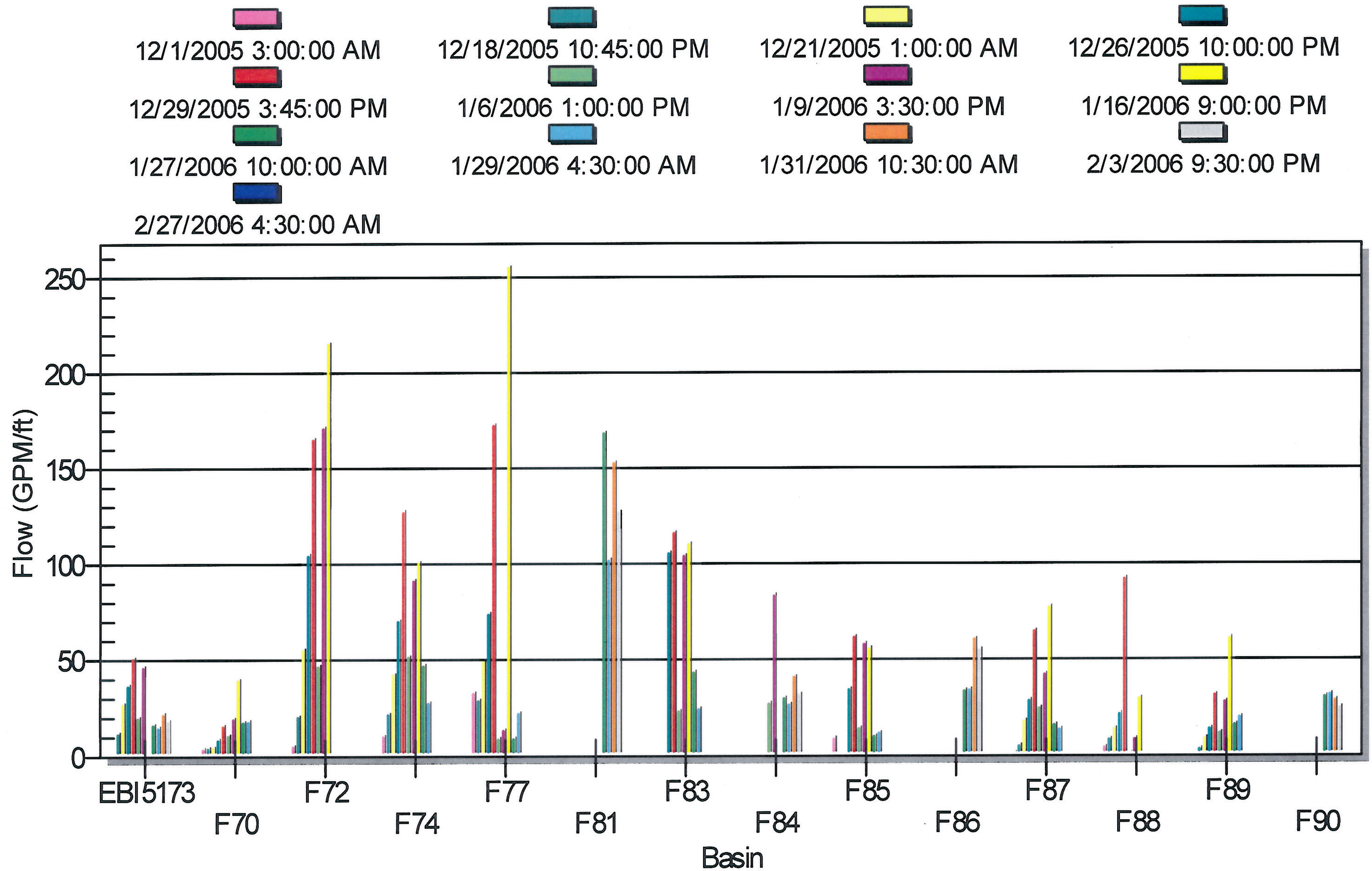
Rainfall Dependent Inflow/Infiltration

NetII Volume Event for Various Storms (Normalized by Acreage)



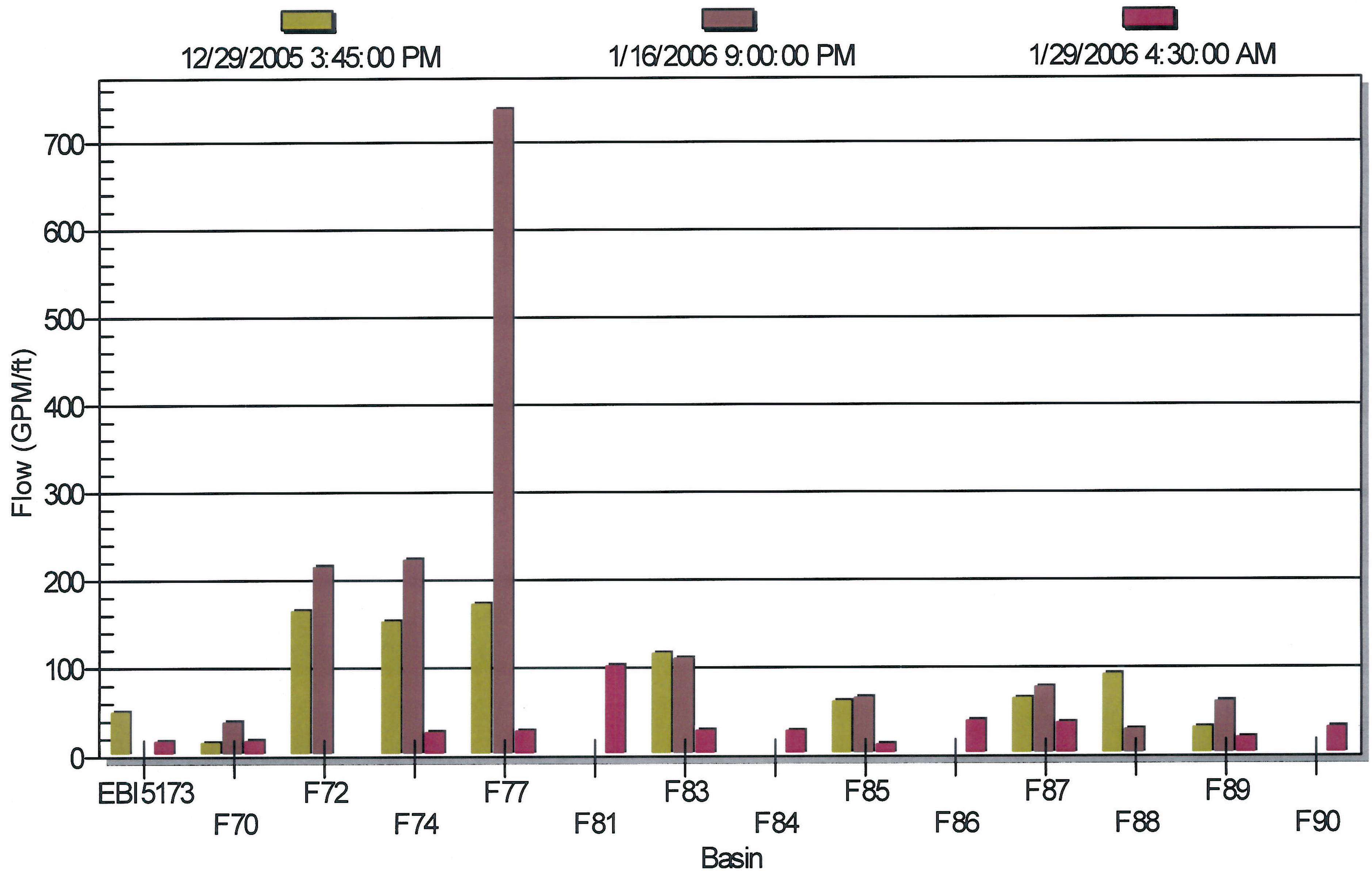
Rainfall Dependent Inflow/Infiltration

NetIIPeakStorm for Various Storms (Normalized by Linear Footage)



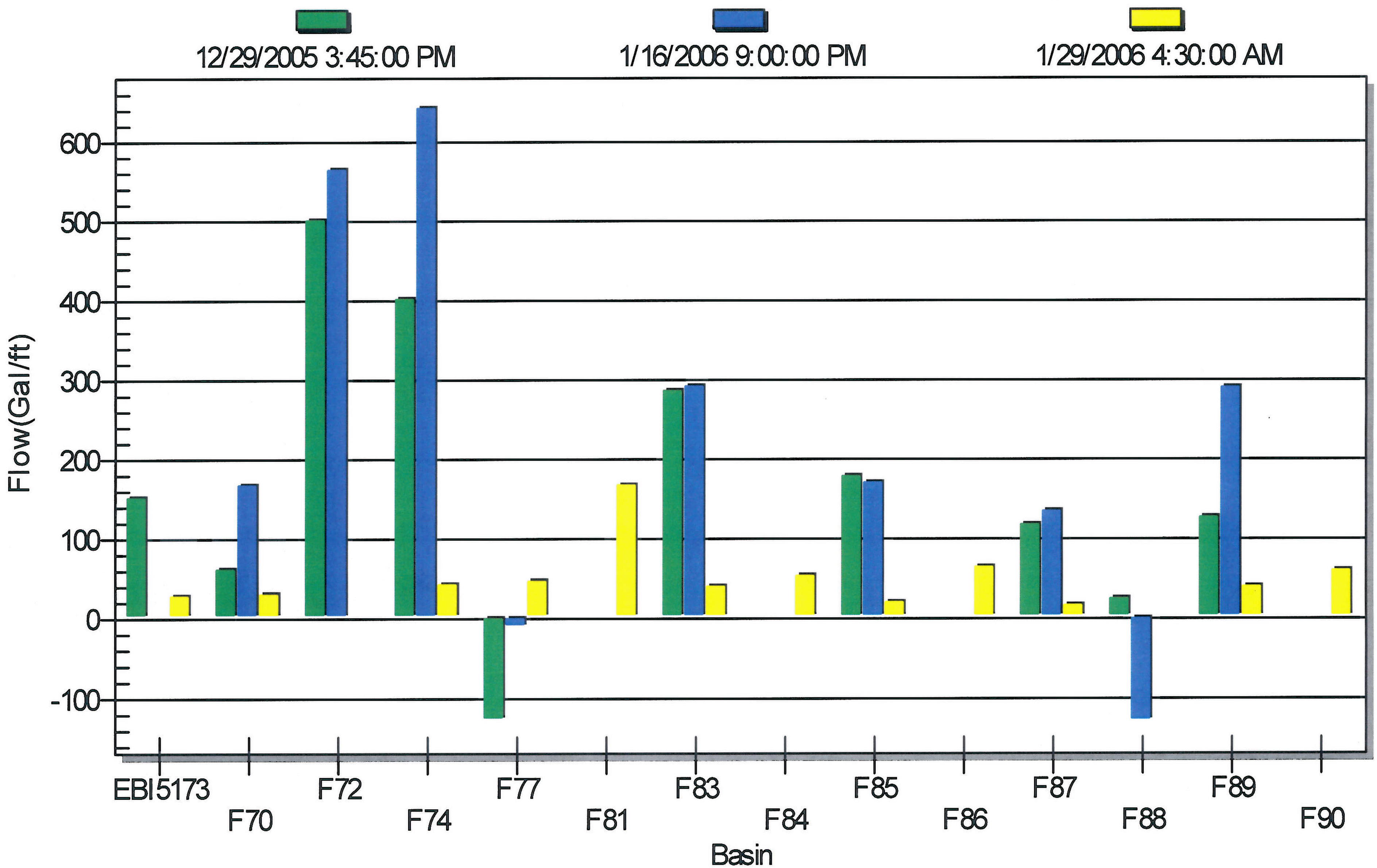
Rainfall Dependent Inflow/Infiltration

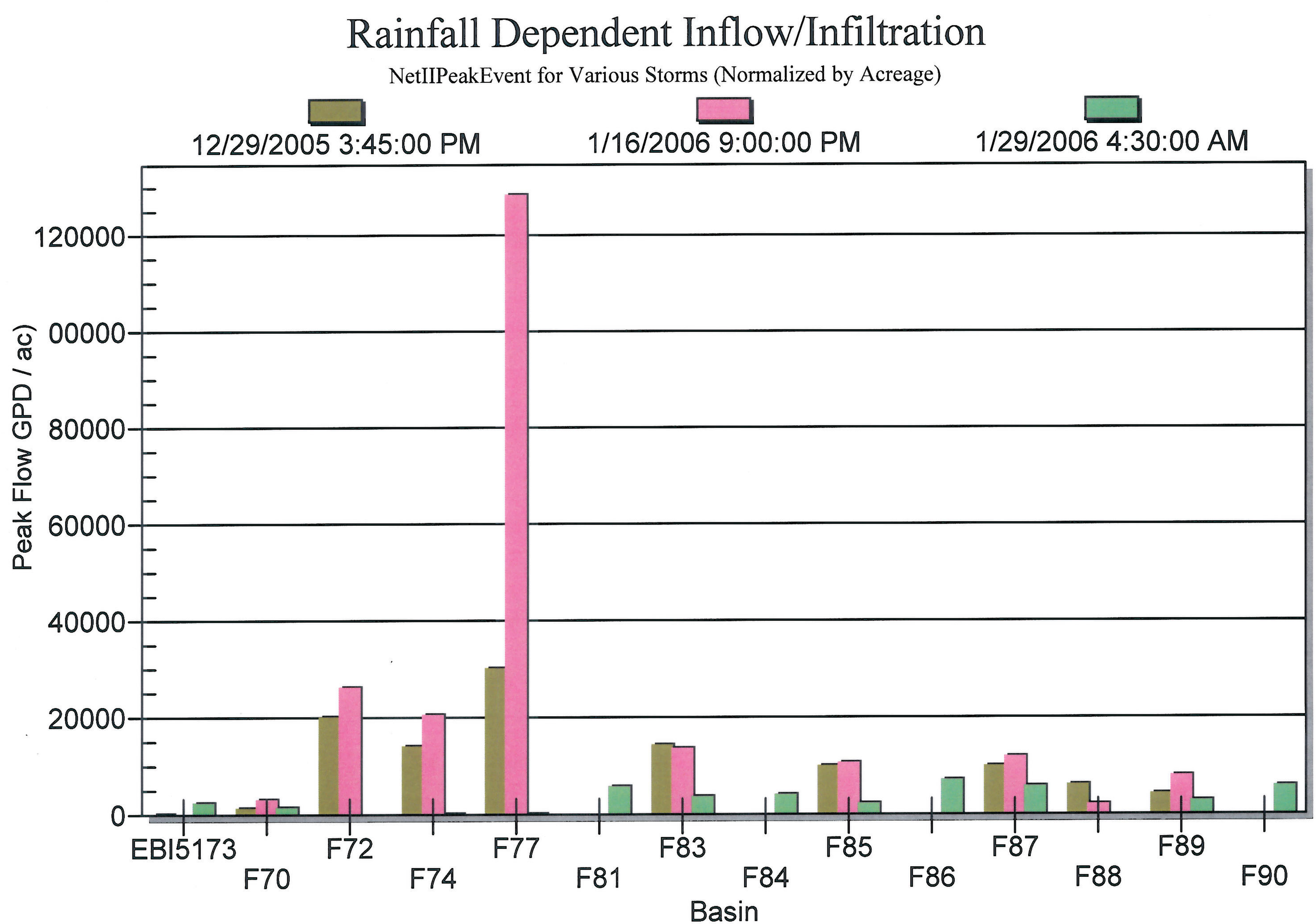
NetIIPeakStorm for Various Storms (Normalized by Linear Footage)



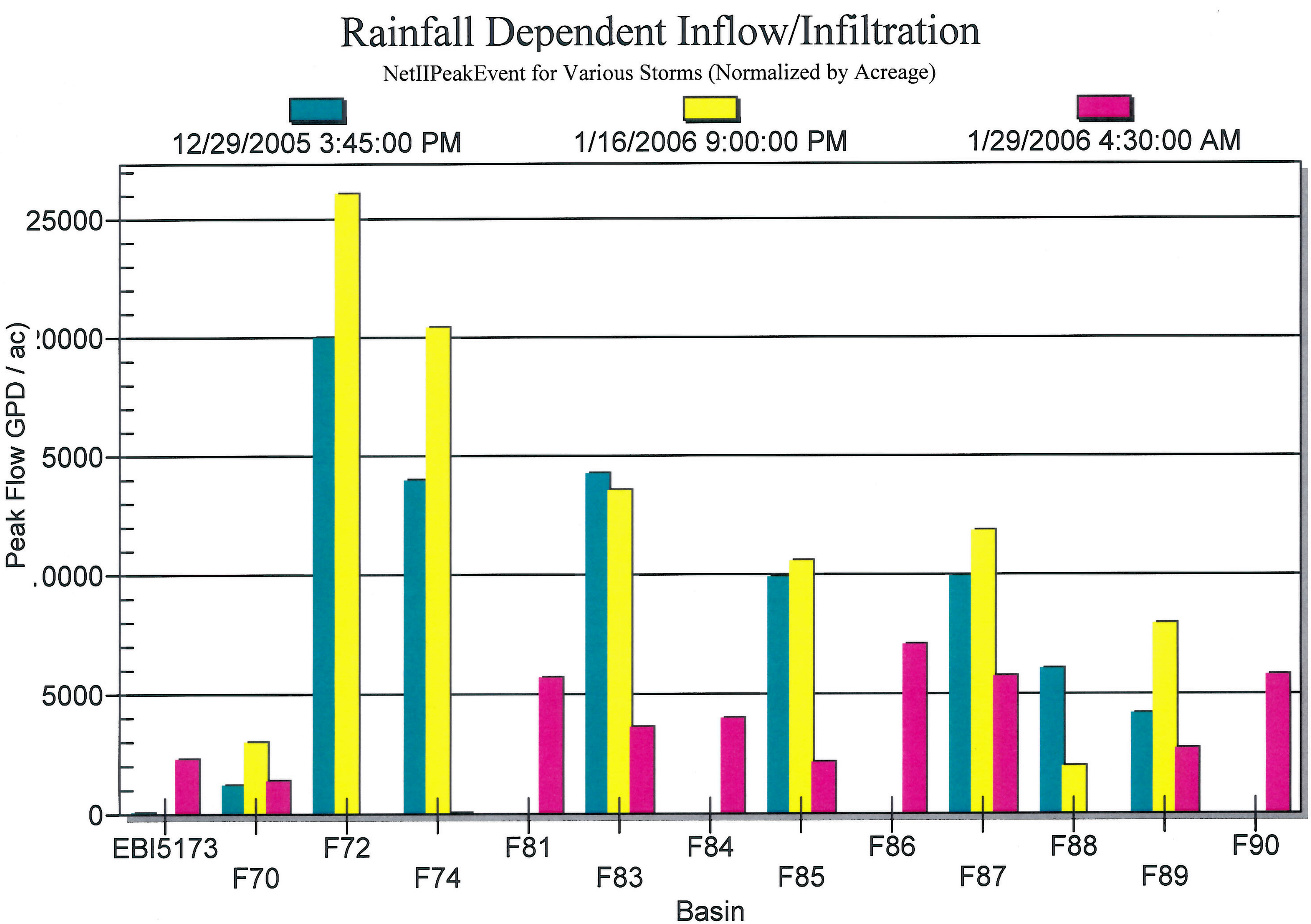
Rainfall Dependent Inflow/Infiltration

NetIIVolumeEvent for Various Storms (Normalized by Linear Footage)





Rainfall Dependent Inflow/Infiltration
NetIIPeakEvent for Various Storms (Normalized by Acreage)
12/29/2005 3:45:00 PM
1/16/2006 9:00:00 PM
1/29/2006 4:30:00 AM
Peak Flow GPD / ac
120000
00000
80000
60000
40000
20000
0
EBI5173
F70
F72
F74
F77
F81
F83
F84
F85
F86
F87
F88
F89
F90
Basin



Rainfall Dependent Inflow/Infiltration
NetIIPeakEvent for Various Storms (Normalized by Acreage)
12/29/2005 3:45:00 PM
1/16/2006 9:00:00 PM
1/29/2006 4:30:00 AM
Peak Flow GPD / ac)
25000
:0000
5000
.0000
5000
0
EBI5173
F70
F72
F74
F81
F83
F84
F85
F86
F87
F88
F89
F90
Basin

Rainfall Dependent I/I by Monitor Basin for the 5-year Storm Event

Flow Monitor	Area (acres)	Discrete Peak Flow (mgd)	Discrete Avg DWF (mgd)	Discrete Peak RDI (mgd)	Peak RDI/Area (gpad)	Ranking
F70	433	1.43	0.27	1.16	2,678	12
F72	251	6.28	0.12	6.16	24,551	2
F74	928	9.76	1.3	8.46	9,120	9
F77	109	2.12	0.18	1.94	17,758	4
F81	324	7.83	0.2	7.63	23,552	3
F83	84	1.60	0.16	1.44	17,114	5
F84	69	0.90	0.04	0.86	12,415	8
F85	88	1.28	0.08	1.20	13,619	6
F86	53	1.79	0.03	1.76	33,136	1
F87	43	0.65	0.07	0.58	13,501	7
F88	704	1.15	0.44	0.71	1,008	13
F89	924	7.23	0.29	6.94	7,516	11
F90	258	-0.32	0.28	-0.60	(2,307)	14
F5173	5779	55.12	5.64	49.48	8,562	10
Totals		**97.1**	**9.1**	**88.3**	**--**	

Note: F90 has a negative RDI due to the calibrated peak flows from upstream basins (e.g., F83, F84)

Appendix C - Design Storm Development

The December 2000 Metropolitan Wastewater Management Commission (MWMC) Wet Weather Flow Management Plan "defines" the 5-year, 24-hour wet season precipitation as 3.9 inches. However, the document does not specify how the value of 3.9 inches was obtained. A review of available published documents shows some uncertainty in the 5-year, 24 hour rainfall total. The following list summarizes the 5-year, 24-hour values obtained from several sources:

- 3.9 inches from the MWMC *Wet Weather Flow Management Plan* (December 2000).
- Greater than 3.5 inches, but less than 4.0 inches, from NOAA Atlas 2, Volume X, Figure 26. Published in 1970, and based on precipitation-reporting stations that had at least 20 years of daily or hourly precipitation data between 1897 and 1970, the NOAA frequency analysis is based on full year annual series data that is transformed to partial duration data using empirical conversion factors. Figure 26 is included as an attachment.
- 3.6 inches from the *Eugene Areawide Drainage Master Plan*, Figure 4.1 (OTAK, 1990). Results of this analysis are included in the City of Eugene *Stormwater Management Manual* (July 2006), but does not include any discussion of the methodology that produced these results.
- 3.8 inches from the City of Springfield *Engineering Design Standards and Procedures* (EDSP, April 2006). The Springfield EDSP is "based on information gathered from the *West Springfield Master Plan*, as well as the *Eugene Areawide Drainage Master Plan*".

Updated Rainfall Frequency Analysis

Because of the relatively wide range in these 5-year, 24-hour rainfall totals, uncertainty about the study methodologies, and the relative remoteness in time when the rainfall frequency analyses were conducted, a new frequency analysis was performed using Eugene Airport historic hourly rainfall data for the 1948 to 2005 period. The frequency analysis uses wet season (not full year) annual maximums to calculate a 5-year, 24-hour rainfall of 3.83 inches. The wet season is defined as November 1 to May 21 according to Oregon Administrative Rules (OAR) 340. The more rigorous (and time consuming) approach to rainfall frequency analysis (not performed for this updated frequency analysis) requires the use of a partial duration series. This means that rather than using only the largest rainfall event for each year in the analysis (annual series), the partial duration series recognizes that more than one large rainfall event may occur in the same year. The partial duration analysis will therefore result in a higher rainfall total for a given frequency and duration. Figure C-1 shows a comparison between the Eugene Airport 5-year depth-duration-frequency curve calculated using the annual series frequency analysis methodology and the 5-year, 24-hour design rainfall used in the 2000 Wet Weather Flow Management Plan. The design storm follows the calculated depth-duration-frequency curve quite closely except for the longer durations. The Wet Weather Flow Management Plan 5-year design storm is a 16-day period of rainfall that includes a peak 24-hour rainfall total of 3.9 inches. It includes antecedent rainfall that the Wet Weather Flow Management Plan considered conservative.
Figure C-2 compares the updated Eugene Airport 5-year depth-duration-frequency curve with depth-duration values from some recent historic rainfall events in the Eugene/Springfield area. As can be seen, for example, the 12-hour rainfall for the January 2006 rainfall event approached a 5-year event, but was over one inch less than the 5-year frequency for the 24-hour duration. The November 1996 storm produced rainfall in excess of the 5-year event for all durations between 6 and 72 hours.

Eugene Airport Rainfall Study

Further study of precipitation data by the City of Eugene (City of Eugene Analysis of Precipitation Data For Use in Hydrologic/Hydraulic Modeling, April 12, 1996, referenced in the City's Stormwater Basin Master Plan of August 2002) showed that annual precipitation at the Eugene Airport was significantly higher than the annual rainfall in the City of Eugene. The most reliable precipitation measurements in the Eugene area are those made with the weighing rain gage at the Eugene Airport, as opposed to tipping bucket gages used in the City of Eugene. Side-by-side operation of the two types of rain gages at the Eugene Airport showed that the tipping bucket gage measured about 81% of the rainfall measured by the weighing gage. This comparison indicates that the rainfall values recorded by the City's tipping bucket gages should be multiplied by a factor of 1.2. The study also states that the Oregon State Climatologist confirmed that "tipping bucket-type gages commonly underestimate rainfall amounts". The study outlined three separate courses of action that could be used in the interpretation of recorded rainfall values:

- Use the long-term precipitation data from the airport without adjustment.
- Adjust the long-term precipitation record at the airport downward by a recommended 10% based on the study findings.
- Further analyze the historic precipitation data to better define the relationship between precipitation at the airport and the City.
- The study recommended the third course of action.

Given this study recommendation, the use of Eugene Airport rainfall data without adjustment in the frequency analysis is a conservative, but not overly conservative, approach. As the 1996 study states, "If an estimation error is made, it is better that it be on the high side because the consequences of a high estimate (economic inefficiency) are less severe than those of a low estimate (inadequate design).

Figure C-1. Comparison of WWFMP 5-year Design Storm and 5-year Frequency Wet Season Depth-Duration-Frequency Curve Based on 1948-2005 Annual Maximums (Eugene Airport: Extreme Value [Gumbel] Distribution)

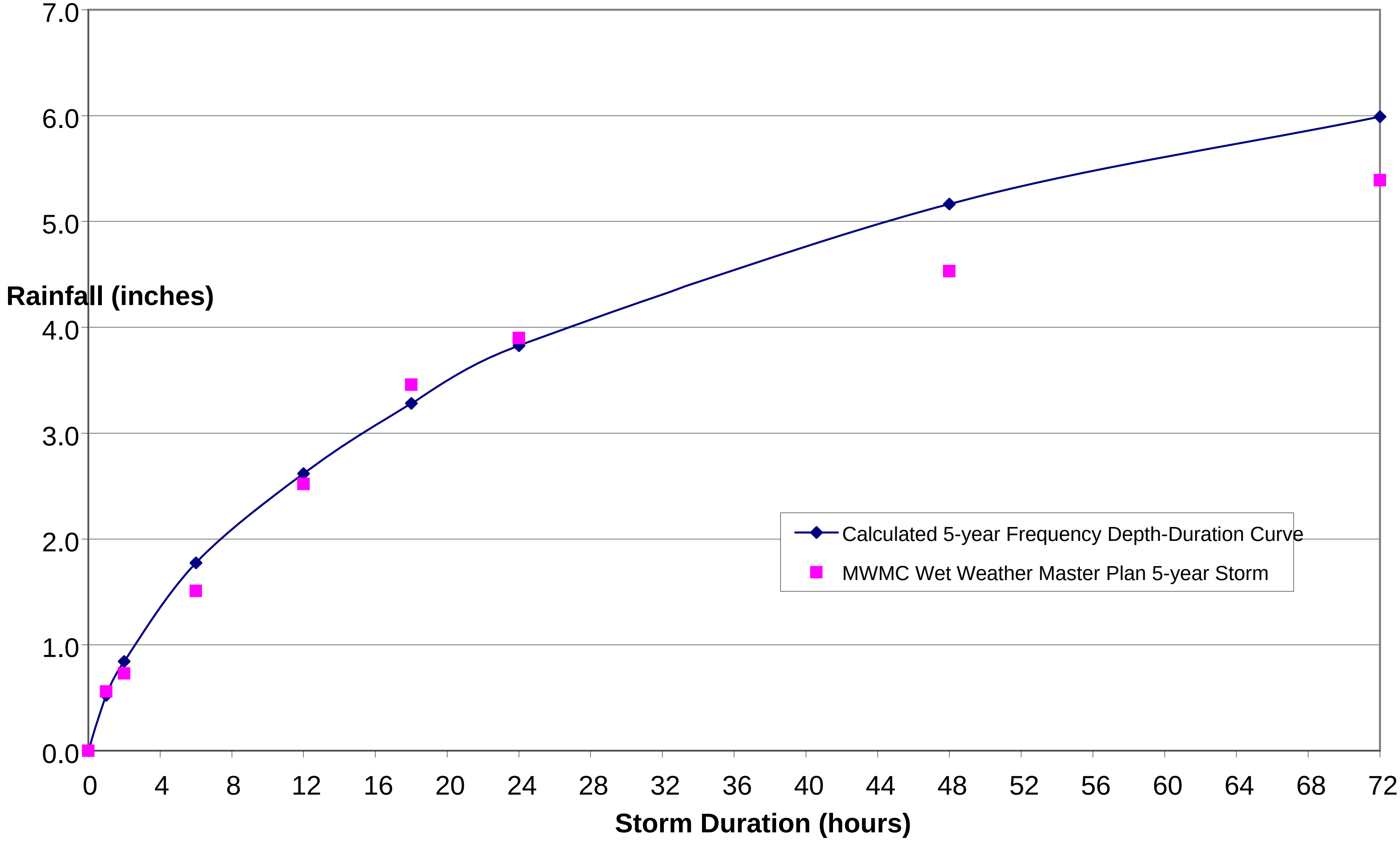
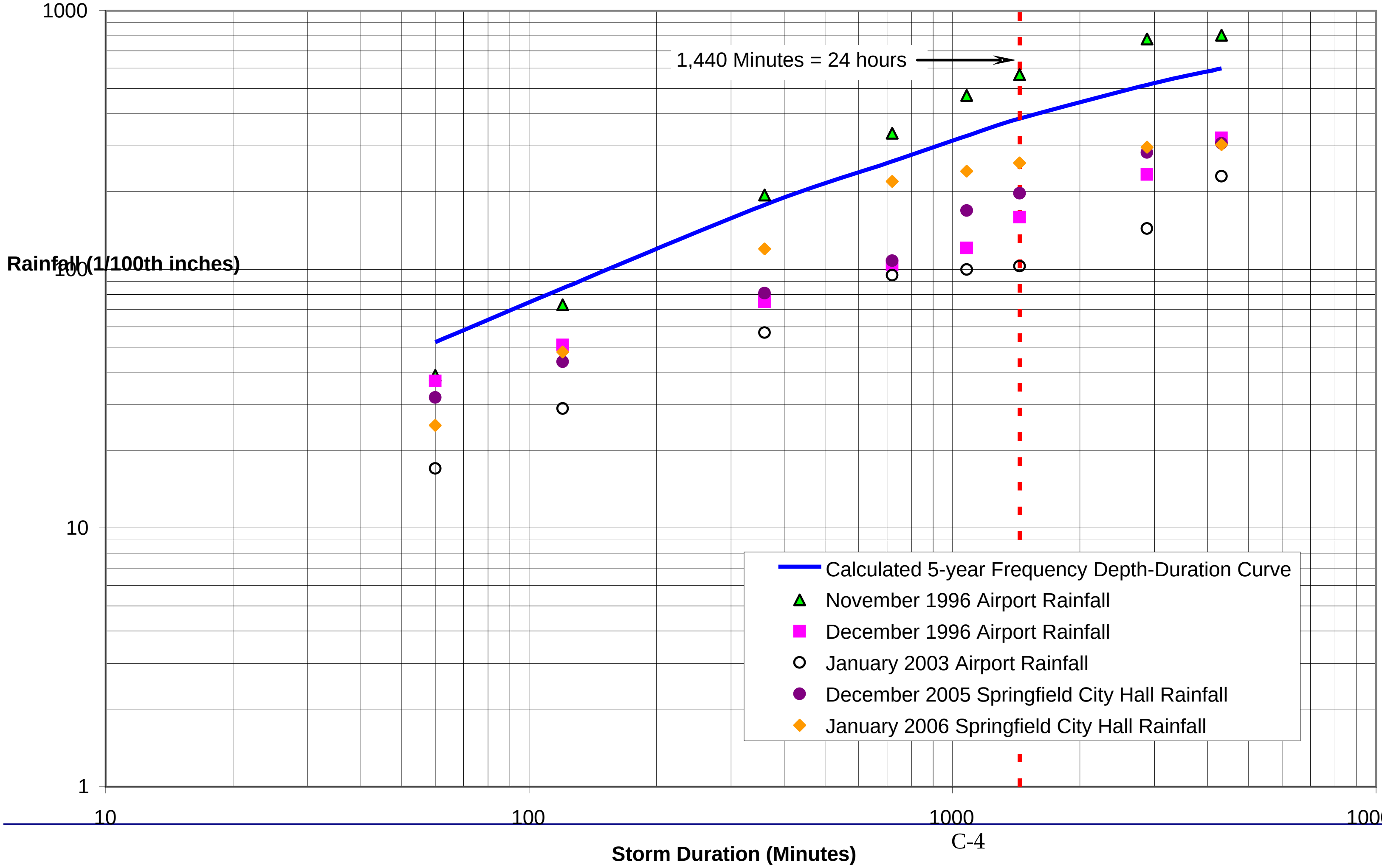
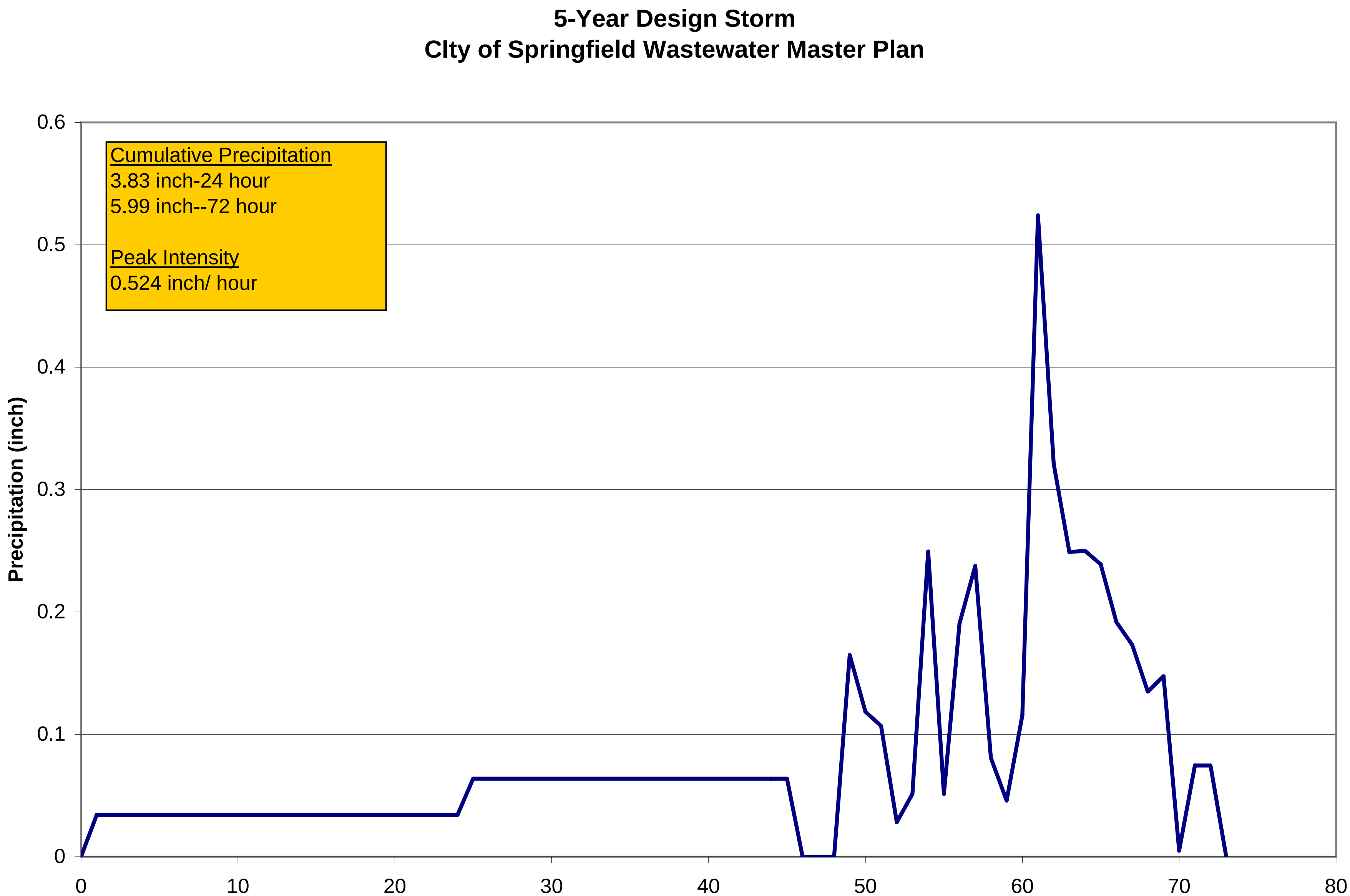
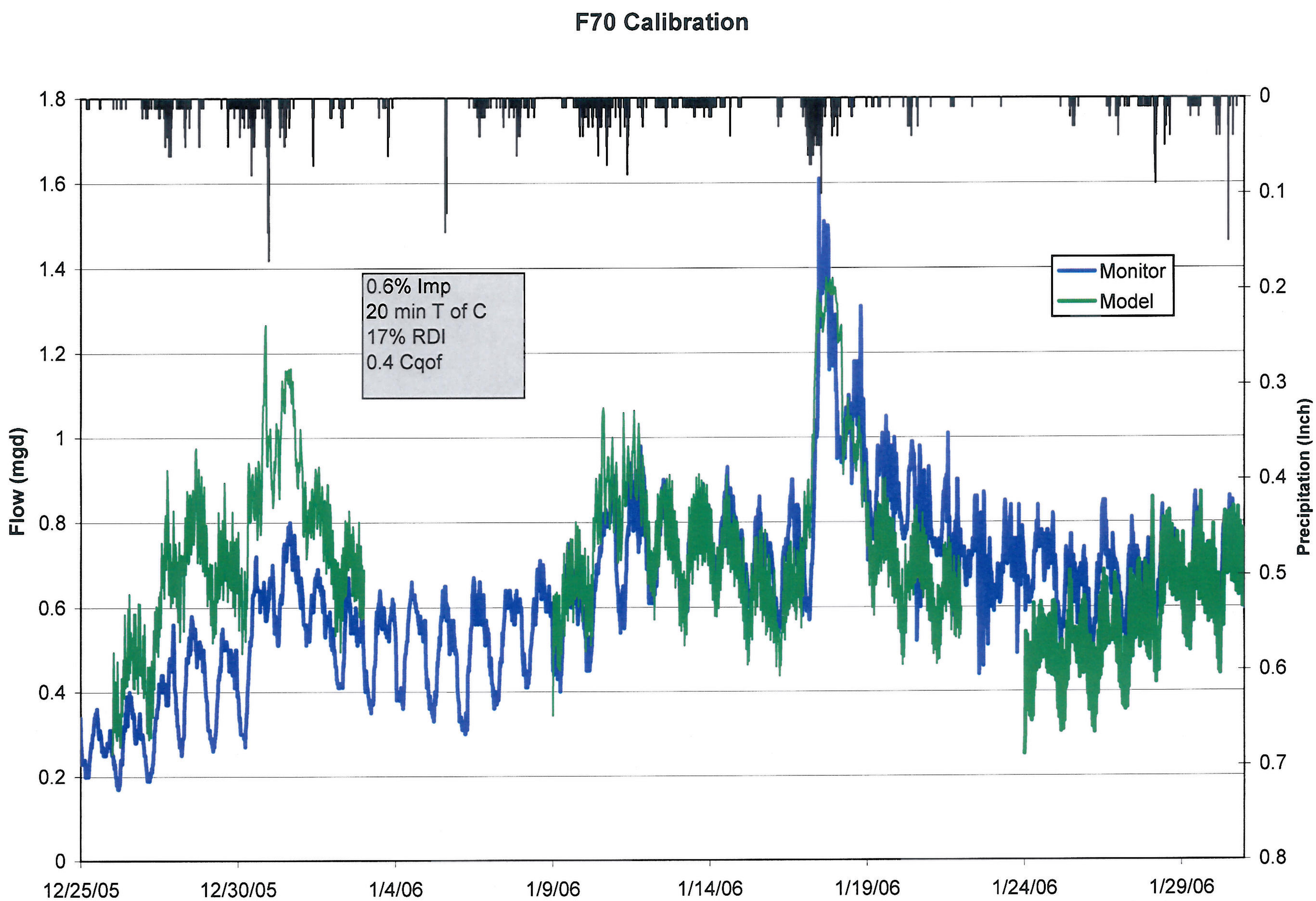


Figure C-2. Comparison of Historic Rainfall Events and 5-year Frequency Wet Season Depth-Duration-Frequency Curve Based on 1948-2005 Eugene Airport Annual Maximums



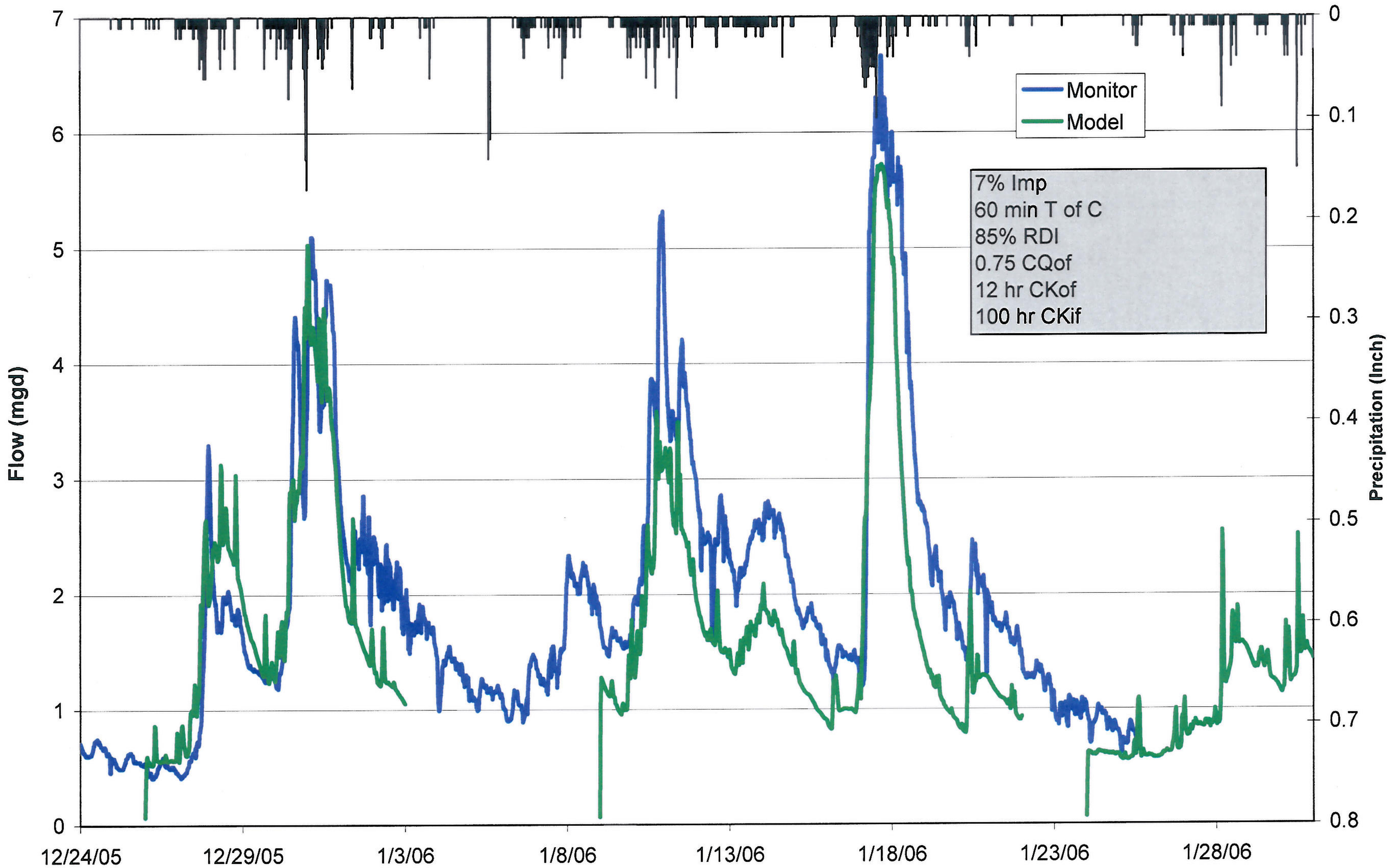

5-Year Design Storm
CIty of Springfield Wastewater Master Plan
Cumulative Precipitation
3.83 inch-24 hour
5.99 inch--72 hour
Peak Intensity
0.524 inch/ hour
Precipitation (inch)
0
0.1
0.2
0.3
0.4
0.5
0.6
0
10
20
30
40
50
60
70
80

Appendix D – Calibration Hydrographs for Monitoring Basins

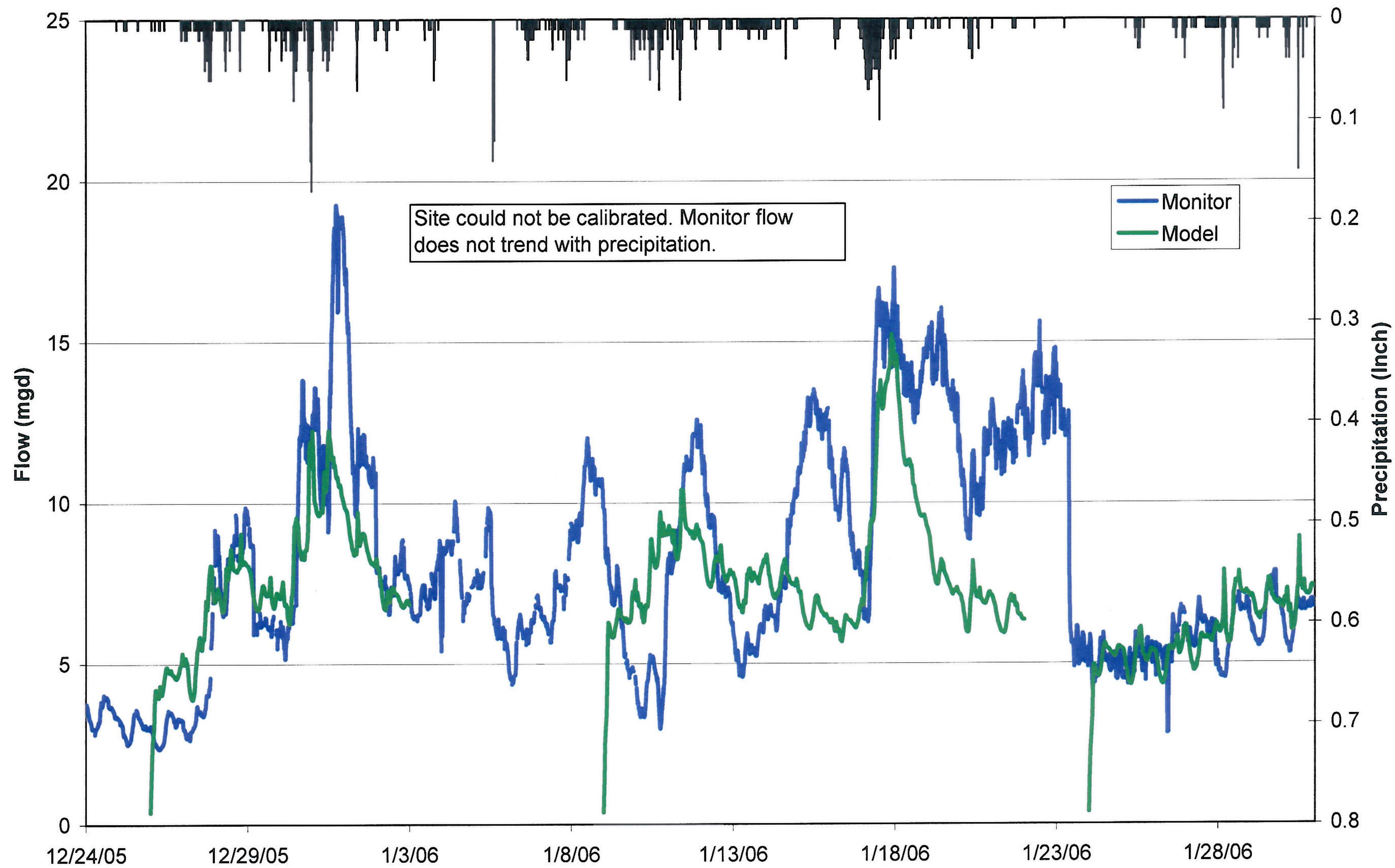


F70 Calibration
0.6% Imp
20 min T of C
17% RDI
0.4 Cqof
Monitor
Model
Flow (mgd)
Precipitation (Inch)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
12/25/05
12/30/05
1/4/06
1/9/06
1/14/06
1/19/06
1/24/06
1/29/06

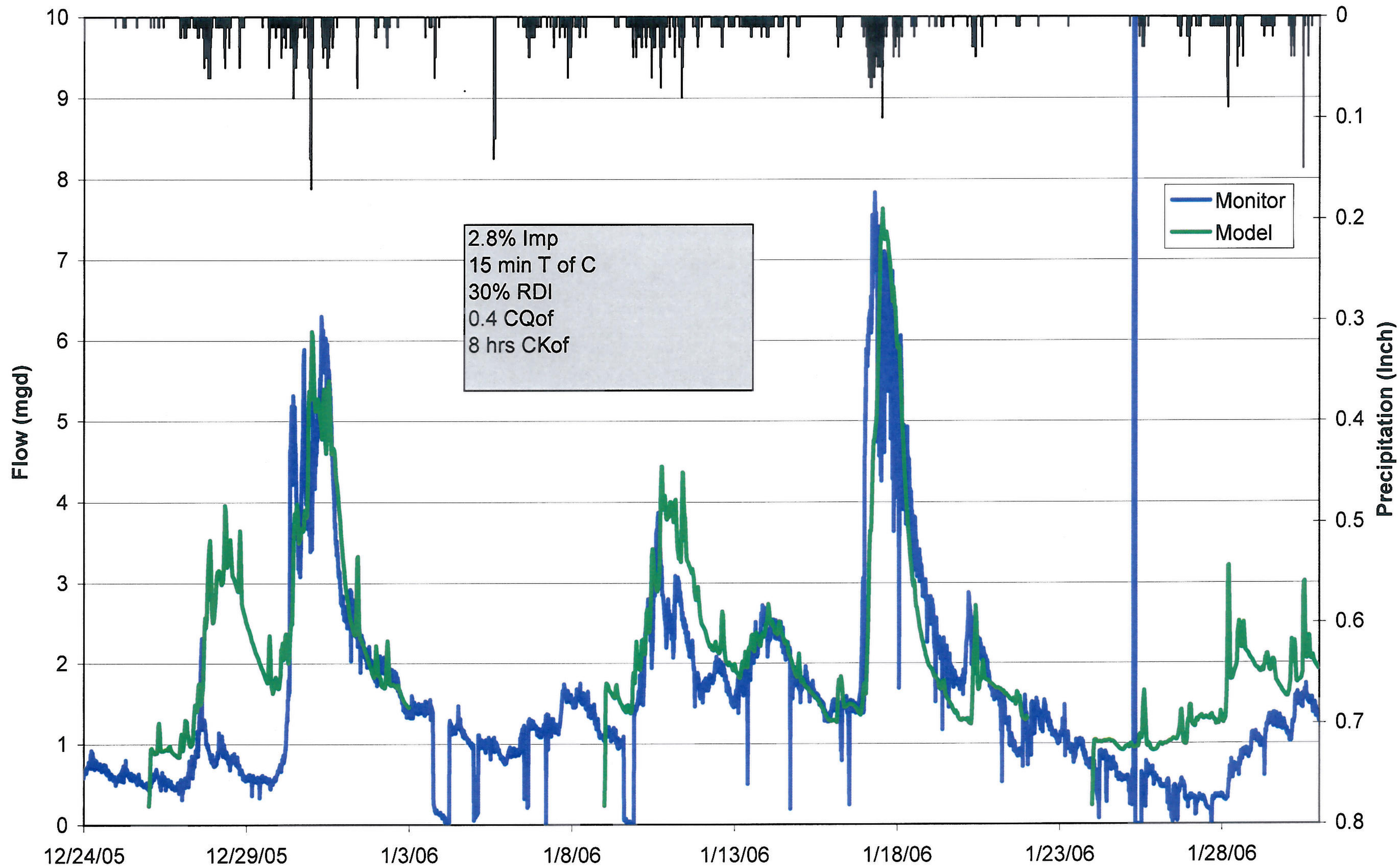
F72 Calibration



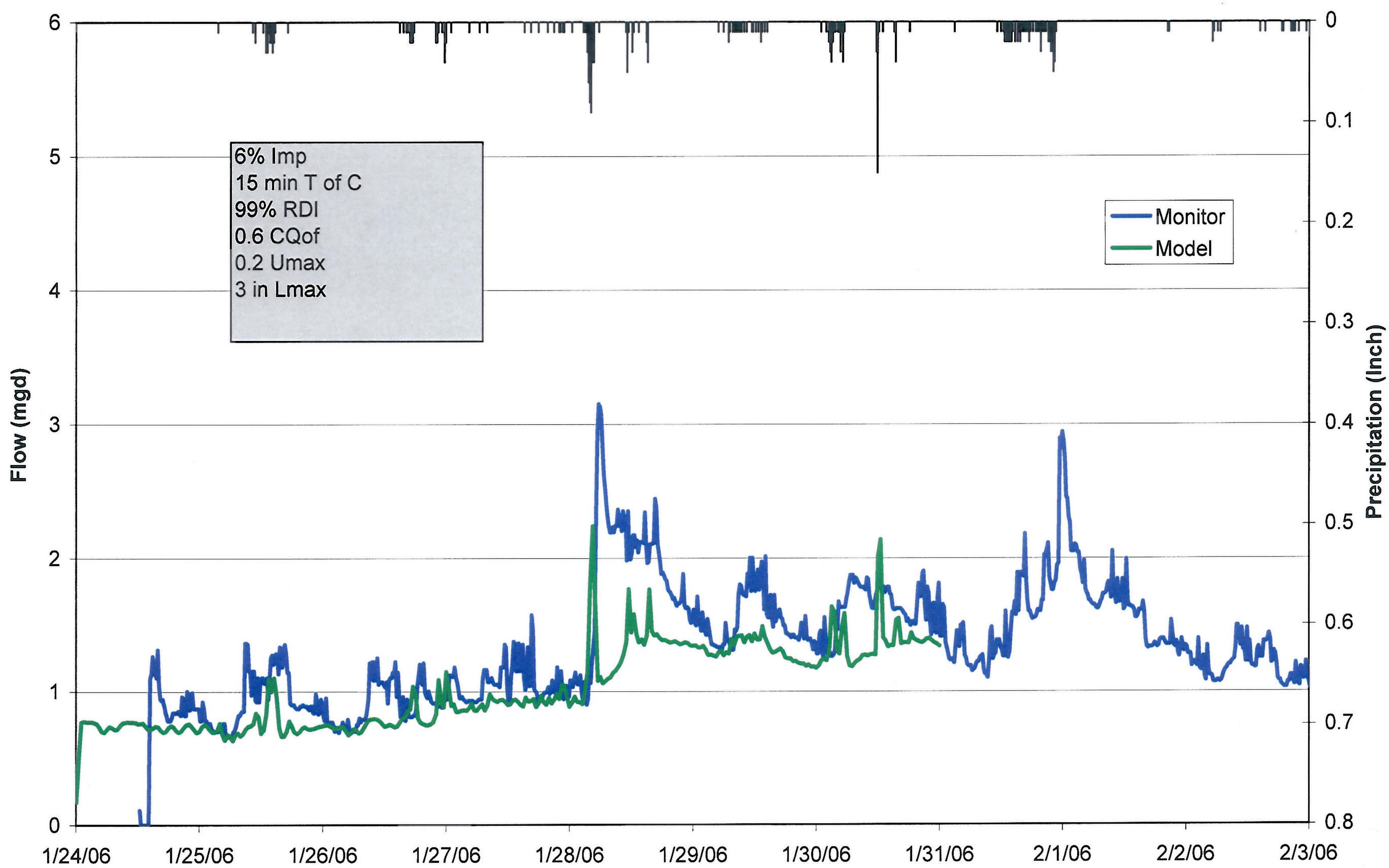
F74 Calibration



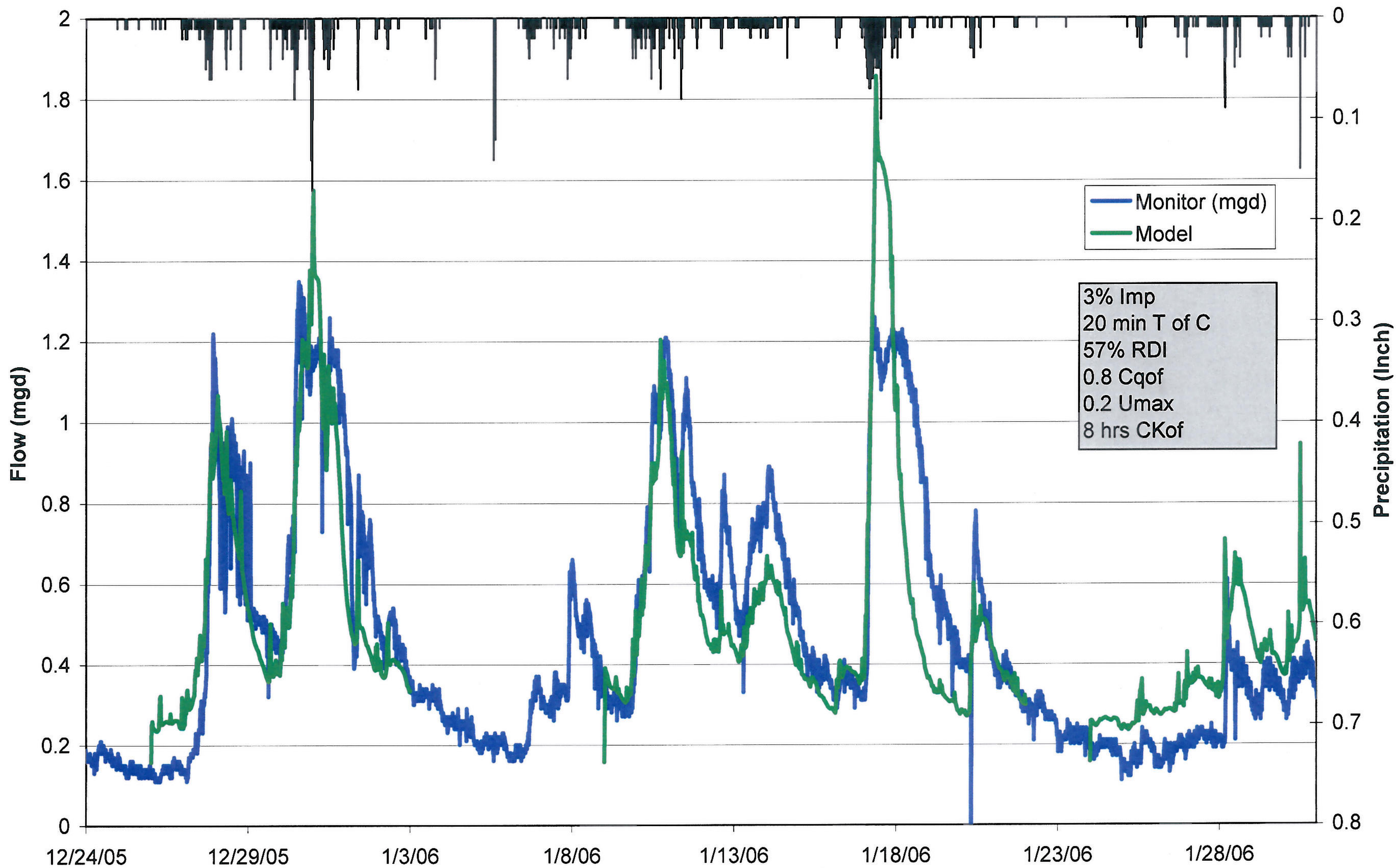
F77 Calibration



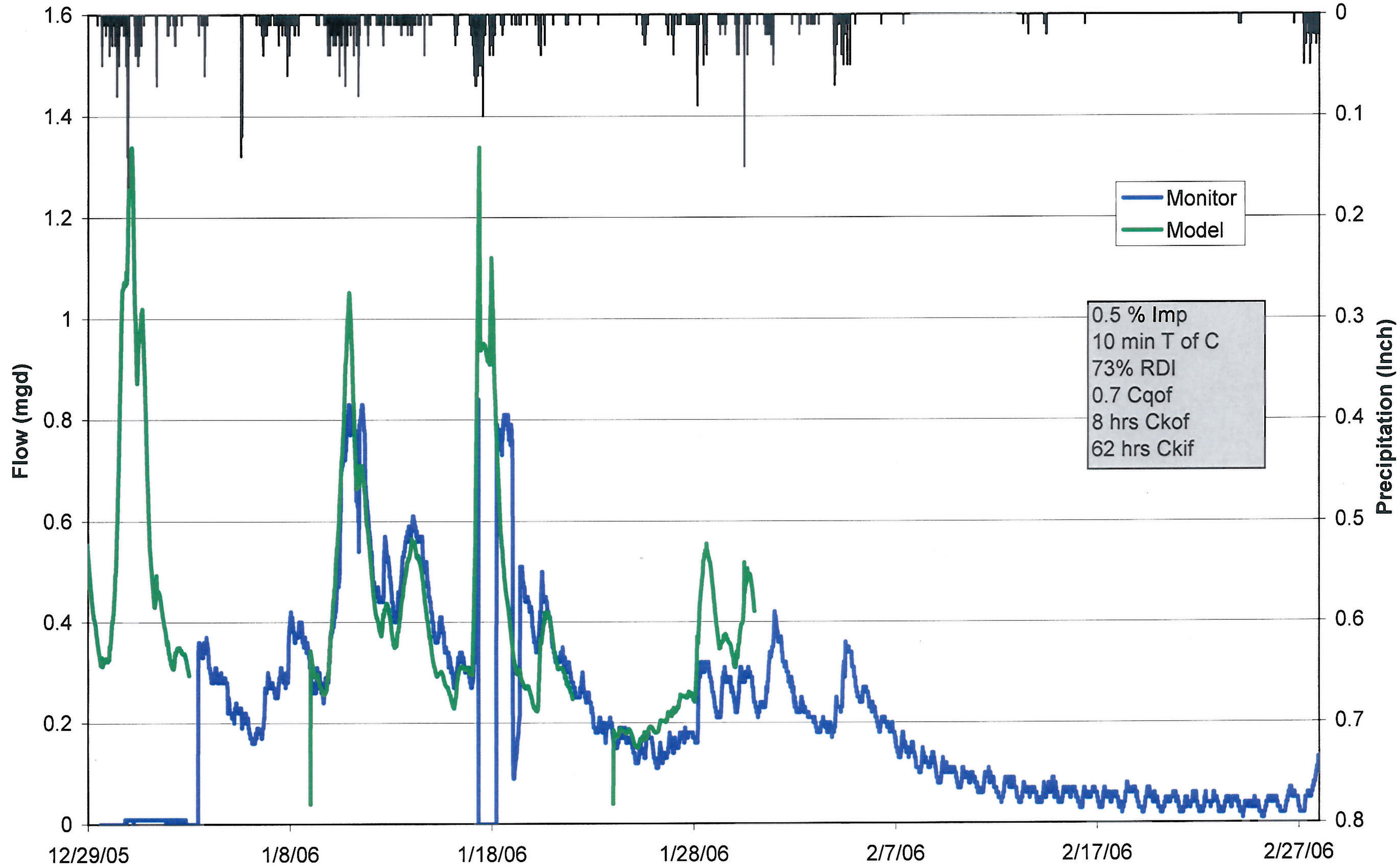
F81 Calibration



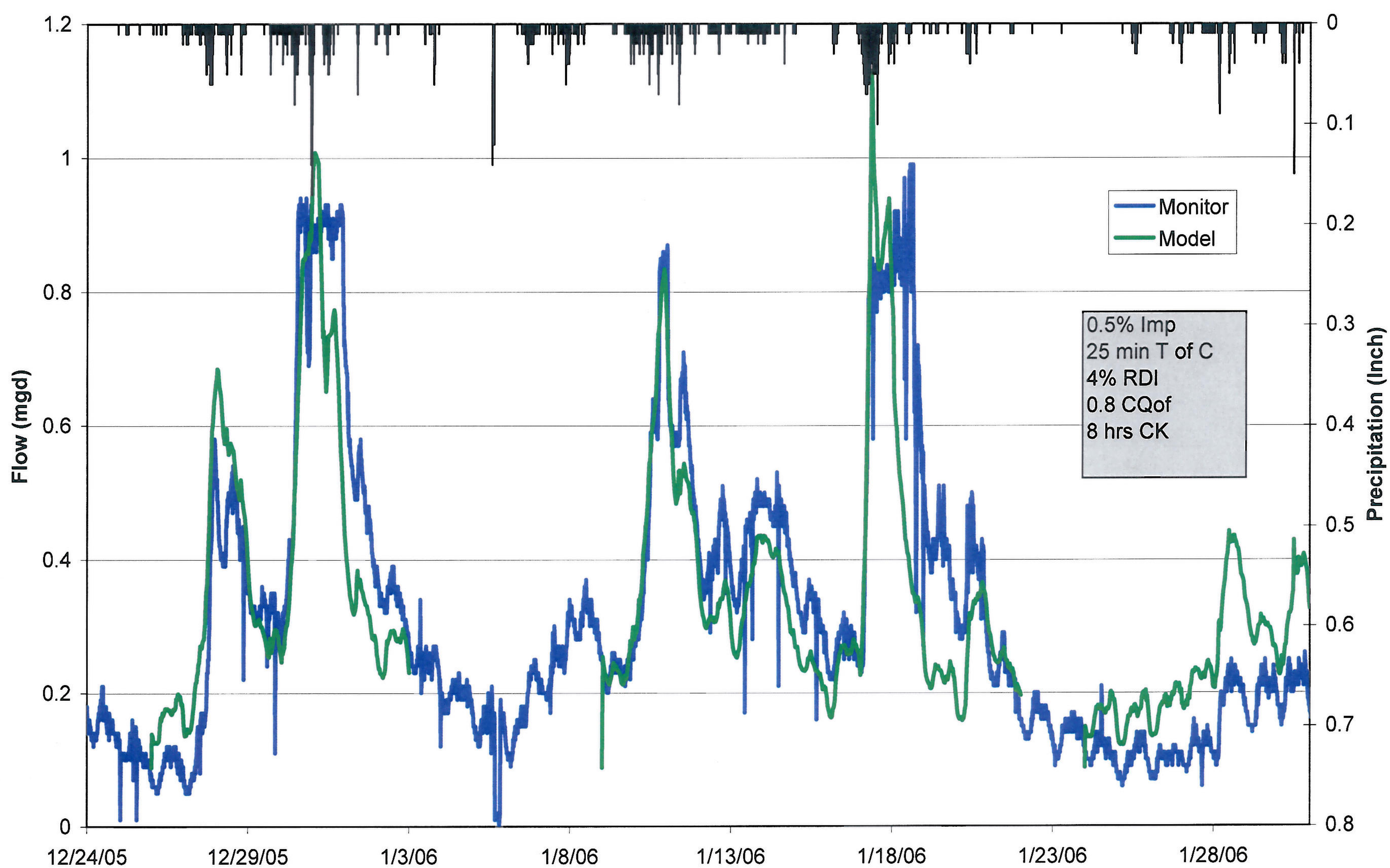
F83 Calibration



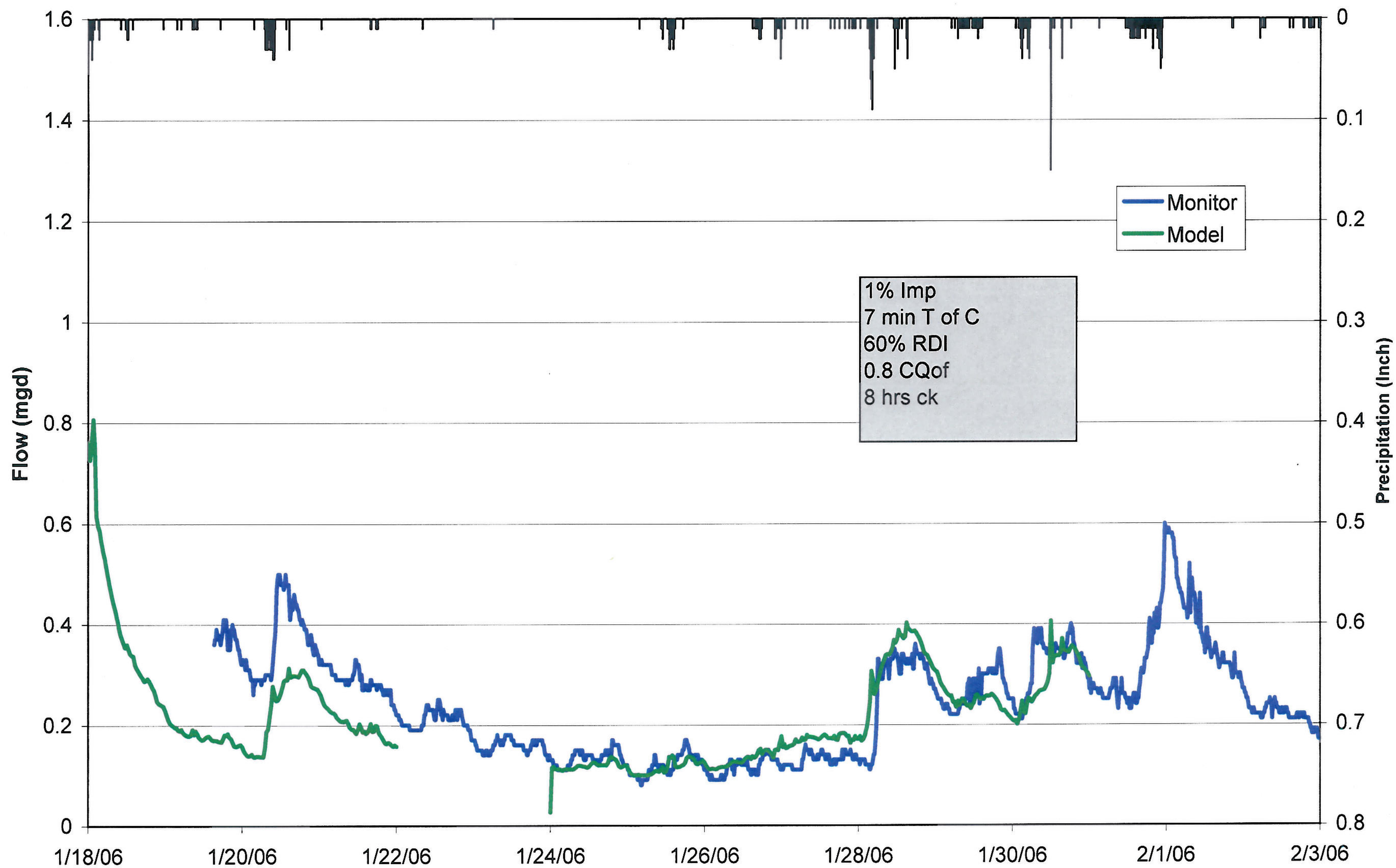
F84 Calibration



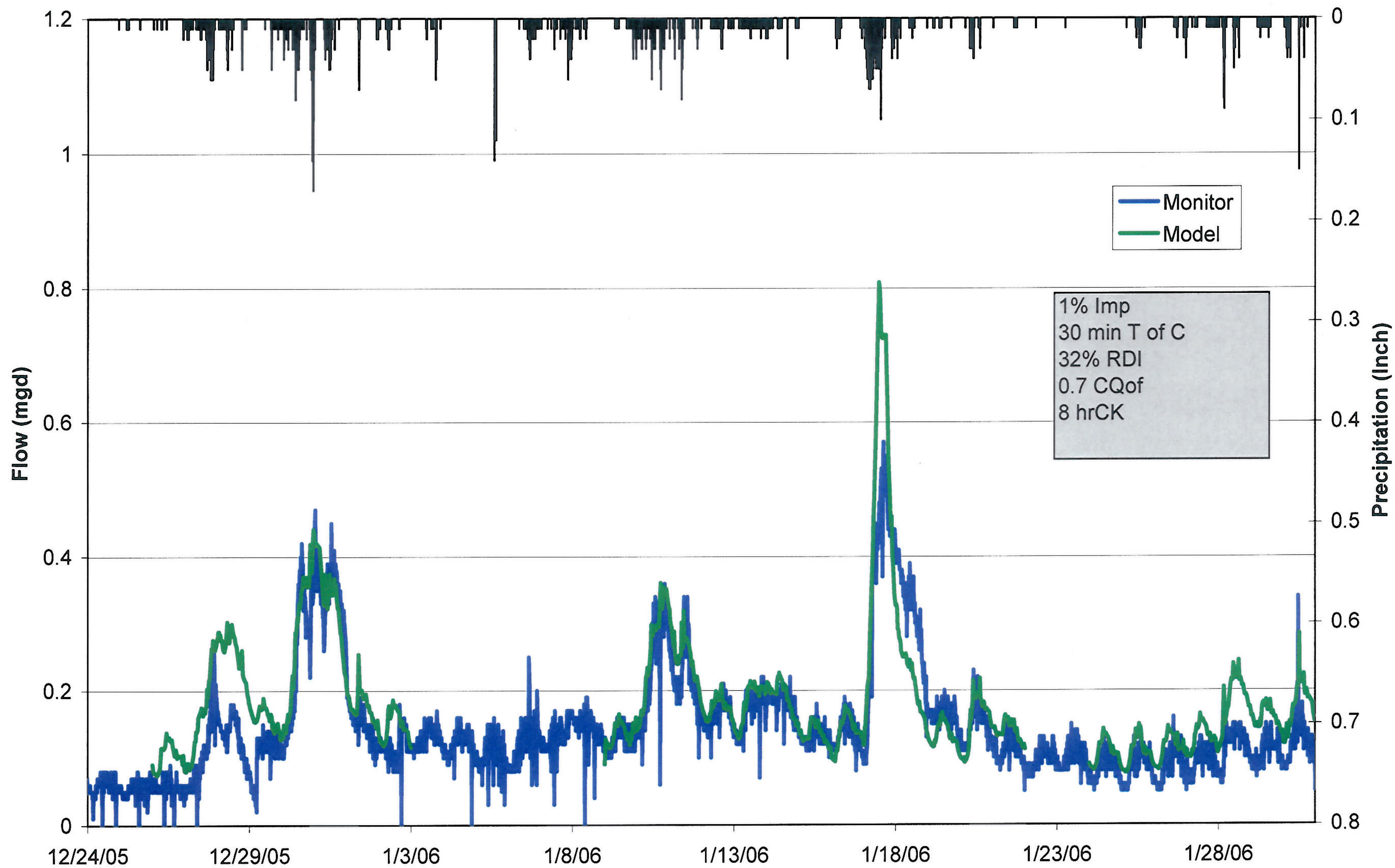
F85 Calibration



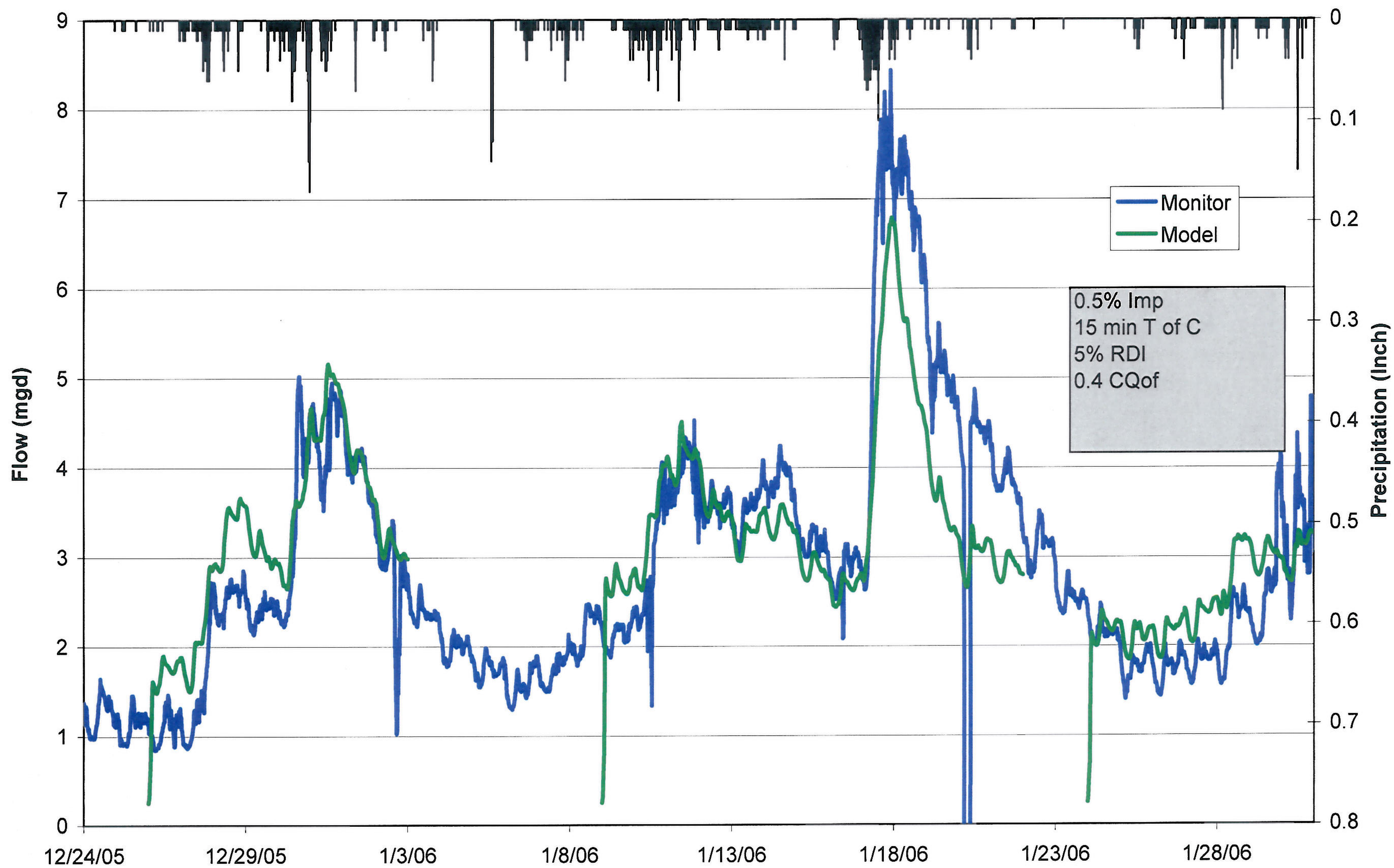
F86 Calibration



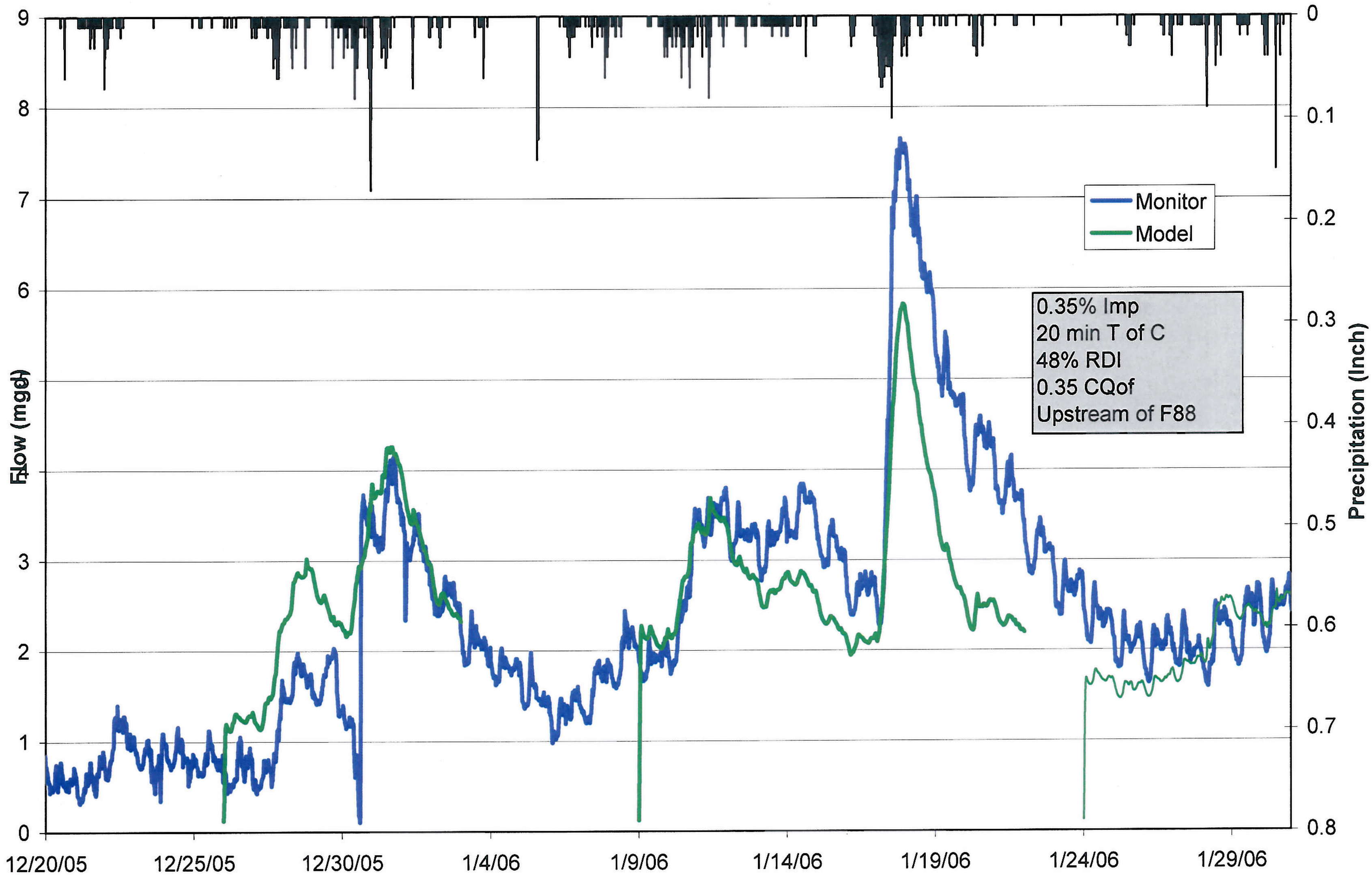
F87 Calibration

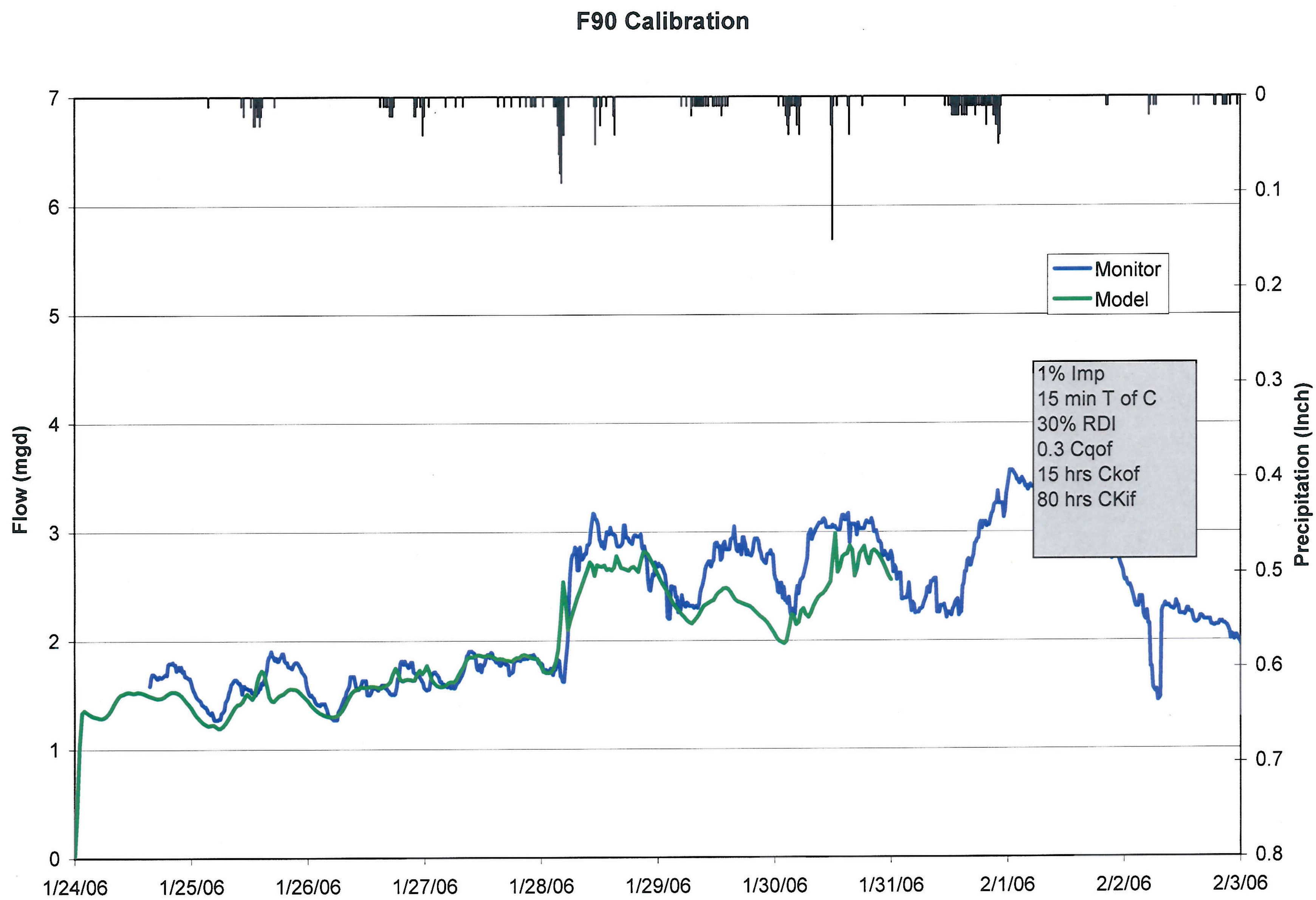


F88 Calibration

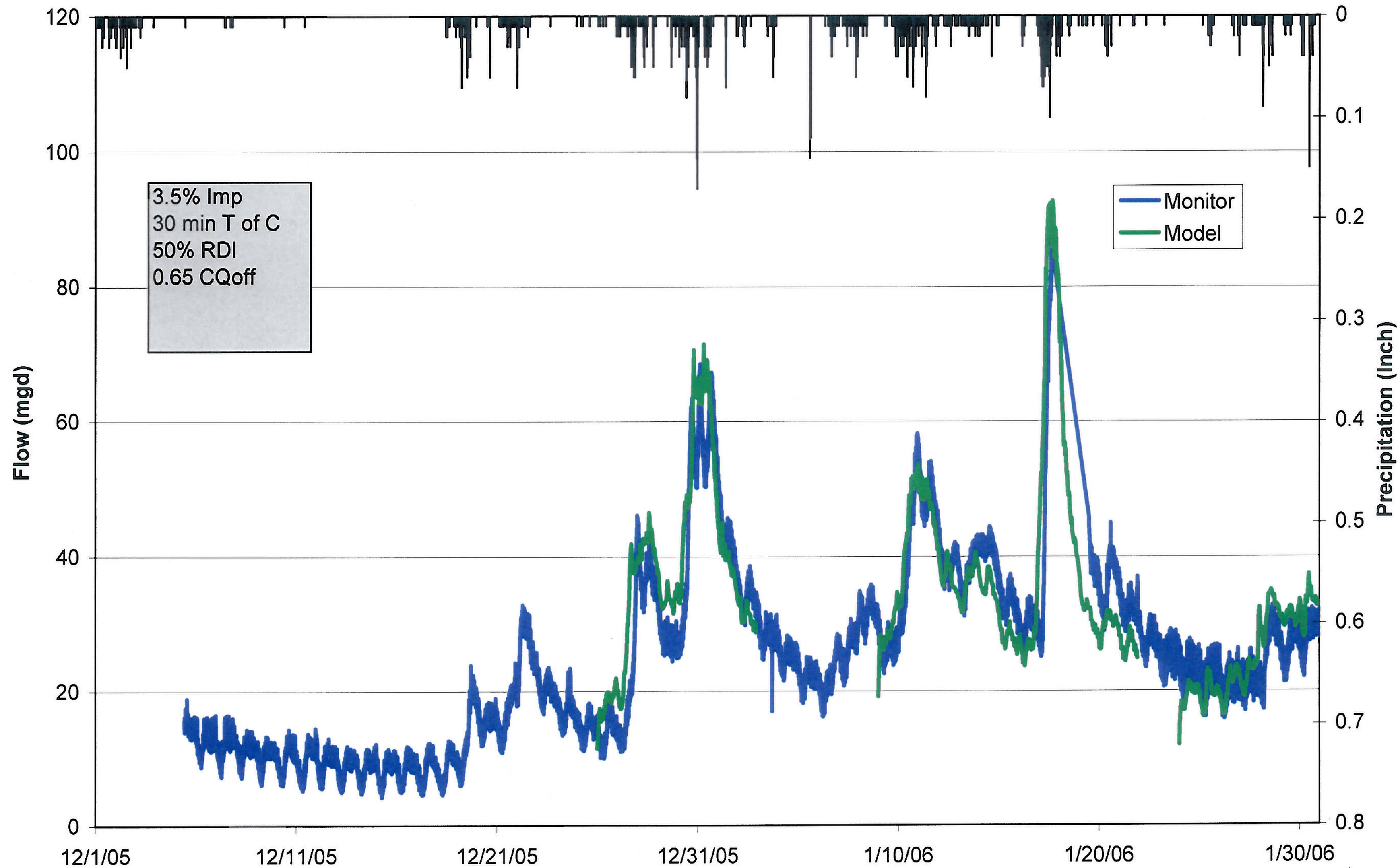


F89 Calibration

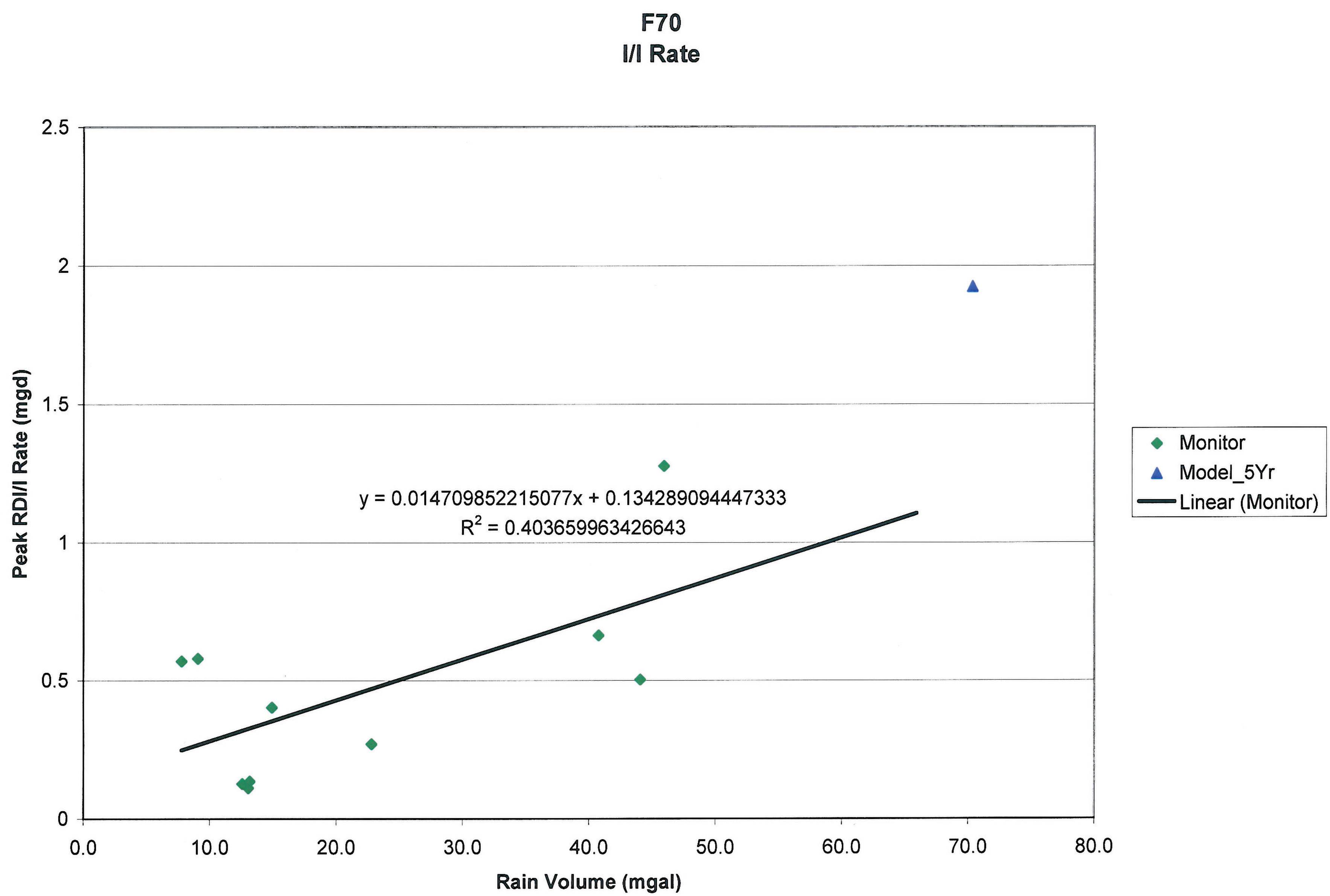



F90 Calibration
Flow (mgd)
Precipitation (Inch)
Monitor
Model
1% Imp
15 min T of C
30% RDI
0.3 Cqof
15 hrs Ckof
80 hrs CKif
1/24/06
1/25/06
1/26/06
1/27/06
1/28/06
1/29/06
1/30/06
1/31/06
2/1/06
2/2/06
2/3/06

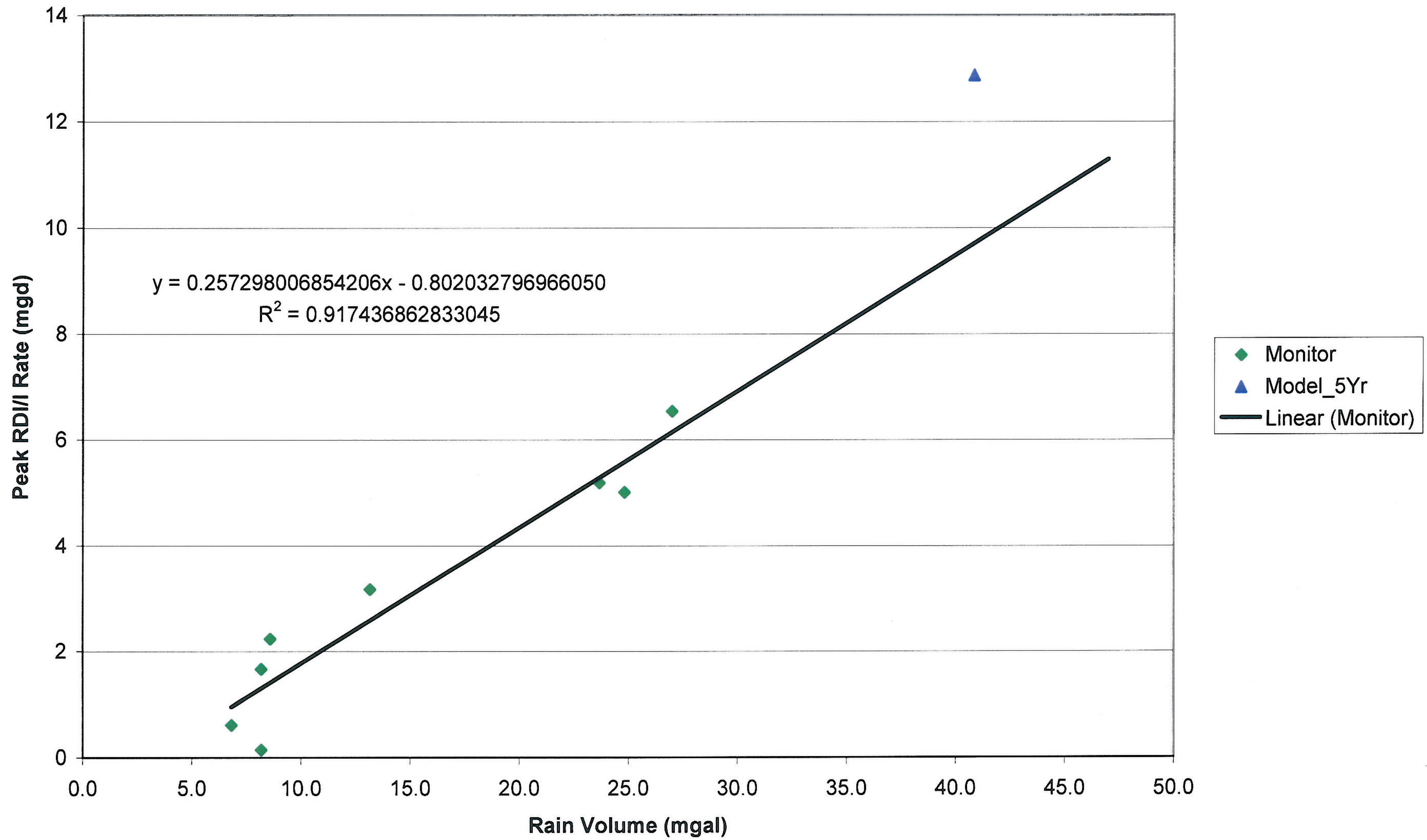
F5173 Calibration



Appendix E – Regression Plots

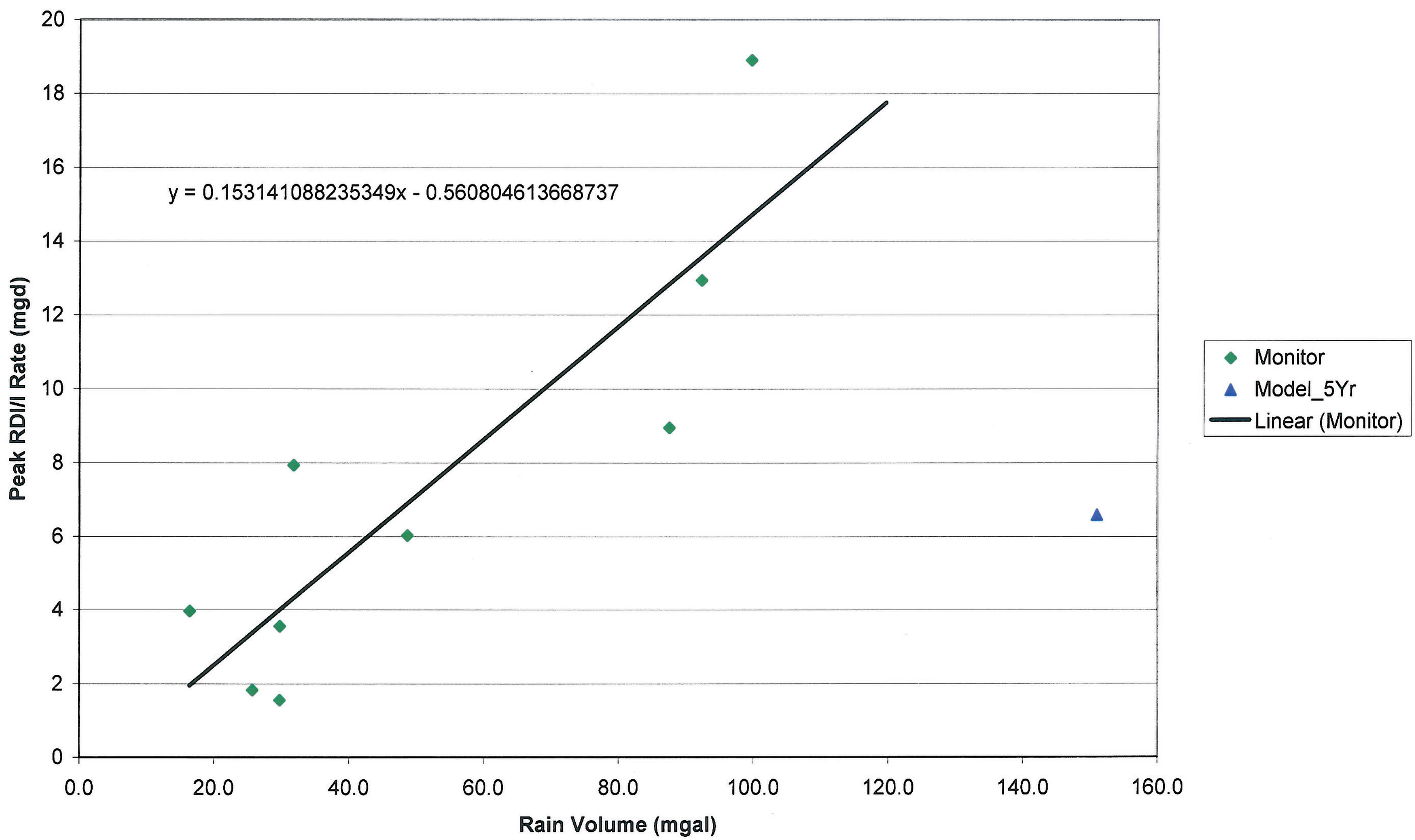

F70
I/I Rate
Peak RDI/I Rate (mgd)
2.5
2
1.5
1
0.5
0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Rain Volume (mgal)
y = 0.014709852215077x + 0.134289094447333
R2 = 0.403659963426643
Monitor
Model_5Yr
Linear (Monitor)

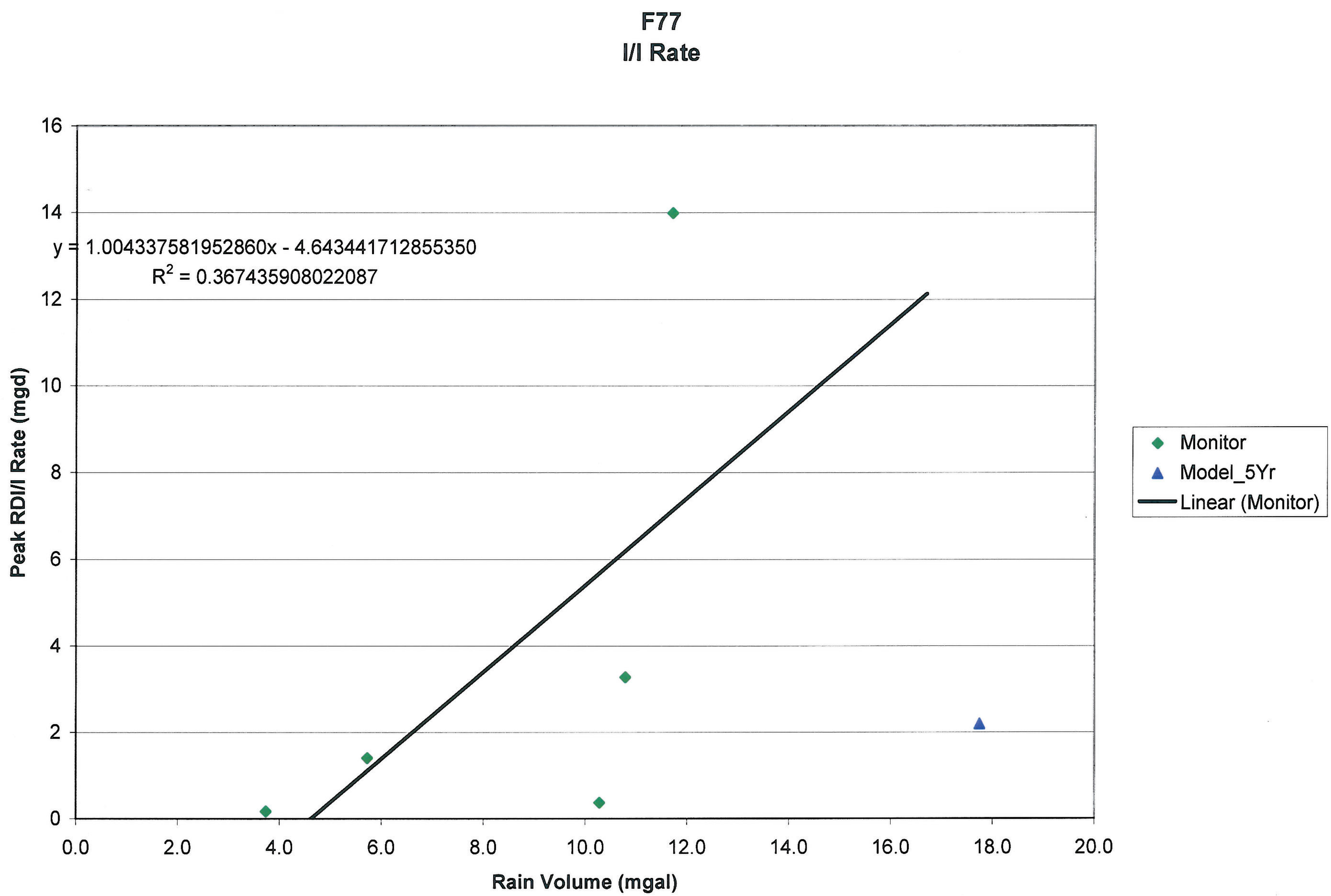
F72
I/I Rate



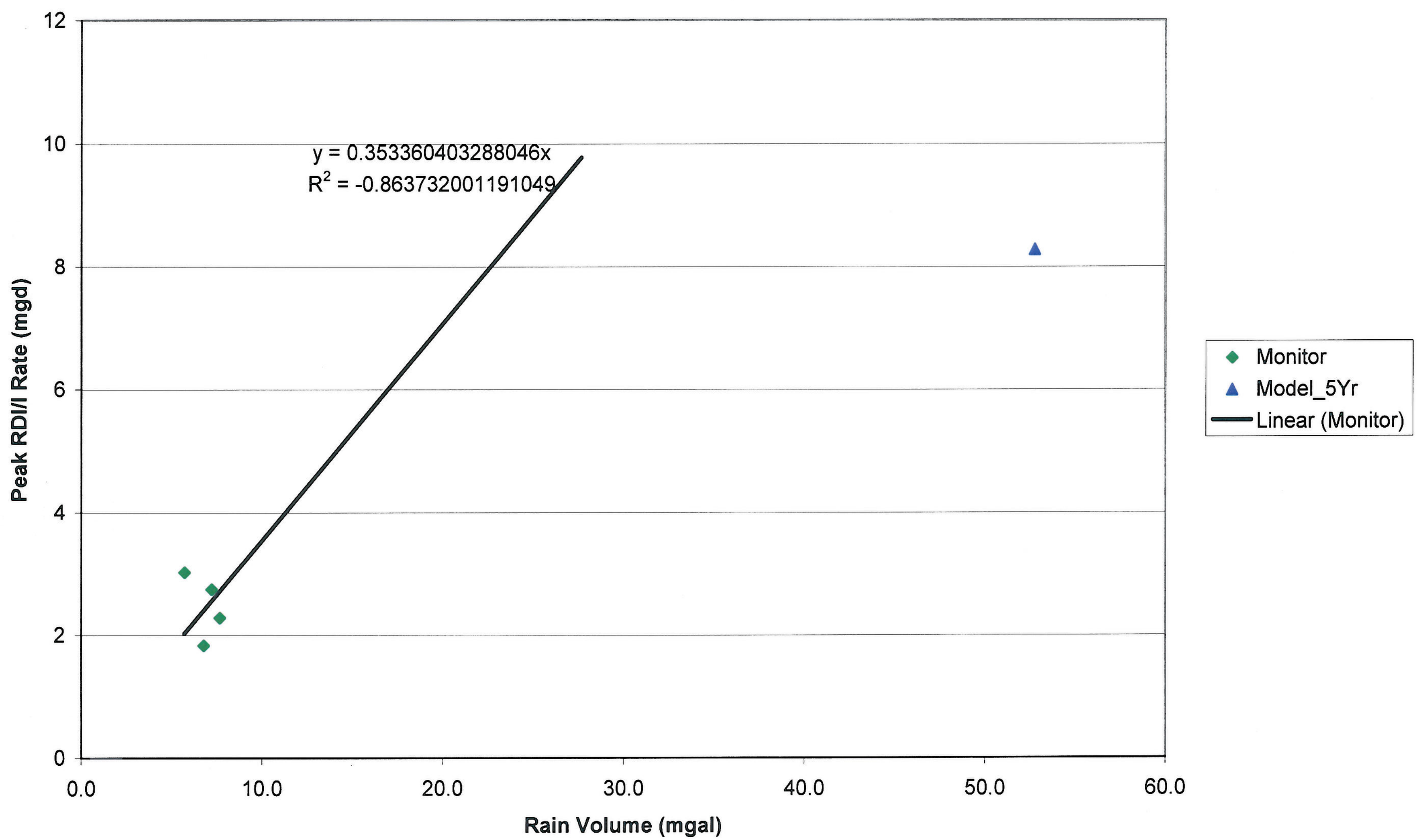
y = 0.257298006854206x - 0.802032796966050
R2 = 0.917436862833045
Peak RDI/I Rate (mgd)
Rain Volume (mgal)
0
2
4
6
8
10
12
14
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
Monitor
Model_5Yr
Linear (Monitor)

F74
I/I Rate


y = 0.153141088235349x - 0.560804613668737
Peak RDI/I Rate (mgd)
0
2
4
6
8
10
12
14
16
18
20
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
Rain Volume (mgal)
Monitor
Model_5Yr
Linear (Monitor)

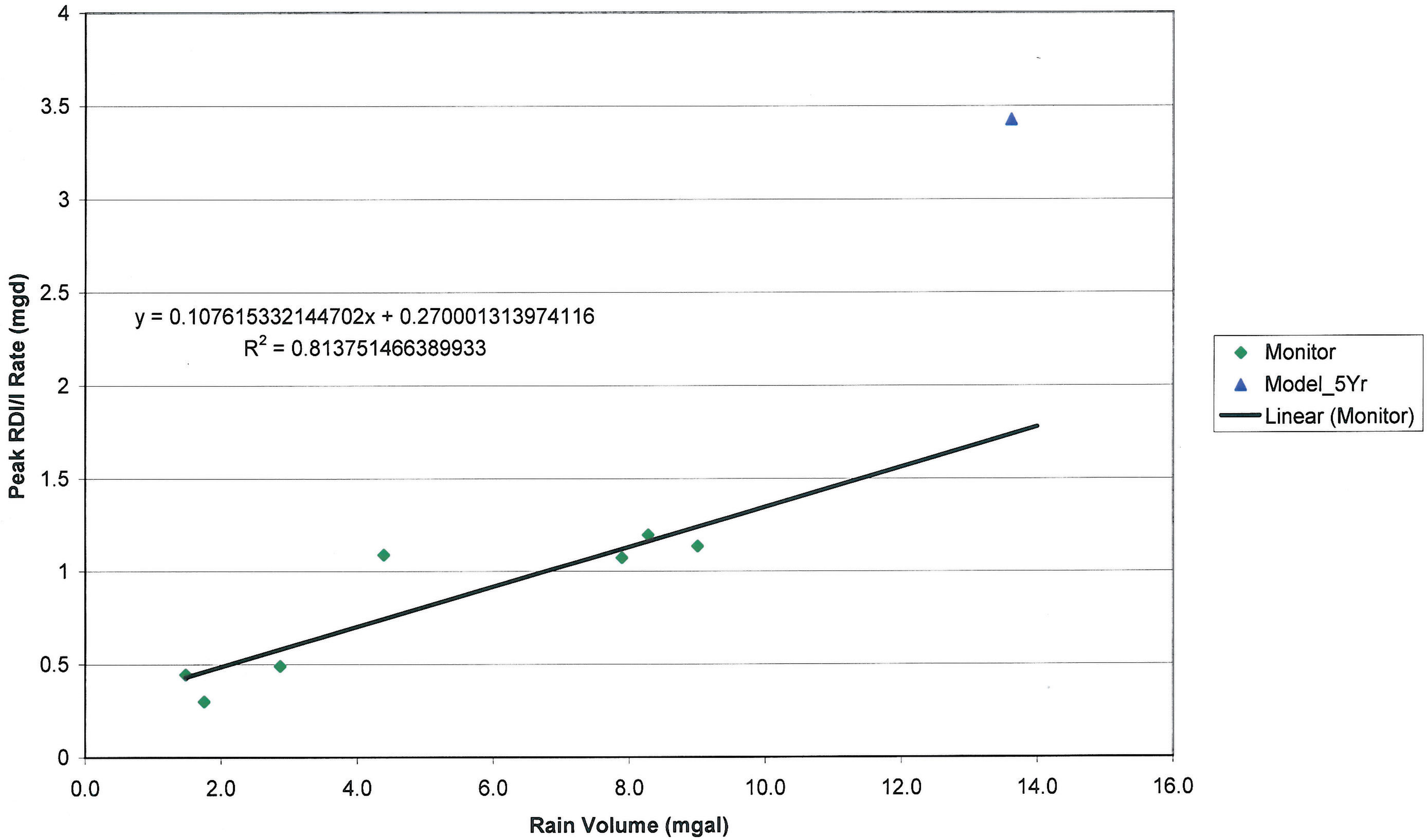

F77
I/I Rate
Peak RDI/I Rate (mgd)
0
2
4
6
8
10
12
14
16
y = 1.004337581952860x - 4.643441712855350
R2 = 0.367435908022087
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
Rain Volume (mgal)
Monitor
Model_5Yr
Linear (Monitor)

F81
I/I Rate



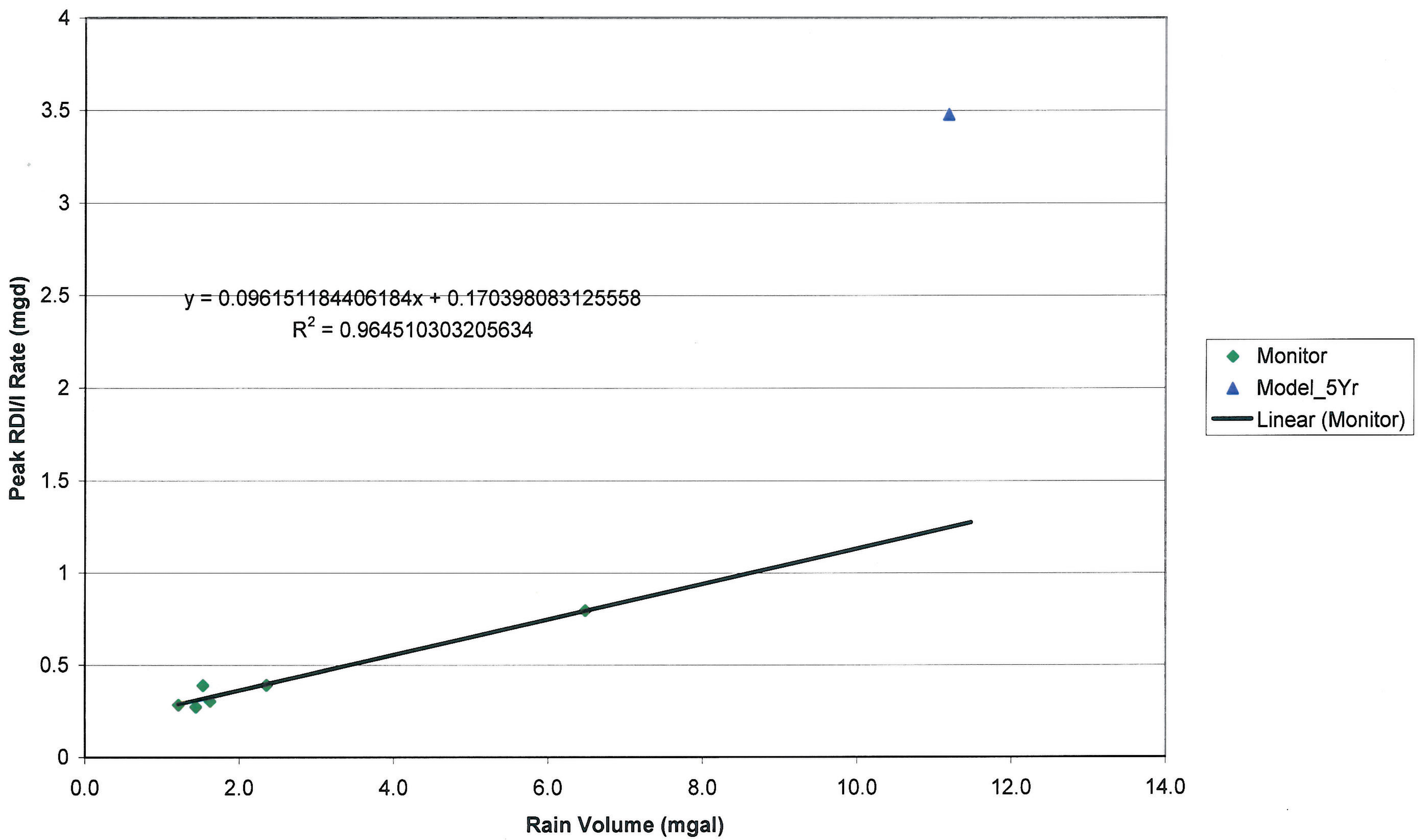
y = 0.353360403288046x
R2 = -0.863732001191049
Peak RDI/I Rate (mgd)
Rain Volume (mgal)
0
2
4
6
8
10
12
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Monitor
Model_5Yr
Linear (Monitor)

F83
I/I Rate



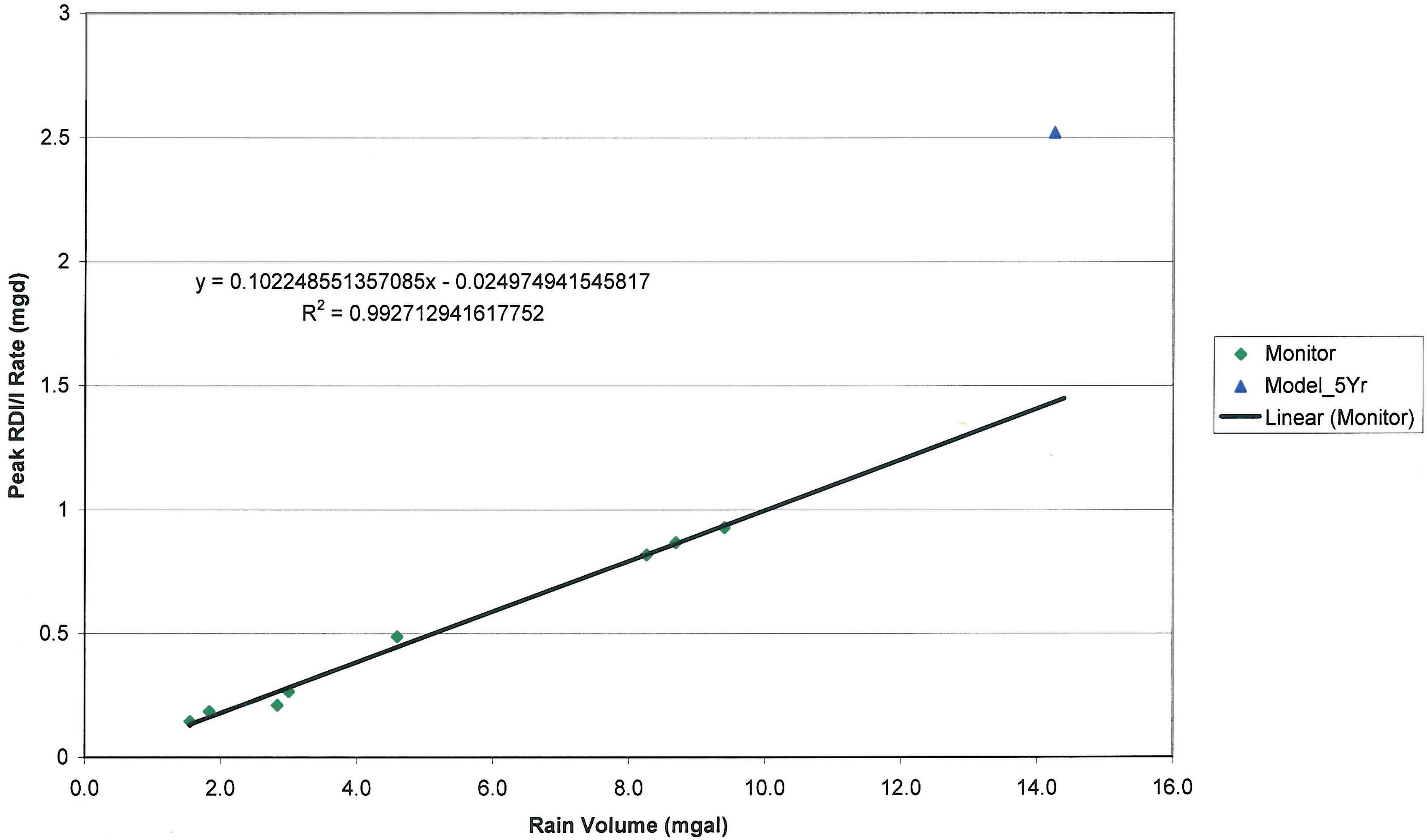
Peak RDI/I Rate (mgd)
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Rain Volume (mgal)
y = 0.107615332144702x + 0.270001313974116
R2 = 0.813751466389933
Monitor
Model_5Yr
Linear (Monitor)

F84
I/I Rate

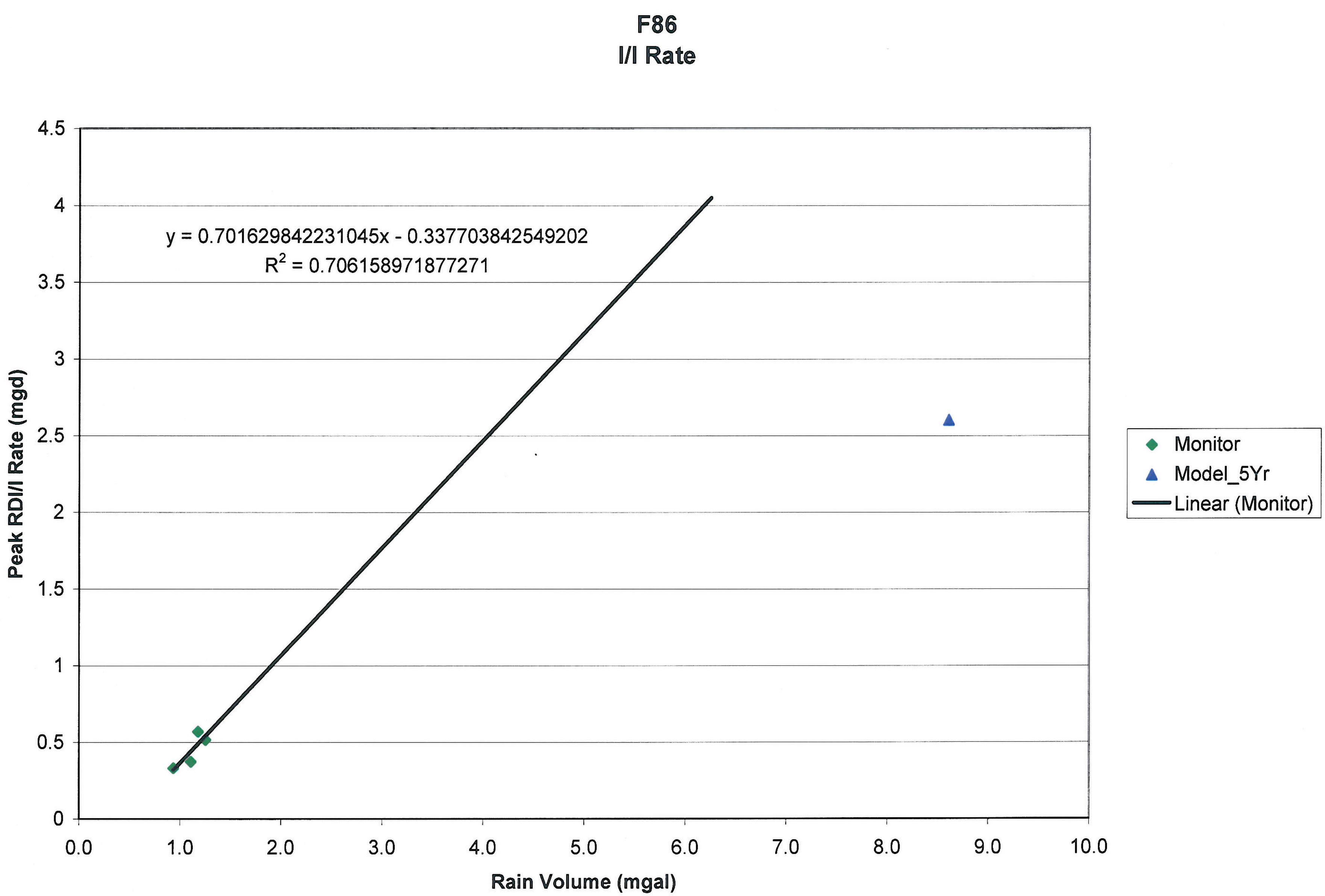


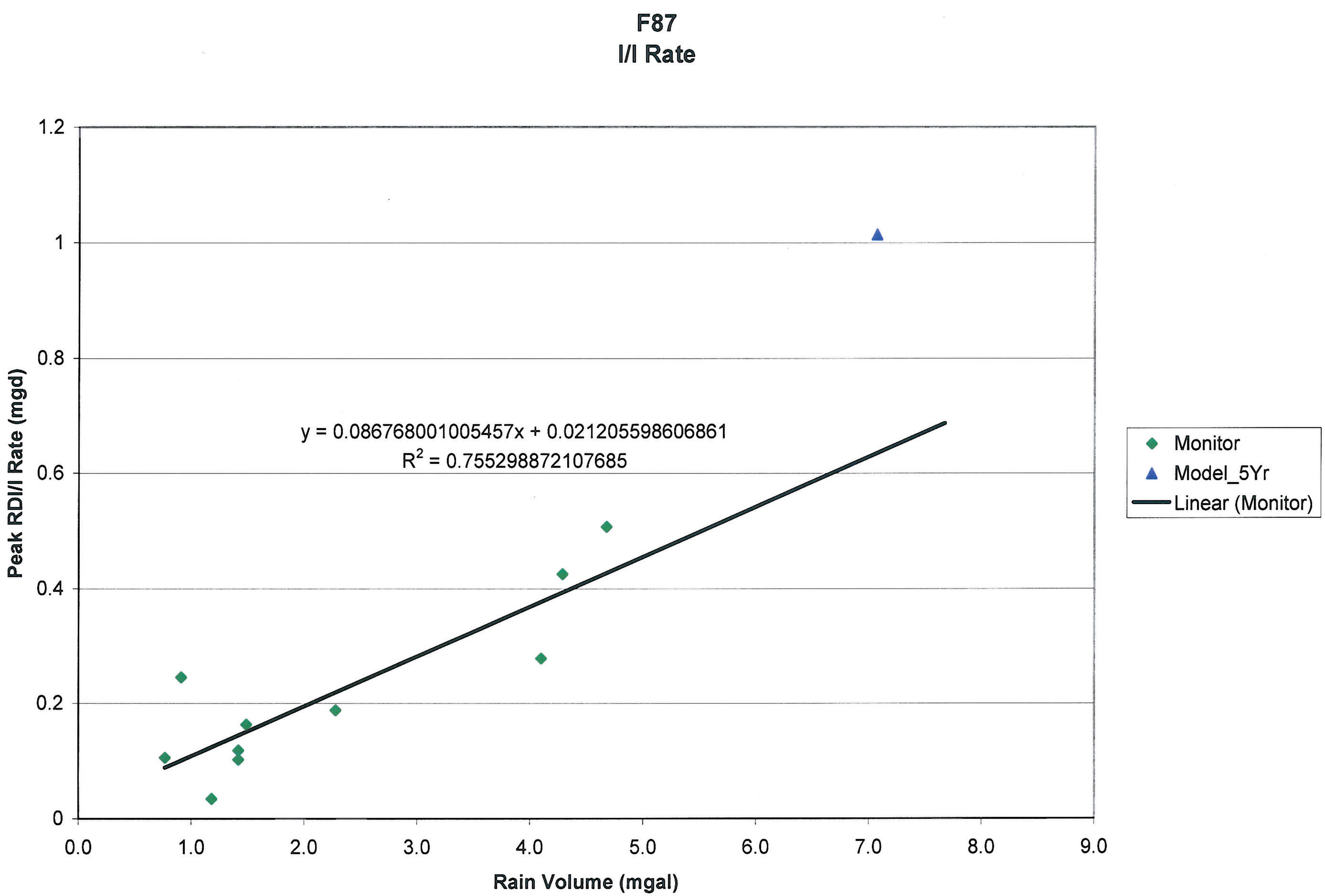
4
3.5
3
2.5
2
1.5
1
0.5
0
Peak RDI/I Rate (mgd)
y = 0.096151184406184x + 0.170398083125558
R2 = 0.964510303205634
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Rain Volume (mgal)
Monitor
Model_5Yr
Linear (Monitor)

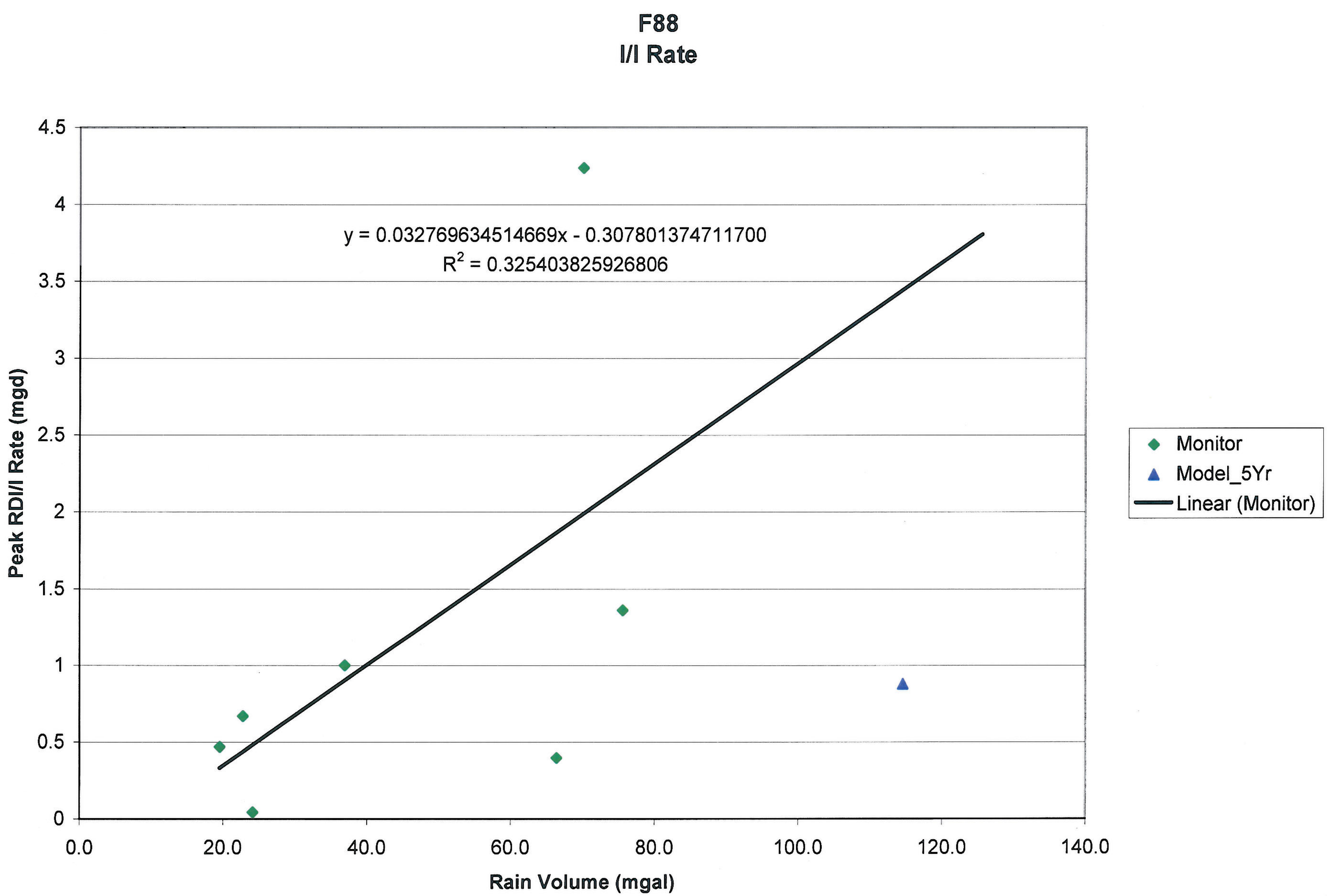
F85
I/I Rate



3
2.5
2
1.5
1
0.5
0
Peak RDI/I Rate (mgd)
y = 0.102248551357085x - 0.024974941545817
R2 = 0.992712941617752
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Rain Volume (mgal)
Monitor
Model_5Yr
Linear (Monitor)

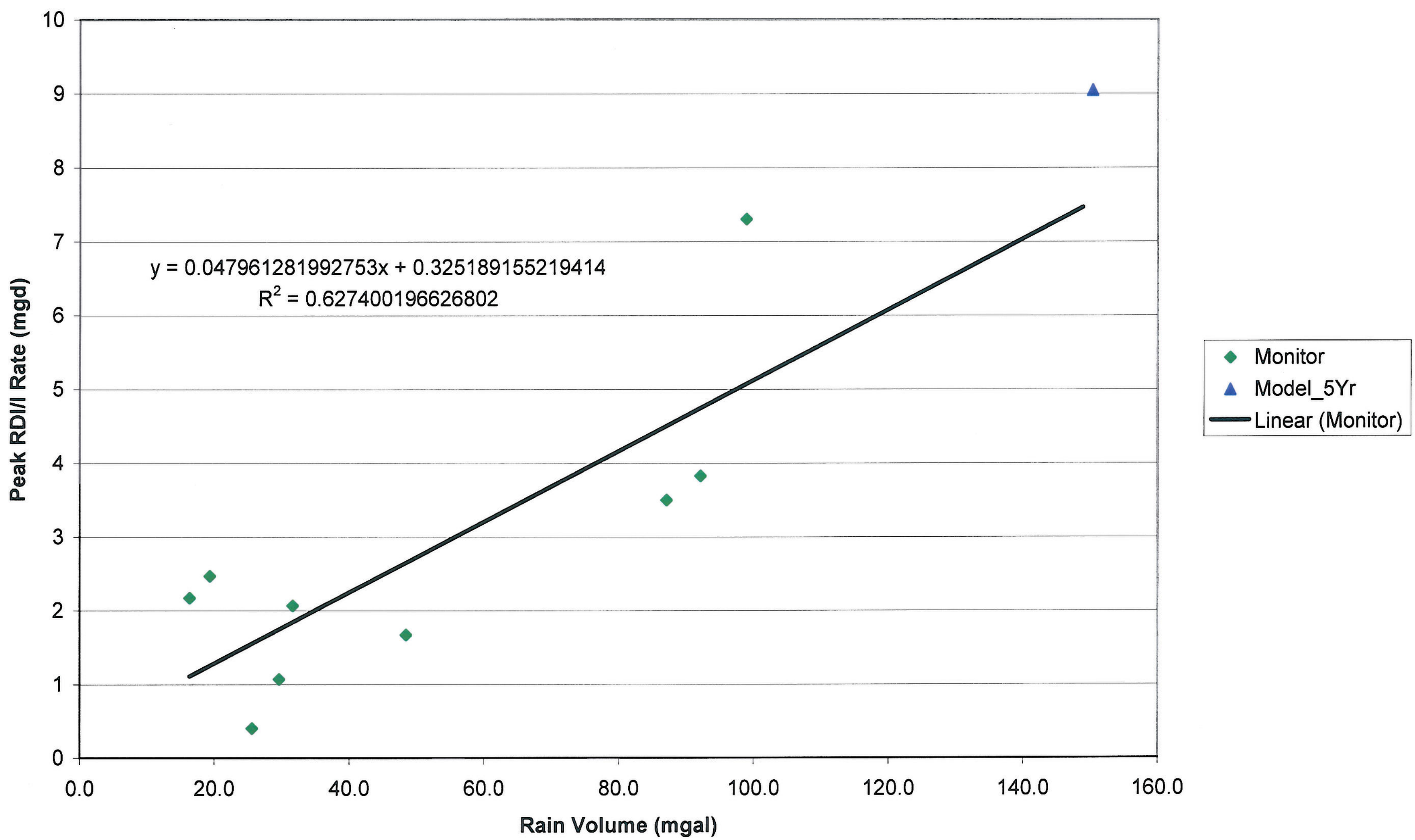

F86
I/I Rate
y = 0.701629842231045x - 0.337703842549202
R2 = 0.706158971877271
Peak RDI/I Rate (mgd)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rain Volume (mgal)
Monitor
Model_5Yr
Linear (Monitor)


F87
I/I Rate
Peak RDI/I Rate (mgd)
1.2
1
0.8
0.6
0.4
0.2
0
y = 0.086768001005457x + 0.021205598606861
R2 = 0.755298872107685
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Rain Volume (mgal)
Monitor
Model_5Yr
Linear (Monitor)



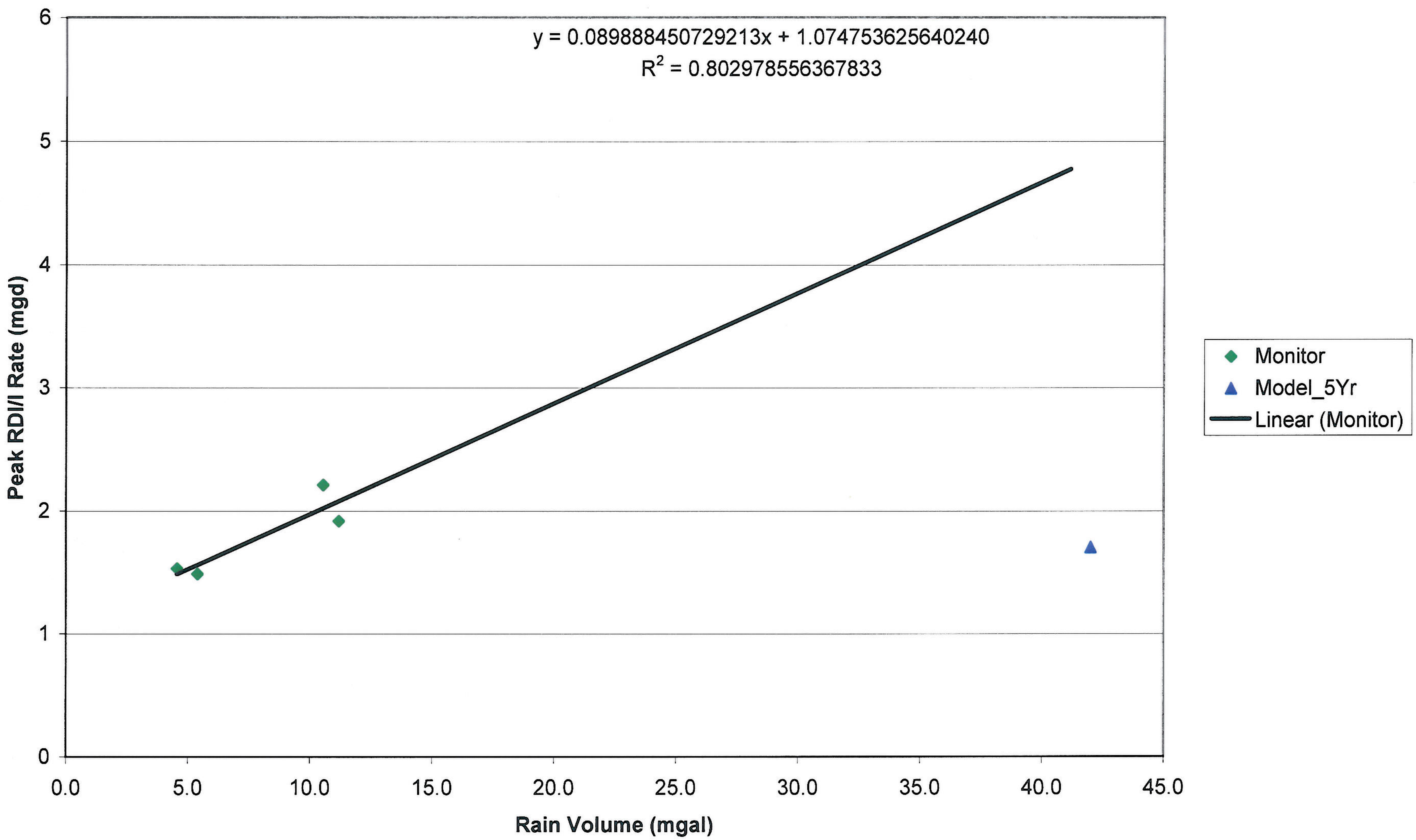
F88
I/I Rate
y = 0.032769634514669x - 0.307801374711700
R2 = 0.325403825926806
Peak RDI/I Rate (mgd)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
Rain Volume (mgal)
Monitor
Model_5Yr
Linear (Monitor)

F89
I/I Rate

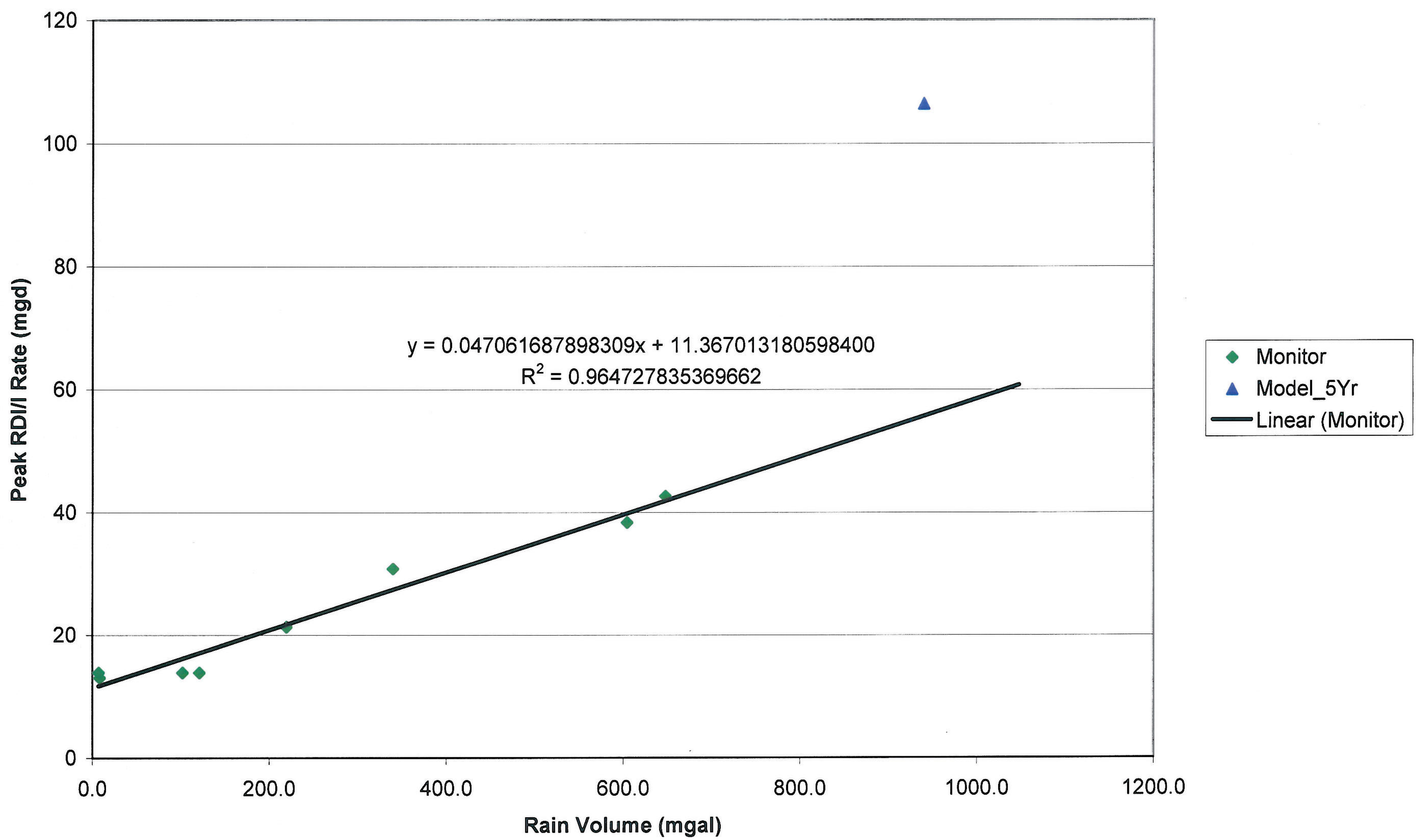


Peak RDI/I Rate (mgd)
10
9
8
7
6
5
4
3
2
1
0
y = 0.047961281992753x + 0.325189155219414
R2 = 0.627400196626802
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
Rain Volume (mgal)
Monitor
Model_5Yr
Linear (Monitor)

F90
I/I Rate


y = 0.089888450729213x + 1.074753625640240
R2 = 0.802978556367833
Peak RDI/I Rate (mgd)
0
1
2
3
4
5
6
Rain Volume (mgal)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Monitor
Model_5Yr
Linear (Monitor)

F5173
I/I Rate



Appendix F – Inventory Data by Monitoring Basin

Flow Basin	Diameter (inch)	Length of Pipe (feet)	Flow Basin	Diameter (inch)	Length of Pipe (feet)
F70	4	22	F86	6	385
	6	985		8	6031
	8	19314		10	1031
	10	6300		12	796
	12	2274		15	621
	15	3153	F87	4	100
	18	297		8	6485
F72	8	22502	F88	6	2280
	10	918		8	31526
	12	2750		10	1377
	18	2943		12	155
	21	1124		27	11271
	24	89	F89	6	8345
F74	4	826		8	92705
	6	7802		10	1752
	8	58521		12	725
	10	4522		15	7183
	12	587		18	3080
	27	1101		21	4348
	30	2731		24	1942
	42	8621	F90	4	73
F77	6	1108		6	2111
	8	11187		8	26094
	10	2819		10	4306
	12	501		12	2092
	21	1610		15	5230
	27	1429		18	733
F81	6	3581		24	3323
	8	2445	5173	2	1135
	10	2199		3	300
	12	3331		4	3536
	15	290		5	2186
	18	1445		6	47332
	24	4504		8	475999
	30	200		10	48319
F83	6	32		12	36919
	8	8595		14	1781
	12	1693		15	12923
F84	4	197		18	20086
	6	240		20	1973
	8	7578		21	7594
	10	1528		24	19979
F85	6	1363		27	11142
	8	10834		30	9186
	10	1940		36	6764
				42	12454
				48	28124
				60	5379
				72	435

Note: Based on 2007 City GIS

Length of pipe denotes "Active" or pipes not otherwise designated

Appendix G – Detailed Cost Data for Capital Improvement Projects

CITY OF SPRINGFIELD
PIPELINE IMPROVEMENTS
CLASS 5 COST OPINION

DATE: 10/1/2007
PROJECT NO.: 350467
ESTIMATE BY: D OLeary

CIP ID	DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
1	Gravity Pipeline - 24" with new alignment				
	Gravity Pipeline - 24" with new alignment	6,418	LF	$272	$1,743,268
	Bore & Jack Undercrossing (36" Casing)	300	LF	$250	$75,000
	Manhole - 48" diameter x 8' deep	20	EA	$5,124	$102,488
	Manhole - 84" Extra Depth	2	EA	$15,990	$31,979
	DIRECT SUBTOTAL				$1,952,736
	CONTINGENCIES	30.0%			$585,821
	CONSTRUCTION TOTAL (ROUNDED)				$2,539,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$2,539,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$761,700
	CONSTRUCTION ENGINEERING	15.0%			$380,850
	ENVIRONMENTAL MITIGATION	5.0%			$126,950
	EASEMENTS & ROW ACQUISITION	5.0%			$126,950
	INDIRECT COST TOTAL (ROUNDED)				$1,396,000
	PROJECT TOTAL (ROUNDED)				$ 3,935,000
2	Gravity Pipeline - 21" with Removal				
	Gravity Pipeline - 21" with Removal	795	LF	$271	$215,770
	Manhole - 48" diameter x 8' deep	4	EA	$5,124	$20,498
	DIRECT SUBTOTAL				$236,268
	CONTINGENCIES	30.0%			$70,880
	CONSTRUCTION TOTAL (ROUNDED)				$307,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$307,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$92,100
	CONSTRUCTION ENGINEERING	15.0%			$46,050
	ENVIRONMENTAL MITIGATION	5.0%			$15,350
	EASEMENTS & ROW ACQUISITION	5.0%			$15,350
	INDIRECT COST TOTAL (ROUNDED)				$169,000
	PROJECT TOTAL (ROUNDED)				$ 476,000
3	Gravity Pipeline - 18" with Removal				
	Gravity Pipeline - 18" with Removal	1,112	LF	$252	$280,238
	Manhole - 48" diameter x 8' deep	5	EA	$5,124	$25,622
	DIRECT SUBTOTAL				$305,860
	CONTINGENCIES	30.0%			$91,758
	CONSTRUCTION TOTAL (ROUNDED)				$398,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$398,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$119,400
	CONSTRUCTION ENGINEERING	15.0%			$59,700
	ENVIRONMENTAL MITIGATION	5.0%			$19,900
	EASEMENTS & ROW ACQUISITION	5.0%			$19,900
	INDIRECT COST TOTAL (ROUNDED)				$219,000
	PROJECT TOTAL (ROUNDED)				$ 617,000
4	Gravity Pipeline - 12" with Removal				
	Gravity Pipeline - 12" with Removal	1,538	LF	$212	$325,586
	Manhole - 48" diameter x 8' deep	11	EA	$5,124	$56,368
	DIRECT SUBTOTAL				$381,954
	CONTINGENCIES	25.0%			$95,489
	CONSTRUCTION TOTAL (ROUNDED)				$477,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$477,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$143,100
	CONSTRUCTION ENGINEERING	15.0%			$71,550
	ENVIRONMENTAL MITIGATION	5.0%			$23,850
	EASEMENTS & ROW ACQUISITION	5.0%			$23,850
	INDIRECT COST TOTAL (ROUNDED)				$262,000

CITY OF SPRINGFIELD
PIPELINE IMPROVEMENTS
CLASS 5 COST OPINION

DATE: 10/1/2007
PROJECT NO.: 350467
ESTIMATE BY: D OLeary

CIP ID	DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
	PROJECT TOTAL (ROUNDED)				$ 739,000
5	Gravity Pipeline - 24" with Removal				
	Gravity Pipeline - 24" with Removal	4,161	LF	$287	$1,192,757
	Manhole - 48" diameter x 8' deep	21	EA	$5,124	$107,612
	DIRECT SUBTOTAL				$1,300,370
	CONTINGENCIES	25.0%			$325,092
	CONSTRUCTION TOTAL (ROUNDED)				$1,625,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$1,625,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$487,500
	CONSTRUCTION ENGINEERING	15.0%			$243,750
	ENVIRONMENTAL MITIGATION	5.0%			$81,250
	EASEMENTS & ROW ACQUISITION	5.0%			$81,250
	INDIRECT COST TOTAL (ROUNDED)				$894,000
	PROJECT TOTAL (ROUNDED)				$ 2,519,000
6	Gravity Pipeline - 15" with Removal				
	Gravity Pipeline - 15" with Removal	1,231	LF	$229	$282,200
	Manhole - 48" diameter x 8' deep	6	EA	$5,124	$30,746
	DIRECT SUBTOTAL				$312,946
	CONTINGENCIES	25.0%			$78,236
	CONSTRUCTION TOTAL (ROUNDED)				$391,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$391,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$117,300
	CONSTRUCTION ENGINEERING	15.0%			$58,650
	ENVIRONMENTAL MITIGATION	5.0%			$19,550
	EASEMENTS & ROW ACQUISITION	5.0%			$19,550
	INDIRECT COST TOTAL (ROUNDED)				$215,000
	PROJECT TOTAL (ROUNDED)				$ 606,000
7	Vault Reconfiguration				
	Vault Reconfiguration	--	LF	$201	$0
	Manhole - 48" diameter x 8' deep	--	EA	$5,124	$0
	DIRECT SUBTOTAL				$0
	CONTINGENCIES	25.0%			$0
	CONSTRUCTION TOTAL (ROUNDED)				$0
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$0
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$0
	CONSTRUCTION ENGINEERING	15.0%			$0
	ENVIRONMENTAL MITIGATION	5.0%			$0
	EASEMENTS & ROW ACQUISITION	5.0%			$0
	INDIRECT COST TOTAL (ROUNDED)				$0
	PROJECT TOTAL (ROUNDED)				$ -
8	Gravity Pipeline - 15" with Removal				
	Gravity Pipeline - 15" with Removal	714	LF	$229	$163,680
	Manhole - 48" diameter x 8' deep	3	EA	$5,124	$15,373
	DIRECT SUBTOTAL				$179,054
	CONTINGENCIES	25.0%			$44,763
	CONSTRUCTION TOTAL (ROUNDED)				$224,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$224,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$67,200
	CONSTRUCTION ENGINEERING	15.0%			$33,600
	Gravity Pipeline - 30" New Alignment	5.0%			$11,200
	EASEMENTS & ROW ACQUISITION	5.0%			$11,200
	INDIRECT COST TOTAL (ROUNDED)				$123,000
	PROJECT TOTAL (ROUNDED)				$ 347,000

CITY OF SPRINGFIELD
PIPELINE IMPROVEMENTS
CLASS 5 COST OPINION

DATE: 10/1/2007
PROJECT NO.: 350467
ESTIMATE BY: D OLeary

CIP ID	DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
9	Gravity Pipeline - 15" with new alignment				
	Gravity Pipeline - 15" with new alignment	4,837	LF	$216	$1,045,395
	Manhole - 48" diameter x 8' deep	17	EA	$5,124	$87,115
	DIRECT SUBTOTAL				$1,132,510
	CONTINGENCIES	25.0%			$283,127
	CONSTRUCTION TOTAL (ROUNDED)				$1,416,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$1,416,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$424,800
	CONSTRUCTION ENGINEERING	15.0%			$212,400
	ENVIRONMENTAL MITIGATION	5.0%			$70,800
	EASEMENTS & ROW ACQUISITION	5.0%			$70,800
	INDIRECT COST TOTAL (ROUNDED)				$779,000
	PROJECT TOTAL (ROUNDED)				$ 2,195,000
10	Gravity Pipeline - 24" with Removal				
	Gravity Pipeline - 24" with Removal	3,589	LF	$287	$1,028,793
	Manhole - 48" diameter x 8' deep	11	EA	$5,124	$56,368
	DIRECT SUBTOTAL				$1,085,161
	CONTINGENCIES	25.0%			$271,290
	CONSTRUCTION TOTAL (ROUNDED)				$1,356,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$1,356,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$406,800
	CONSTRUCTION ENGINEERING	15.0%			$203,400
	ENVIRONMENTAL MITIGATION	5.0%			$67,800
	EASEMENTS & ROW ACQUISITION	5.0%			$67,800
	INDIRECT COST TOTAL (ROUNDED)				$746,000
	PROJECT TOTAL (ROUNDED)				$ 2,102,000
11	Gravity Pipeline - 15" with Removal				
	Gravity Pipeline - 15" with Removal	1,014	LF	$229	$232,454
	Manhole - 48" diameter x 8' deep	9	EA	$5,124	$46,120
	DIRECT SUBTOTAL				$278,573
	CONTINGENCIES	25.0%			$69,643
	CONSTRUCTION TOTAL (ROUNDED)				$348,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$348,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$104,400
	CONSTRUCTION ENGINEERING	15.0%			$52,200
	ENVIRONMENTAL MITIGATION	5.0%			$17,400
	EASEMENTS & ROW ACQUISITION	5.0%			$17,400
	INDIRECT COST TOTAL (ROUNDED)				$191,000
	PROJECT TOTAL (ROUNDED)				$ 539,000
12	Gravity Pipeline - 12" with Removal				
	Gravity Pipeline - 12" with Removal	529	LF	$212	$111,986
	Manhole - 48" diameter x 8' deep	3	EA	$5,124	$15,373
	DIRECT SUBTOTAL				$127,359
	CONTINGENCIES	25.0%			$31,840
	CONSTRUCTION TOTAL (ROUNDED)				$159,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$159,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$47,700
	CONSTRUCTION ENGINEERING	15.0%			$23,850
	ENVIRONMENTAL MITIGATION	5.0%			$7,950
	EASEMENTS & ROW ACQUISITION	5.0%			$7,950
	INDIRECT COST TOTAL (ROUNDED)				$87,000
	PROJECT TOTAL (ROUNDED)				$ 246,000

CITY OF SPRINGFIELD
PIPELINE IMPROVEMENTS
CLASS 5 COST OPINION

DATE: 10/1/2007
PROJECT NO.: 350467
ESTIMATE BY: D OLeary

CIP ID	DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
13	Gravity Pipeline - 18" with Removal				
	Gravity Pipeline - 18" with Removal	2,224	LF	$252	$560,475
	Manhole - 48" diameter x 8' deep	6	EA	$5,124	$30,746
	DIRECT SUBTOTAL				$591,222
	CONTINGENCIES	25.0%			$147,805
	CONSTRUCTION TOTAL (ROUNDED)				$739,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$739,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$221,700
	CONSTRUCTION ENGINEERING	15.0%			$110,850
	ENVIRONMENTAL MITIGATION	5.0%			$36,950
	EASEMENTS & ROW ACQUISITION	5.0%			$36,950
	INDIRECT COST TOTAL (ROUNDED)				$406,000
	PROJECT TOTAL (ROUNDED)				$ 1,145,000
14	Gravity Pipeline - 12" with Removal				
	Gravity Pipeline - 12" with Removal	325	LF	$212	$68,801
	Manhole - 48" diameter x 8' deep	3	EA	$5,124	$15,373
	DIRECT SUBTOTAL				$84,174
	CONTINGENCIES	25.0%			$21,043
	CONSTRUCTION TOTAL (ROUNDED)				$105,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$105,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$31,500
	CONSTRUCTION ENGINEERING	15.0%			$15,750
	ENVIRONMENTAL MITIGATION	5.0%			$5,250
	EASEMENTS & ROW ACQUISITION	5.0%			$5,250
	INDIRECT COST TOTAL (ROUNDED)				$58,000
	PROJECT TOTAL (ROUNDED)				$ 163,000
Existing Rehab	Gravity Pipeline - 8-12" with Removal				
	Gravity Pipeline - 8-12" with Removal	23,548	LF	$166	$3,908,968
	Manhole - 48" diameter x 8' deep	0	EA	$0	$0
	DIRECT SUBTOTAL				$3,908,968
	CONTINGENCIES	25.0%			$977,242
	CONSTRUCTION TOTAL (ROUNDED)				$4,886,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$4,886,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$1,465,800
	CONSTRUCTION ENGINEERING	15.0%			$732,900
	ENVIRONMENTAL MITIGATION	5.0%			$244,300
	EASEMENTS & ROW ACQUISITION	5.0%			$244,300
	INDIRECT COST TOTAL (ROUNDED)				$2,687,000
	PROJECT TOTAL (ROUNDED)				$ 7,573,000
Future Rehab	Gravity Pipeline - 8-12" with Removal				
	Gravity Pipeline - 8-12" with Removal	31,211	LF	$166	$5,181,026
	Manhole - 48" diameter x 8' deep	0	EA	$0	$0
	DIRECT SUBTOTAL				$5,181,026
	CONTINGENCIES	25.0%			$1,295,257
	CONSTRUCTION TOTAL (ROUNDED)				$6,476,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$6,476,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$1,942,800
	CONSTRUCTION ENGINEERING	15.0%			$971,400
	ENVIRONMENTAL MITIGATION	5.0%			$323,800
	EASEMENTS & ROW ACQUISITION	5.0%			$323,800
	INDIRECT COST TOTAL (ROUNDED)				$3,562,000
	PROJECT TOTAL (ROUNDED)				$ 10,038,000
Existing PS	Nugget Way PS				
	Nugget Way PS	1,822	GPM	$422	$769,417

CITY OF SPRINGFIELD
PIPELINE IMPROVEMENTS
CLASS 5 COST OPINION

DATE: 10/1/2007
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ESTIMATE BY: D OLeary

CIP ID	DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
	Manhole - 48" diameter x 8' deep	0	EA	$0	$0
	DIRECT SUBTOTAL				**$769,417**
	CONTINGENCIES	**25.0%**			**$192,354**
	CONSTRUCTION TOTAL (ROUNDED)				**$962,000**
	SALES TAX	**0.0%**			**$0**
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				**$962,000**
	ENGINEERING, LEGAL/ADMIN, COORDINATION	**30.0%**			**$288,600**
	CONSTRUCTION ENGINEERING	**15.0%**			**$144,300**
	ENVIRONMENTAL MITIGATION	**5.0%**			**$48,100**
	EASEMENTS & ROW ACQUISITION	**0.0%**			**$0**
	INDIRECT COST TOTAL (ROUNDED)				**$481,000**
	PROJECT TOTAL (ROUNDED)				**$ 1,443,000**
Existing PS	**Hayden PS**				
	Hayden PS	988	GPM	$567	$560,379
	Manhole - 48" diameter x 8' deep	0	EA	$0	$0
	DIRECT SUBTOTAL				**$560,379**
	CONTINGENCIES	**25.0%**			**$140,095**
	CONSTRUCTION TOTAL (ROUNDED)				**$700,000**
	SALES TAX	**0.0%**			**$0**
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				**$700,000**
	ENGINEERING, LEGAL/ADMIN, COORDINATION	**30.0%**			**$210,000**
	CONSTRUCTION ENGINEERING	**15.0%**			**$105,000**
	ENVIRONMENTAL MITIGATION	**5.0%**			**$35,000**
	EASEMENTS & ROW ACQUISITION	**0.0%**			**$0**
	INDIRECT COST TOTAL (ROUNDED)				**$350,000**
	PROJECT TOTAL (ROUNDED)				**$ 1,050,000**
Existing PS	**River Glen PS**				
	River Glen PS	1,328	GPM	$492	$653,152
	Manhole - 48" diameter x 8' deep	0	EA	$0	$0
	DIRECT SUBTOTAL				**$653,152**
	CONTINGENCIES	**25.0%**			**$163,288**
	CONSTRUCTION TOTAL (ROUNDED)				**$816,000**
	SALES TAX	**0.0%**			**$0**
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				**$816,000**
	ENGINEERING, LEGAL/ADMIN, COORDINATION	**30.0%**			**$244,800**
	CONSTRUCTION ENGINEERING	**15.0%**			**$122,400**
	ENVIRONMENTAL MITIGATION	**5.0%**			**$40,800**
	EASEMENTS & ROW ACQUISITION	**0.0%**			**$0**
	INDIRECT COST TOTAL (ROUNDED)				**$408,000**
	PROJECT TOTAL (ROUNDED)				**$ 1,224,000**
Exp_Harbor Drive	**Gravity Pipeline - 8" New Alignment**				
	Gravity Pipeline - 8" New Alignment	7684	LF	$173	$1,329,878
	Manhole - 48" diameter x 8' deep	32	EA	$5,124	$163,981
	DIRECT SUBTOTAL				**$1,493,859**
	CONTINGENCIES	**25.0%**			**$373,465**
	CONSTRUCTION TOTAL (ROUNDED)				**$1,867,000**
	SALES TAX	**0.0%**			**$0**
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				**$1,867,000**
	ENGINEERING, LEGAL/ADMIN, COORDINATION	**30.0%**			**$560,100**
	CONSTRUCTION ENGINEERING	**15.0%**			**$280,050**
	ENVIRONMENTAL MITIGATION	**5.0%**			**$93,350**
	EASEMENTS & ROW ACQUISITION	**5.0%**			**$93,350**
	INDIRECT COST TOTAL (ROUNDED)				**$1,027,000**
	PROJECT TOTAL (ROUNDED)				**$ 2,894,000**
Exp_Harbor Drive	**Harbor Drive PS**				
	Harbor Drive PS	145	GPM	$1,430	$207,389
	Manhole - 48" diameter x 8' deep	0	EA	$0	$0

CITY OF SPRINGFIELD
PIPELINE IMPROVEMENTS
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DATE: 10/1/2007
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ESTIMATE BY: D OLeary

CIP ID	DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
	DIRECT SUBTOTAL				$207,389
	CONTINGENCIES	25.0%			$51,847
	CONSTRUCTION TOTAL (ROUNDED)				$259,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$259,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$77,700
	CONSTRUCTION ENGINEERING	15.0%			$38,850
	ENVIRONMENTAL MITIGATION	5.0%			$12,950
	EASEMENTS & ROW ACQUISITION	5.0%			$12,950
	INDIRECT COST TOTAL (ROUNDED)				$142,000
	PROJECT TOTAL (ROUNDED)				$ 401,000
Exp_Harbor Drive	Forcemain Pipeline - 5" New Alignment				
	Forcemain Pipeline - 5" New Alignment	134	LF	$182	$24,365
	Manhole - 48" diameter x 8' deep	0	EA	$5,124	$0
	DIRECT SUBTOTAL				$24,365
	CONTINGENCIES	25.0%			$6,091
	CONSTRUCTION TOTAL (ROUNDED)				$30,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$30,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$9,000
	CONSTRUCTION ENGINEERING	15.0%			$4,500
	ENVIRONMENTAL MITIGATION	5.0%			$1,500
	EASEMENTS & ROW ACQUISITION	5.0%			$1,500
	INDIRECT COST TOTAL (ROUNDED)				$17,000
	PROJECT TOTAL (ROUNDED)				$ 47,000
Exp_Jasper Road	Gravity Pipeline - 10" New Alignment				
	Gravity Pipeline - 10" New Alignment	2581	LF	$186	$479,256
	Manhole - 48" diameter x 8' deep	11	EA	$5,124	$56,368
	DIRECT SUBTOTAL				$535,625
	CONTINGENCIES	25.0%			$133,906
	CONSTRUCTION TOTAL (ROUNDED)				$670,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$670,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$201,000
	CONSTRUCTION ENGINEERING	15.0%			$100,500
	ENVIRONMENTAL MITIGATION	5.0%			$33,500
	EASEMENTS & ROW ACQUISITION	5.0%			$33,500
	INDIRECT COST TOTAL (ROUNDED)				$369,000
	PROJECT TOTAL (ROUNDED)				$ 1,039,000
Exp_Jasper Road	Gravity Pipeline - 12" New Alignment				
	Gravity Pipeline - 12" New Alignment	3395	LF	$197	$668,097
	Manhole - 48" diameter x 8' deep	15	EA	$5,124	$76,866
	DIRECT SUBTOTAL				$744,964
	CONTINGENCIES	25.0%			$186,241
	CONSTRUCTION TOTAL (ROUNDED)				$931,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$931,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$279,300
	CONSTRUCTION ENGINEERING	15.0%			$139,650
	ENVIRONMENTAL MITIGATION	5.0%			$46,550
	EASEMENTS & ROW ACQUISITION	5.0%			$46,550
	INDIRECT COST TOTAL (ROUNDED)				$512,000
	PROJECT TOTAL (ROUNDED)				$ 1,443,000
Exp_Jasper Road	Gravity Pipeline - 21" New Alignment				
	Gravity Pipeline - 21" New Alignment	17016	LF	$256	$4,362,548
	Manhole - 48" diameter x 8' deep	69	EA	$5,124	$353,584
	DIRECT SUBTOTAL				$4,716,131
	CONTINGENCIES	25.0%			$1,179,033

CITY OF SPRINGFIELD
PIPELINE IMPROVEMENTS
CLASS 5 COST OPINION

DATE: 10/1/2007
PROJECT NO.: 350467
ESTIMATE BY: D OLeary

CIP ID	DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
	CONSTRUCTION TOTAL (ROUNDED)				$5,895,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$5,895,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$1,768,500
	CONSTRUCTION ENGINEERING	15.0%			$884,250
	ENVIRONMENTAL MITIGATION	5.0%			$294,750
	EASEMENTS & ROW ACQUISITION	5.0%			$294,750
	INDIRECT COST TOTAL (ROUNDED)				$3,242,000
	PROJECT TOTAL (ROUNDED)				$ 9,137,000
Exp_Franklin Blvd	Gravity Pipeline - 8" New Alignment				
	Gravity Pipeline - 8" New Alignment	2411	LF	$173	$417,274
	Manhole - 48" diameter x 8' deep	11	EA	$5,124	$56,368
	DIRECT SUBTOTAL				$473,643
	CONTINGENCIES	25.0%			$118,411
	CONSTRUCTION TOTAL (ROUNDED)				$592,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$592,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$177,600
	CONSTRUCTION ENGINEERING	15.0%			$88,800
	ENVIRONMENTAL MITIGATION	5.0%			$29,600
	EASEMENTS & ROW ACQUISITION	5.0%			$29,600
	INDIRECT COST TOTAL (ROUNDED)				$326,000
	PROJECT TOTAL (ROUNDED)				$ 918,000
Exp_Franklin Blvd	Gravity Pipeline - 15" New Alignment				
	Gravity Pipeline - 15" New Alignment	3868	LF	$256	$991,675
	Manhole - 48" diameter x 8' deep	16	EA	$5,124	$81,990
	DIRECT SUBTOTAL				$1,073,665
	CONTINGENCIES	25.0%			$268,416
	CONSTRUCTION TOTAL (ROUNDED)				$1,342,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$1,342,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$402,600
	CONSTRUCTION ENGINEERING	15.0%			$201,300
	ENVIRONMENTAL MITIGATION	5.0%			$67,100
	EASEMENTS & ROW ACQUISITION	5.0%			$67,100
	INDIRECT COST TOTAL (ROUNDED)				$738,000
	PROJECT TOTAL (ROUNDED)				$ 2,080,000
Exp_Thurston Road	Gravity Pipeline - 8" New Alignment				
	Gravity Pipeline - 8" New Alignment	3882	LF	$173	$671,862
	Manhole - 48" diameter x 8' deep	17	EA	$5,124	$87,115
	DIRECT SUBTOTAL				$758,977
	CONTINGENCIES	25.0%			$189,744
	CONSTRUCTION TOTAL (ROUNDED)				$949,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$949,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$284,700
	CONSTRUCTION ENGINEERING	15.0%			$142,350
	ENVIRONMENTAL MITIGATION	5.0%			$47,450
	EASEMENTS & ROW ACQUISITION	5.0%			$47,450
	INDIRECT COST TOTAL (ROUNDED)				$522,000
	PROJECT TOTAL (ROUNDED)				$ 1,471,000
Exp_McKenzie Highway	Gravity Pipeline - 10" New Alignment				
	Gravity Pipeline - 10" New Alignment	1924	LF	$186	$357,260
	Manhole - 48" diameter x 8' deep	9	EA	$5,124	$46,120
	DIRECT SUBTOTAL				$403,380
	CONTINGENCIES	25.0%			$100,845
	CONSTRUCTION TOTAL (ROUNDED)				$504,000
	SALES TAX	0.0%			$0

CITY OF SPRINGFIELD
PIPELINE IMPROVEMENTS
CLASS 5 COST OPINION

DATE: 10/1/2007
PROJECT NO.: 350467
ESTIMATE BY: D OLeary

CIP ID	DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$504,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$151,200
	CONSTRUCTION ENGINEERING	15.0%			$75,600
	ENVIRONMENTAL MITIGATION	5.0%			$25,200
	EASEMENTS & ROW ACQUISITION	5.0%			$25,200
	INDIRECT COST TOTAL (ROUNDED)				$277,000
	PROJECT TOTAL (ROUNDED)				$ 781,000
Exp_McKenzie Highway	Gravity Pipeline - 12" New Alignment				
	Gravity Pipeline - 12" New Alignment	1983	LF	$197	$390,232
	Manhole - 48" diameter x 8' deep	9	EA	$5,124	$46,120
	DIRECT SUBTOTAL				$436,352
	CONTINGENCIES	25.0%			$109,088
	CONSTRUCTION TOTAL (ROUNDED)				$545,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$545,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$163,500
	CONSTRUCTION ENGINEERING	15.0%			$81,750
	ENVIRONMENTAL MITIGATION	5.0%			$27,250
	EASEMENTS & ROW ACQUISITION	5.0%			$27,250
	INDIRECT COST TOTAL (ROUNDED)				$300,000
	PROJECT TOTAL (ROUNDED)				$ 845,000
Exp_Vera_PS Area	Gravity Pipeline - 8" New Alignment				
	Gravity Pipeline - 8" New Alignment	1703	LF	$173	$294,740
	Manhole - 48" diameter x 8' deep	8	EA	$5,124	$40,995
	DIRECT SUBTOTAL				$335,735
	CONTINGENCIES	25.0%			$83,934
	CONSTRUCTION TOTAL (ROUNDED)				$420,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$420,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$126,000
	CONSTRUCTION ENGINEERING	15.0%			$63,000
	ENVIRONMENTAL MITIGATION	5.0%			$21,000
	EASEMENTS & ROW ACQUISITION	5.0%			$21,000
	INDIRECT COST TOTAL (ROUNDED)				$231,000
	PROJECT TOTAL (ROUNDED)				$ 651,000
Exp_Vera_PS Area	Gravity Pipeline - 12" New Alignment				
	Gravity Pipeline - 12" New Alignment	7880	LF	$197	$1,550,695
	Manhole - 48" diameter x 8' deep	33	EA	$5,124	$169,105
	DIRECT SUBTOTAL				$1,719,800
	CONTINGENCIES	25.0%			$429,950
	CONSTRUCTION TOTAL (ROUNDED)				$2,150,000
	SALES TAX	0.0%			$0
	CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)				$2,150,000
	ENGINEERING, LEGAL/ADMIN, COORDINATION	30.0%			$645,000
	CONSTRUCTION ENGINEERING	15.0%			$322,500
	ENVIRONMENTAL MITIGATION	5.0%			$107,500
	EASEMENTS & ROW ACQUISITION	5.0%			$107,500
	INDIRECT COST TOTAL (ROUNDED)				$1,183,000
	PROJECT TOTAL (ROUNDED)				$ 3,333,000

Appendix C - Design Storm Development

The December 2000 Metropolitan Wastewater Management Commission (MWMC) Wet Weather Flow Management Plan "defines" the 5-year, 24-hour wet season precipitation as 3.9 inches. However, the document does not specify how the value of 3.9 inches was obtained. A review of available published documents shows some uncertainty in the 5-year, 24 hour rainfall total. The following list summarizes the 5-year, 24-hour values obtained from several sources:

- 3.9 inches from the MWMC *Wet Weather Flow Management Plan* (December 2000).
- Greater than 3.5 inches, but less than 4.0 inches, from NOAA Atlas 2, Volume X, Figure 26. Published in 1970, and based on precipitation-reporting stations that had at least 20 years of daily or hourly precipitation data between 1897 and 1970, the NOAA frequency analysis is based on full year annual series data that is transformed to partial duration data using empirical conversion factors. Figure 26 is included as an attachment.
- 3.6 inches from the *Eugene Areawide Drainage Master Plan*, Figure 4.1 (OTAK, 1990). Results of this analysis are included in the City of Eugene *Stormwater Management Manual* (July 2006), but does not include any discussion of the methodology that produced these results.
- 3.8 inches from the City of Springfield *Engineering Design Standards and Procedures* (EDSP, April 2006). The Springfield EDSP is "based on information gathered from the *West Springfield Master Plan*, as well as the *Eugene Areawide Drainage Master Plan*".

Updated Rainfall Frequency Analysis

Because of the relatively wide range in these 5-year, 24-hour rainfall totals, uncertainty about the study methodologies, and the relative remoteness in time when the rainfall frequency analyses were conducted, a new frequency analysis was performed using Eugene Airport historic hourly rainfall data for the 1948 to 2005 period. The frequency analysis uses wet season (not full year) annual maximums to calculate a 5-year, 24-hour rainfall of 3.83 inches. The wet season is defined as November 1 to May 21 according to Oregon Administrative Rules (OAR) 340. The more rigorous (and time consuming) approach to rainfall frequency analysis (not performed for this updated frequency analysis) requires the use of a partial duration series. This means that rather than using only the largest rainfall event for each year in the analysis (annual series), the partial duration series recognizes that more than one large rainfall event may occur in the same year. The partial duration analysis will therefore result in a higher rainfall total for a given frequency and duration. Figure C-1 shows a comparison between the Eugene Airport 5-year depth-duration-frequency curve calculated using the annual series frequency analysis methodology and the 5-year, 24-hour design rainfall used in the 2000 Wet Weather Flow Management Plan. The design storm follows the calculated depth-duration-frequency curve quite closely except for the longer durations. The Wet Weather Flow Management Plan 5-year design storm is a 16-day period of rainfall that includes a peak 24-hour rainfall total of 3.9 inches. It includes antecedent rainfall that the Wet Weather Flow Management Plan considered conservative.
Figure C-2 compares the updated Eugene Airport 5-year depth-duration-frequency curve with depth-duration values from some recent historic rainfall events in the Eugene/Springfield area. As can be seen, for example, the 12-hour rainfall for the January 2006 rainfall event approached a 5-year event, but was over one inch less than the 5-year frequency for the 24-hour duration. The November 1996 storm produced rainfall in excess of the 5-year event for all durations between 6 and 72 hours.

Eugene Airport Rainfall Study

Further study of precipitation data by the City of Eugene (City of Eugene Analysis of Precipitation Data For Use in Hydrologic/Hydraulic Modeling, April 12, 1996, referenced in the City's Stormwater Basin Master Plan of August 2002) showed that annual precipitation at the Eugene Airport was significantly higher than the annual rainfall in the City of Eugene. The most reliable precipitation measurements in the Eugene area are those made with the weighing rain gage at the Eugene Airport, as opposed to tipping bucket gages used in the City of Eugene. Side-by-side operation of the two types of rain gages at the Eugene Airport showed that the tipping bucket gage measured about 81% of the rainfall measured by the weighing gage. This comparison indicates that the rainfall values recorded by the City's tipping bucket gages should be multiplied by a factor of 1.2. The study also states that the Oregon State Climatologist confirmed that "tipping bucket-type gages commonly underestimate rainfall amounts". The study outlined three separate courses of action that could be used in the interpretation of recorded rainfall values:

- Use the long-term precipitation data from the airport without adjustment.
- Adjust the long-term precipitation record at the airport downward by a recommended 10% based on the study findings.
- Further analyze the historic precipitation data to better define the relationship between precipitation at the airport and the City.
- The study recommended the third course of action.

Given this study recommendation, the use of Eugene Airport rainfall data without adjustment in the frequency analysis is a conservative, but not overly conservative, approach. As the 1996 study states, "If an estimation error is made, it is better that it be on the high side because the consequences of a high estimate (economic inefficiency) are less severe than those of a low estimate (inadequate design).

Figure C-1. Comparison of WWFMP 5-year Design Storm and 5-year Frequency Wet Season Depth-Duration-Frequency Curve Based on 1948-2005 Annual Maximums (Eugene Airport: Extreme Value [Gumbel] Distribution)

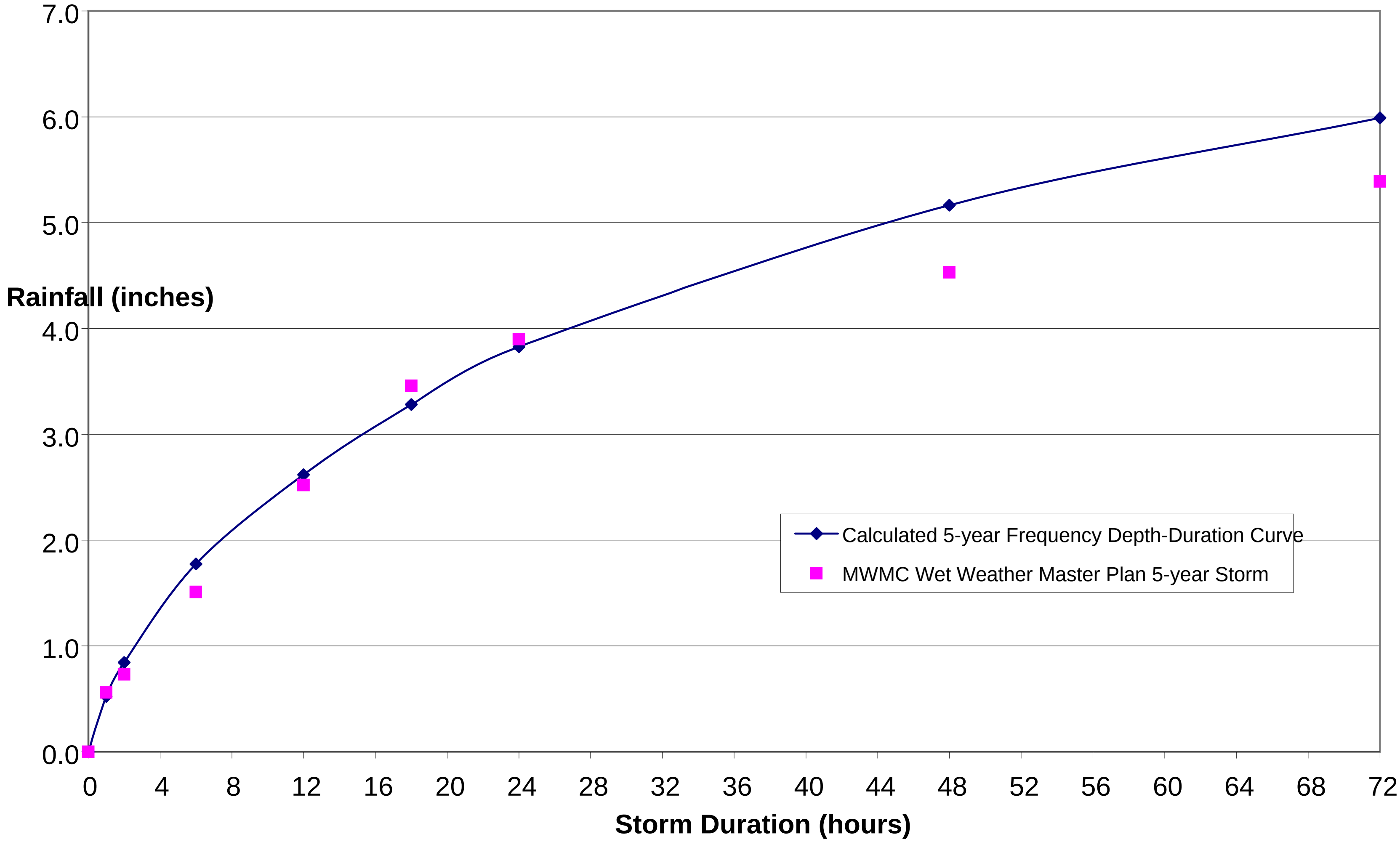
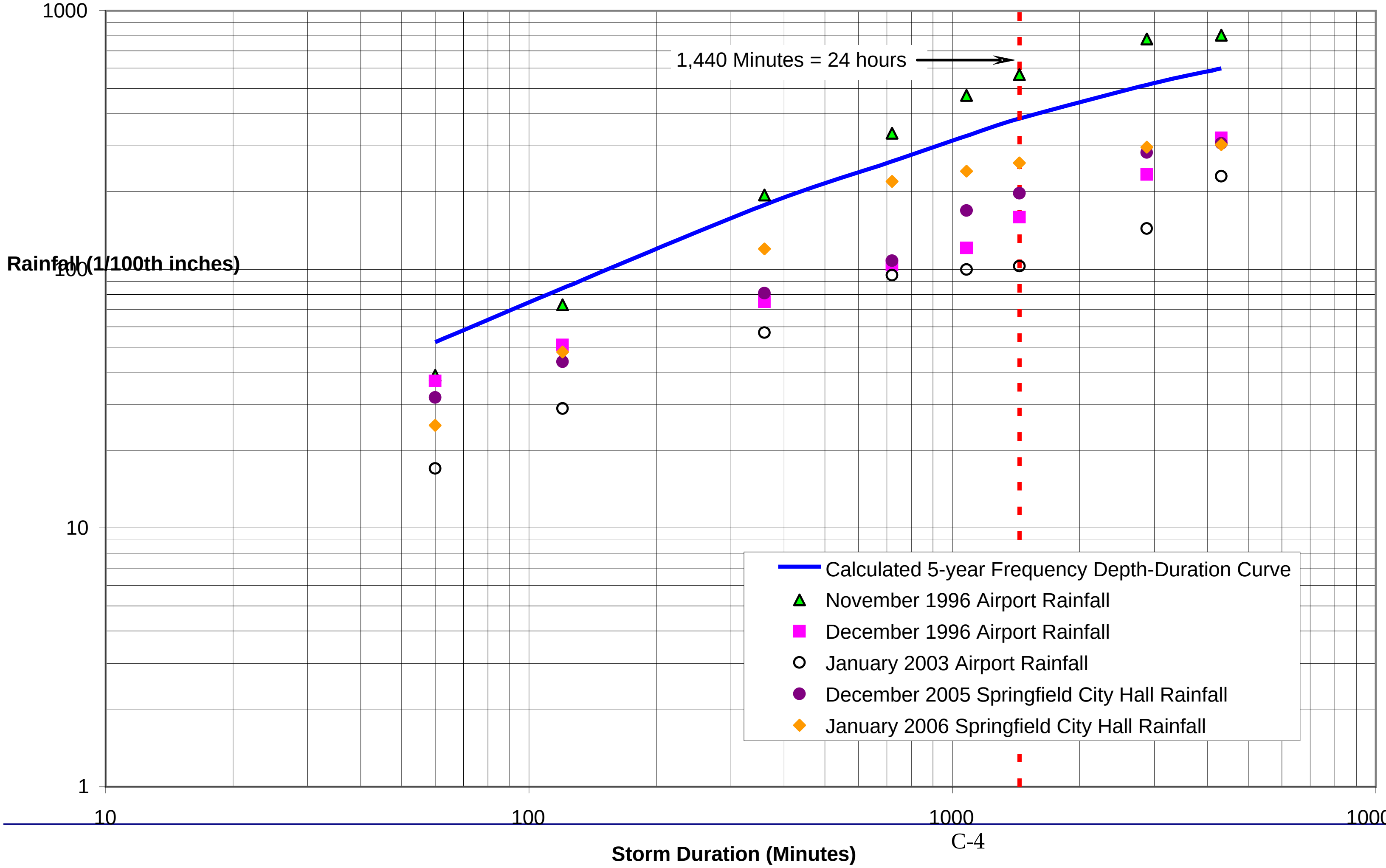


Figure C-2. Comparison of Historic Rainfall Events and 5-year Frequency Wet Season Depth-Duration-Frequency Curve Based on 1948-2005 Eugene Airport Annual Maximums



Appendix D – Calibration Hydrographs for Monitoring Basins

Appendix E – Regression Plots

Appendix F – Inventory Data by Monitoring Basin

Appendix G – Detailed Cost Data for Capital Improvement Projects