Stormwater Management Strategic Plan

City of Santa Fe, New Mexico

CITY OF SANTA FE
RIVER & WATERSHED

Contents

Acknowledgments 2
Executive Summary 5
Chapter 1: Introduction 10
  Purpose & Goals of the Plan 11
Chapter 2: The Evaluation and Planning Process 12
  Background 13
  Existing Stormwater Management Program Evaluation 13
  Water Quality and Flood Modeling 17
  Strategy Development 17
Chapter 3: Stormwater Challenges & Evaluation Findings 18
  Stormwater Challenges 20
  Evaluation Findings 22
Chapter 4: Recommended Stormwater Strategies 35
  Revise Code of Ordinances 38
  Improve Program Management 40
  Create Equitable Rate Structure and Ensure Revenue 43
  Strengthen Stormwater Requirements for Private Development 47
  Integrate Innovative Stormwater Management into City Facilities & ROW 49
  Practice Good Housekeeping and Pollution Prevention at City Facilities 53
  Map and Manage Stormwater Infrastructure and Assets 54
  Educate Santa Fe Residents About Stormwater Management 57
  High Priority Strategies Index 58

ACKNOWLEDGMENTS

Acknowledgments

Governing Body:

Alan Webber, Mayor
Signe Lindell, City Councilor District 1
Renee Villarreal, City Councilor District 1
Carol Romero-Wirth, City Councilor District 2
Peter Ives, City Councilor District 2
Chris Rivera, City Councilor District 3
Roman ‘Tiger’ Abeyta, City Councilor District 3
Mike Harris, City Councilor District 4
JoAnne Vigil Coppler, City Councilor District 4

City Staff:

John Alejandro, Sustainability Coordinator*
Erick Aune, Transportation Planner
Dee Beingessner, Engineer
Noah Berke, Planning and Policy Administrator
Matthew Brown, Economic Development Director
Sam Burnett, Project Administrator Facilities
Rick Carpenter, Water Resources and Conservation Manager
Rob Carter, Parks and Recreation Director*
David Catanach, Streets and Drainage Director*
Porfirio N. Chavarria, Wildland Urban Interface Specialist
Christine Chavez, Water Conservation Manager
Halona Crowe, Water Utility Billing Dept.
Andrew Erdmann, Water Reuse Coordinator
Brad Fluetsch, Cash & Investment Manager
Caryn Fiorina, Water Utility Billing Director
Lee Gagnon, Water Division Project Manager Asset Management
Greg Gallegos, Wildland Superintendent
Teresita Garcia, Assistant Finance Director
Lawrence Garcia, Environmental Services
Kathleen Garcia, Wastewater Engineer
Jon Griego, Land Use Enforcement
Caryn Grosse, Water Conservation Specialist*
Michelle Gutierrez, Stormwater Department Compliance
Stan Holland, Wastewater Engineer
Alan Hook, Water Resources Coordinator
Carol Johnson, Land Use Department Director
Shannon Jones, Utilities Division Director
Robert Jorgensen, Engineer
Adam K. Johnson, Finance Director*
Christina Keyes, Treasury Officer
Jason Kluck, Project Administrator Facilities
Marie Lee, Budget Officer*
Reed Liming, Long Range Planning Director
Ladd Lucero, Project Manager, Street Cut Permits
Alan MacGregor, Wastewater Engineer Supervisor
Boguslaw Malecki, IT Director
Renee Martinez, Deputy City Manager
Lisa Martinez, Land Use Director*
Erica Martinez, Senior Financial Analyst
Javier Martinez, Streets and Drainage Maintenance Division
James A. Martinez, Traffic Engineering Supervisor
Mary McCoy, Finance Department Director
Melissa McDonald, River Watershed and Trails Coordinator
William Montoya, Project Manager
William Moore, Land Use Senior Engineering Tech/Enforcement
Katherine Mortimer, Planner (Green Codes/WERS)
Mike Moya, Transmission and Distribution Manager
Chris Ortiz, Parks Supervisor
Leroy Pacheco, River Watershed and Trail Supervisor
Leonard Padilla, GIS Analyst
David Pfeifer, Facilities Director*
David Pike, Stormwater Department Enforcement Officer
Alex Puglisi, Source of Supply/Environmental Compliance
David Quintana, Streets and Drainage Division Section Supervisor*
Robert Rodarte, Purchasing Director*
Oscar Rodriquez, Finance Department Director*
John Romero, Engineering Division Director
Enrico Ruiz, Parks Supervisor

Joshua Sammons, GIS Analyst
Augustine Sanchez, Streets Supervisors
Nick Schiavo, Water Division/Acting Public Works Director
William Schneider, Water Reuse Coordinator
Shirlene Sitton, Environmental Division Director
Brian Snyder, City Manager*
Curt Temple, Project Administrator
Richard Thompson, Parks Department Director
Mark Tibbets, MPO Transportation Planner
Lynette Trujillo, HR Director*
Lee Ann Valdez, Project Administrator Facilities*
Gary Varela, Parks Supervisor
Ed Vigil, Property Manager
Regina Wheeler, Public Works Director
Keith Wilson, Transportation Planner
Jean Woods, Information Technology Business Liaison
R.B. Zaxus, Land Use Engineer*

*Former title

External Stakeholders:

Tyler Ashton, Wilson & Associates
Nate Downey, PermaDesign, Inc
Kenneth Francis, Surroundings, Landscape Architect
Michael Gomez, Engineer, Santa Fe Engineering
Sterling Grogan, Citizen Conservationist
Oralynn Guerreortiz, DesignEnginuity, Engineering Consultant
Jim Hays, Home Builder
Claudia Horn, Landscape Architect
Aaron Kaufman, Consultant & Water Conservation Committee
Tim Michael, Santa Fe Water Conservation Committee
Andy Otto, Santa Fe Watershed Association
Rich Schrader, RiverSource, Educator/Consultant
Melynn Schuyler, Youthworks
Jim Siebert, Siebert & Assoc.
Beverley Spears, Architect/Arroyo Advocate
Brad Sumrall, Weston Solutions, Inc
Daniel Werwath, Affordable Housing Advocate
Jan-Willem Jansens, Stormwater management/Forester/Planner

Committees & Other Organizations:

City of Santa Fe River Commission
City of Santa Fe Water Conservation
MS4 Collaborative
Santa Fe Watershed Association
Sustainable Santa Fe

Santa Fe County:

Claudia Borchert, Santa Fe Sustainability Coordinator
Paul Kavanaugh, Building and Development Services Supervisor
Maria E. Lohmann, Santa Fe County Community Planner
Vicki Lucero, Building and Development Services Manager
Jacob L. Stock, Santa Fe County Infrastructure Planner

Consultant Team:

Kristin Dors, Tetra Tech
Troy Dorman, Tetra Tech
Jesse Roach, Tetra Tech
Rosemary Romero Consulting
Rick Schaefer, Tetra Tech
Christy Williams, Tetra Tech

Environmental Protection Agency Team:

Jake Albright, PG Environmental
Ellie Baker, Horsley Witten Group
Joanna Kind, Environmental Scientist, Eastern Research Group, Inc
Jamie Piziali, EPA/Office of Water/Stormwater Team
Rachel Urban, EPA/Office of Water/Stormwater Team

Photo Credits:

City of Santa Fe
Railyard Park Conservancy
Santa Fe Watershed Association
Southwest Urban Hydrology

EXECUTIVE SUMMARY

USEPA Region 6 regulates urban stormwater through the National Pollution Discharge Elimination System Municipal Separate Storm Sewer System Permit program. For more information, visit https://www.epa.gov/npdes/stormwater-discharges-municipal-sources.

Executive Summary

Santa Fe's excellent quality of life is renowned in the region and across the country; and water–in the river, in the ground, and falling from the sky–is a crucial part of creating the "human habitat" that makes Santa Fe unique. In the fragile high-desert environment to maintain a sustainable ecosystem and the quality of life residents expect, the City needs to be proactive and use all available water resources. Further, the City is required by a permit issued by the U.S. Environmental Protection Agency (USEPA) to manage the discharge of stormwater to minimize the pollution of the Santa Fe River. This permit will be reissued in 2018, and the City anticipates additional, more prescriptive requirements. USEPA compliance audits are typical after the issuance of a new permit. A changing climate and these new regulatory requirements necessitate a broader view of how the City manages stormwater runoff, which has historically been regarded as a nuisance. In addition, stormwater is now seen as a valuable resource with unrealized opportunities.

In the 1990s, the City of Santa Fe began requiring private developers to mitigate off-site erosion by detaining stormwater on-site; however, current research indicates that this approach can be enhanced by infiltrating rainwater into multifunctioning landscapes. Infiltrating rainwater into green infrastructure and low impact development stormwater controls provides numerous water-related benefits beyond preventing erosion such as water quality treatment and aquifer recharge. In addition, vegetation supported by the infiltration of stormwater can be used in multifunctioning landscapes to:

- Encourage walking and biking by providing shade and traffic calming,
- Clean urban pollutants from the air,
- Reduce the urban heat island effect,
- Provide wildlife habitat and migration corridors,
- Improve residents' overall sense of well-being,
- Improve health outcomes of the ill,
- Increase property values,
- Support commercial retail and restaurant businesses,
- Reduce crime, and

- Reduce the need for irrigation, thereby reducing potable water treatment and distribution costs and associated energy usage.

These benefits align directly with goals established in the *Sustainable Santa Fe 25-Year Plan*, *Parks, Open Space, Trails & Recreation Master Plan*, and *City of Santa Fe Land Use & Urban Design Plan.*

In 2016, recognizing the value of these benefits, the City Council passed Resolution No. 2016-25 directing the City Manager to develop a program that updates the City's stormwater management policies in furtherance of the City's environmental protection and sustainability policies and goals. Chapter 3 describes in detail the directives contained in this resolution.

In response to this resolution, the Santa Fe River, Watershed, and Trails Division of Public Works drafted a report titled *An Infiltration Model for Enhanced Stormwater Management: A Preliminary Report for the City of Santa Fe, New Mexico*. The report endorsed the new model for managing stormwater, which encourages the infiltration of rainwater rather than allowing it to run off and provided a set of recommendations as a starting point to ensure the new model was successful. These recommendations serve as the foundation for this *Stormwater Management Strategic Plan*.

In 2017, the River, Watershed, and Trails Division applied for, and was awarded, a USEPA technical assistance grant. USEPA provides long-term stormwater management planning assistance to communities across the country. Santa Fe is one of five communities working with USEPA to sync planned and future activities happening in the community to support long-term stormwater management planning. Also, in 2017, the City began a

12-month collaboration with USEPA to establish goals to support a long-term stormwater vision and to develop two specific elements necessary to sustainable long-term stormwater management planning – *A Guide to Incorporating Green Infrastructure into Roadway Projects in Santa Fe* and *Government Funding Opportunities for Stormwater Management in Santa Fe.* USEPA staff coordinated closely with the City's planning team. Chapter 2 details further the USEPA effort.

Resolution No. 2016-25 authorized the hiring of a third party to explore alternate stormwater management concepts, so in 2017, the City funded a comprehensive evaluation of the existing stormwater management program. This evaluation included a review of existing programs that play a role in stormwater management, an update of the City's existing drainage management plans, a fiscal analysis of budget and revenues, and an evaluation of current data and asset management processes.

The consultants and River, Watershed, and Trails staff (the planning team) spent more than a year conducting interviews, reviewing existing documentation, and conducting analyses. Staff from the following departments were interviewed during the evaluation: Finance, Information Tech and Telecommunications, Land Use, Parks and Recreation, Public Utilities, Public Works, and the Santa Fe Metropolitan Planning Organization. In addition, the team reviewed a variety of documents, including the City's existing stormwater discharge permit, the Middle Rio Grande general permit, the City's recent annual reports to USEPA, the City of Santa Fe Municipal Code, and the Sustainable Santa Fe plan. During the fiscal analysis of stormwater fees and budget, the team reviewed operating budgets, annual reports, capital improvement plans, and other documentation of the stormwater program and related City divisions engaged in the design, construction, maintenance, and operation of stormwater facilities and services. The team inventoried existing asset management approaches in different departments in the City and conducted interviews with relevant staff.

The team conducted modeling for water quality and flooding in the Santa Fe River and Arroyo de los Chamisos watersheds to better assess flooding conditions, erosion, and pollutant loading and to determine locations for improved stormwater management controls. The City will be able to use the resulting model in the future to prioritize stormwater management controls based on benefits and costs. The team inventoried and evaluated existing datasets and created new datasets that will help guide the continued development of modeling tools.

Chapter 2 describes the evaluation processes in greater detail.

The team identified deficiencies that were either possible permit noncompliance or program inefficiencies or both. These deficiencies are described in Chapter 3. These findings and themes were then presented to an internal stakeholder group for review during a facilitated meeting. The group prioritized the themes and developed a set of recommendations for turning the deficiencies into opportunities:

- Revise Code of Ordinances
- Improve program management
- Create equitable rate structure and ensure revenue
- Strengthen stormwater requirements for private development
- Integrate innovative stormwater management into City facilities and rights-of-way
- Practice good housekeeping and pollution prevention at City facilities
- Map and manage stormwater infrastructure and assets
- Educate Santa Fe Residents about stormwater management

Chapter 4 discusses these recommendations in detail in addition to specific implementation strategies which will provide residents with multiple valuable benefits as well as helping to ensure long-term program viability and regulatory compliance.

CHAPTER 1: INTRODUCTION

Chapter 1: Introduction

In 2016, the Santa Fe City Council passed Resolution No. 2016-25 directing the City Manager to develop a program to update the City's stormwater management policies in furtherance of the City's environmental protection and sustainability policies and goals. This plan is the culmination of the work done by the City to date in response to that directive.

Purpose & Goals of the Plan

In 2016, the Santa Fe City Council passed Resolution No. 2016-25 supporting the use of infiltration through green infrastructure and low impact development controls–on public and private lands. Based on this resolution, a planning process was initiated, and this *Stormwater Management Strategic Plan* is the result of that process. This plan serves as a roadmap for decision makers to use to institutionalize a proactive, compliant, and sustainable stormwater management philosophy based on the infiltration model. It will guide decision makers toward maintaining compliance and implementing policies that will not only protect but also enhance Santa Fe residents' quality of life.

To this end, the Plan has three broad goals:

1. Build on prior work and use staff input to maximize program opportunities and eliminate program redundancies.
2. Ensure compliance with existing and anticipated regulatory requirements.
3. Proactively support existing City goals by incentivizing or requiring the use of multifunctioning landscapes on private and public land.

CHAPTER 2: THE EVALUATION AND PLANNING PROCESS

Chapter 2: The Evaluation and Planning Process

Background

In 2016, the Santa Fe City Council passed Resolution No. 2016-25 directing the City Manager to develop a program to update the City's stormwater management policies in furtherance of the City's environmental protection and sustainability policies and goals.

In response to this resolution, the Santa Fe River, Watershed, and Trails Division of Public Works drafted a report titled *An Infiltration Model for Enhanced Stormwater Management: A Preliminary Report for the City of Santa Fe, New Mexico*. The report endorsed a new model for managing stormwater, which encourages the infiltration of rainwater rather than allowing it to run off and provided a set of recommendations as a starting point to ensure the new model was successful. These recommendations serve as the foundation for this *Stormwater Management Strategic Plan*.

Resolution No. 2016-25 authorized the hiring of a third party to explore alternate stormwater management concepts, so in 2017, the City funded a comprehensive evaluation of the existing stormwater management program. This evaluation included a review of existing programs that play a role in stormwater management, an update of the City's existing drainage management plans, a fiscal analysis of budget and revenues, and an evaluation of current data and asset management processes. The results of this evaluation were used to develop strategies necessary to have a compliant, efficient, and effective stormwater management program.

This chapter describes the evaluation process in detail.

Existing Stormwater Management Program Evaluation

The consultants and River, Watershed, and Trails staff (the planning team) spent more than a year conducting interviews, reviewing existing documentation, and conducting analyses.

Interviewed Departments:

Public Works

- Facilities
- Engineering
- Streets/Drainage Maintenance

Land Use

- Building Permits
- Current Planning
- Technical Review
- Inspections/Enforcement

Parks and Recreation

Public Utilities

- Environmental Services/Solid Waste
- Wastewater
- Water
- Sustainable Santa Fe
- Keep Santa Fe Beautiful

Finance

- Budget

Information Technology & Telecommunications

- Infrastructure Services

Metropolitan Planning Organization

The program evaluation had two primary objectives:

- To determine how the City needed to refine existing programs to ensure compliance with the existing MS4 permit and the new requirements anticipated in the reissued permit
- To identify any operational and administrative inefficiencies, redundancies, or opportunities for improvement

Over three consecutive days, the team conducted individual and group interviews of nearly thirty staff members from City departments. Staff involved with stormwater management were asked questions that delved into a variety of administrative, organizational, and technical topics such as the following:

- Program management, specifically staffing, communication, and coordination
- Legal authority and enforcement mechanisms
- Facilities planning, operation, and maintenance
- Regulation of development projects–both during and after construction
- Practices used to prevent illicit discharges into the storm sewer system

The team also reviewed a variety of documents, including the City's existing stormwater discharge permit, the Middle Rio Grande general permit, the City's recent annual reports to USEPA, and the *Sustainable Santa Fe Plan*.

In addition to this comprehensive review, the team conducted more focused reviews of the City's municipal code, budgets and revenues, and asset management processes.

Municipal Code Review

The team conducted a thorough review of the City's municipal code to identify revisions necessary to comply with the draft USEPA MS4 Permit, to address findings of the stormwater management program evaluation, and to eliminate stormwater management implementation barriers.

The team developed a redline version of the pertinent sections of code and summarized the 10 primary recommended revisions with associated rationale. Revisions were proposed for the following code sections and are summarized in Chapter 3:

- Chapter 13 Stormwater Utility
  - Article 13-1 Stormwater Utility Service Charge
  - Article 13-2 Stormwater Illicit Discharge Control
- Chapter 14 Land Development
  - Article 14-8 Development and Design Standards
    - Section 14-8.2 Terrain and Stormwater Management
    - Section 14-8.3 Flood Regulations
    - Section 14-8.4 Landscape and Site Design
    - Section 14-8.5 Walls and Fences
    - Section 14-8.6 Off-Street Parking and Loading
    - Section 14-9.1 General Purpose and Applicability
    - Section 14-9.2 Street Improvements and Design Standards
- Chapter 25 Water
  - Article 25-2 Comprehensive Water Conservation Requirements
    - Section 25-2.7 Outdoor Conservation

Financial Analysis

The team evaluated the budgets and revenues for the City's stormwater management program. The objective of the financial review and analysis was to develop a conceptual financial planning model to support strategic planning for the City's stormwater program.

The team also reviewed the current rate structure against alternative rate designs that can enhance equity between customer classes and that offer incentives in the form of rate adjustments and/or credits.

EPA Long-Range Planning Process

To complement the City's strategic planning effort, in 2017, the River, Watershed, and Trails Division applied for, and was awarded and accepted into a technical assistance program from USEPA to improve long-term stormwater planning at the community level. Santa Fe is one of five communities selected to participate in the technical assistance program throughout the country. In September 2017, USEPA, the City planning team, and the New Mexico Environment Department met to discuss long-term stormwater planning objectives and priorities. Participants took a tour of the City that highlighted Santa Fe's stormwater challenges and opportunities. The City and USEPA also hosted a public forum during which external stakeholders were invited to provide input on the long-term stormwater planning goals. An additional meeting was held with representatives from various City departments to discuss Santa Fe's stormwater-related challenges and a long-term stormwater vision, and to begin developing long-term goals.

Through the initial stakeholder engagement process, the City identified several specific goals for long-term stormwater planning, including expanding the use of green infrastructure and low impact development in public and private projects, developing reliable funding sources dedicated to the City's stormwater programs and projects, and aligning stormwater efforts with the City's broader responsibilities.

USEPA developed two documents to support the City's stormwater management strategic objectives: *A Guide to Incorporating Green Infrastructure into Roadway Projects in Santa Fe* and *Government Funding Opportunities for Stormwater Management in Santa Fe.*

The team reviewed operating budgets, annual reports, capital improvement plans, and other documentation of stormwater program financing within City divisions engaged in the design, construction, maintenance, and operation of stormwater facilities and services. Interviews were conducted with program staff and with the Public Works and Finance departments. Questions addressed current revenue sources, anticipated changes in the ratepayer base, alternative funding sources and the refinement of the current rate structure by improving equity, and providing credits for benefits and incentives to reduce stormwater impacts. Finally, City staff were questioned regarding available data that could be used to support such refinements.

The team produced a model that integrates the stormwater management program's forecasted costs (for operations, maintenance, and capital projects) with anticipated revenues (rate revenues, internal fund transfers, and external grant funds). To support the expansion of capital investment, the model's functionality provides for debt financing as well. Chapter 3 provides more details regarding the model's assumptions, limitations, and outcomes.

Asset Management

For a city, *asset management* is the process of maintaining a desired level of service at the lowest life cycle cost. *Lowest life cycle cost* refers to the best appropriate cost for rehabilitating, repairing, or replacing an asset. Asset management is implemented through an asset management program and typically includes a written asset management plan. Santa Fe does not currently have a formal asset management plan. As part of the strategic planning process, however, the team evaluated ways in which the City could improve asset tracking, operation, and maintenance while advancing watershed-based stormwater management outcomes. The team interviewed staff and evaluated existing asset management datasets and systems. City staff collaborated with the team to establish asset management goals and develop key recommendations in support of the *Stormwater Management Strategic Plan*. Chapter 4 details these recommendations.

Water Quality and Flood Modeling

The team conducted modeling in the Santa Fe River and Arroyo de los Chamisos watersheds to assess flooding conditions, erosion, and pollutant loading and to identify locations to implement improved stormwater management controls. The team also ensured that the model used in this effort could be used in the future to prioritize implemented controls based on benefits and costs.

The team inventoried and evaluated existing datasets, identified data gaps, and created new datasets to help guide the continued development of modeling tools. Data provided by the City was preprocessed using ArcMap. XPSWMM and LSPC models were built based on existing and field-collected data and used to update the Santa Fe River and Arroyo de los Chamisos drainage plans developed in the late 1990s.

The team interviewed staff, conducted site visits, and reviewed existing documents such as the Santa Fe Watershed Association 2016 *Arroyo Threat Assessment Report*. This information–in conjunction with model outputs–was used to recommend high-priority pilot project areas for green infrastructure projects as well as data acquisition needs, future modeling efforts, stormwater management program revisions, and water quality monitoring approaches.

The City hosted two external stakeholder input events to which local stormwater professionals and community advocates were invited to review and comment on the modeling process and

outcomes. The planning team used the input from these stakeholders to craft the final recommendations.

Strategy Development

Throughout the strategic planning process (i.e., evaluating and modeling the existing program), the team identified deficiencies that indicate either possible noncompliance with the USEPA MS4 permit, program inefficiencies, or both and made discrete findings that were collapsed into overall finding "themes" (see Chapter 3). The team then presented these findings and themes to an internal stakeholder group for review during a facilitated meeting. The group prioritized the themes and developed a set of proposed strategies for turning the deficiencies into opportunities (see Chapter 4).

Chapter 3: Stormwater Challenges & Evaluation Findings

Municipal Separate Storm Sewer System

An MS4 is a conveyance or system of conveyances that is:

- owned by a state, city, town, village, or other public entity that discharges to waters of the U.S.,
- designed or used to collect or convey stormwater (e.g., storm drains, pipes, ditches),
- not a combined sewer, and
- not part of a sewage treatment plant, or publicly owned treatment works (POTW).

Chapter 3: Stormwater Challenges & Evaluation Findings

The City of Santa Fe is faced with a number of stormwater management challenges that, with commitment, planning, and investment, can be turned into significant opportunities. Santa Fe, like other cities, provides certain services to residents, including the management of stormwater using the public rights of way and storm sewer infrastructure. Without proper management, runoff from storms can cause erosion of the arroyos, acequias, and Santa Fe River as well as carry pollution into the river that can impact ecological biodiversity. Further, uncontrolled stormwater can damage private property as well as public assets and infrastructure. With the use of proper management techniques, however, stormwater can be a resource for Santa Fe residents instead of a source of damage and pollution. In addition, because of the pollution potential, stormwater runoff from Santa Fe is regulated through the U.S. Environmental Protection Agency (USEPA) MS4 permit which requires control of the pollutants in the runoff.

This chapter summarizes the City's stormwater challenges and related evaluation findings, which highlight program inefficiencies and potential permit violations. As described in Chapter 2, a City internal working group prioritized the findings of the evaluation for action. The following sections present primary findings and identify each with an alphanumeric indicator. Narrative rationale follows each finding.

Chapter 4 describes the strategies recommended to address these challenges, meet permit requirements, and realize the multiple benefits that can be gained from stormwater control measures. By implementing controls required by the City's permit and other creative stormwater strategies identified in Chapter 4 of this plan, the City can manage stormwater as a resource rather than a nuisance.

High priority strategies to address the evaluation findings are identified in Chapter 4.

Total Maximum Daily Load

A TMDL establishes the maximum amount of a pollutant allowed in a waterbody and serves as the starting point or planning tool for restoring water quality.

Stormwater Challenges

Runoff from parking lots, rooftops, and roadways enters arroyos and the Santa Fe River via overland flow and the storm sewer system. The volume and velocity of this water cause erosion, and pollutants carried by the runoff can pollute waterways. According to the *State of New Mexico Clean Water Act Section 303(d)/Section 305(b) Integrated List and Report*, the Santa Fe River is currently impaired because of excessive sediment and nutrients (stream bottom deposits), bacteria (*Escherichia coli* [*E. coli*]), and high temperatures.

To address these impairments, the New Mexico Environment Department has developed total maximum daily loads (TMDLs) for the river that require reductions in pollution. The City is required to reduce the amount of harmful bacteria in stormwater runoff. These requirements are implemented via the City's existing MS4 permit in addition to other minimum control measures to minimize pollutants in stormwater. These minimum measures include construction site stormwater runoff controls, post-construction stormwater management in new developments, pollution prevention and good housekeeping at municipal operations, illicit discharge controls, control of floatables, public education and outreach, and public involvement and participation. USEPA requires all of these controls to ensure that the City is adequately managing stormwater to prevent impacts on receiving waters.

While the City is growing at a relatively slow pace, every new development brings additional impervious surfaces with the potential to cause additional damage to waterways. The more pavement, rooftops, and driveways there are, the more stormwater will be generated during storms that the City must manage.

The City is regulated under NPDES MS4 Permit No. NMR040000 currently, but anticipates a new, more prescriptive permit by the end of 2018.

In addition, research shows that climate change will result in warmer temperatures and droughts in the Santa Fe region in the future, as well as heavier rain events. These events, such as the one that occurred on July 23, 2018, may result in more flooding and erosion of the arroyo systems and discharge of pollutants to the Santa Fe River if stormwater is not adequately managed on private and public properties. The City's storm sewer infrastructure is facing increased pressure from storms and the creation of new impervious surfaces.

Finally, while the City is a leader in water conservation efforts, the 2015 *Santa Fe Basin Study*[1] identified a future unmet water supply demand of 5,000–9,400 acre-feet in the year 2055 if no additional steps are taken to either reduce demand or augment current supplies. Irrigation water for landscaping is a major source of demand in the City of Santa Fe; this demand could be offset through stormwater infiltration practices and infiltration of rainwater to recharge groundwater supplies.

Santa Fe's stormwater challenges are more accurately characterized as water challenges–how to manage rainfall, ensure adequate supply, and protect groundwater and surface water resources from pollution in a cost-effective and compliant manner. These challenges and associated permit requirements formed the basis of the evaluation findings detailed in this chapter.

In April of 2007, the Santa Fe River was named America's Most Endangered River by American Rivers, a Washington, DC-based advocacy group. In June 2007, the New Mexico Heritage Preservation Alliance named the Santa Fe River as one of the state's 12 most endangered places.

[1] https://www.usbr.gov/watersmart/bsp/docs/finalreport/SantaFe/Santa-Fe-Basin-Final.pdf

Evaluation Findings

Legal Authority

Effective stormwater management starts with having the authority to conduct a program. City codes must allow staff to set and enforce stormwater requirements. The draft, more prescriptive MS4 permit requires that the City have adequate legal authority to control stormwater discharges.

The City's legal authority to require implementation of stormwater management measures is contained in three main chapters of the Santa Fe Code of Ordinances: Chapter 13, *Stormwater Utility*; Chapter 14, *Land Development*; and Chapter 25, *Water*. The team reviewed these chapters of the Code and recommended revisions either because (1) the draft USEPA Small Municipal Separate Storm Sewer System Permit No. NMR040000 requires municipal code updates or (2) code updates were necessary to address findings of the stormwater management program evaluation.

LA-1	**Overall, the Code contains inadequate active construction best management practices, post-construction stormwater management performance standards, and enforcement authority for stormwater management.**

The Code does not currently require development projects to meet a retention performance standard for post-construction stormwater management. The draft MS4 permit requires that this standard be applied to all projects of one acre or larger (Part I.D.5.b.). Applying this standard will support the use of low-impact development techniques on private development projects.

The Code does not currently require that new development projects treat stormwater to remove sediment prior to discharge to the City's storm sewer. This requirement is not included in the draft MS4 permit; however, reducing the discharge of sediment to the storm sewer will improve water quality in the river and will reduce the City's infrastructure maintenance needs (i.e., catch basins and storm sewer pipes).

The existing Code does not specify requirements for the long-term operation and maintenance of stormwater management controls on private development projects and

Predicted Climate Change Effects for the Santa Fe Watershed

According to the Santa Fe Watershed Association's *Forest and Water Climate Adaptation, A Plan for the Santa Fe Watershed*, the projected changes in volume and timing of available water from the Santa Fe Watershed include:

- 11-18% decrease in stream flow above the City's McClure Reservoir by 2060.
- 20-70% reduction in March snowpack by 2050, and up to 100% reduction by 2070.
- Reduction of Middle Rio Grande water of 14% by 2030, and 29% by 2080.
- Spring snowmelt runoff 15-35 days earlier, resulting in the McClure and Nichols reservoirs filling quickly or overflowing in the spring, and less water available overall during summer.
- Increased risk of catastrophic forest fires and resulting soil erosion into reservoirs.
- Higher frequency of spring floods from more violent and heavy thunderstorms, resulting in more property damage.

does not require property owners to proactively inspect the controls to optimize performance. The draft MS4 permit requires that the City have procedures for site inspection and enforcement to ensure proper long-term operation, maintenance, and repair of stormwater control measures. Further, City staff indicated that failing stormwater control measures on private property are a significant administrative and maintenance burden. If controls fail, the City's only recourse is to use City staff and equipment to make the necessary repairs and then bill the property owner. This practice has proved to be inefficient and costly.

There are no administrative penalties available to City staff when enforcing stormwater-related code violations. Having only civil or criminal monetary penalty options limits inspection staff's ability to quickly address noncompliance due to illicit discharges. The Code does not contain adequate enforcement actions to address stormwater management violations during active construction. Enforcement actions such as stop work orders or revoking a project's grading permit are typically quite effective during active construction and are integral to a typical enforcement escalation procedure for construction-related stormwater violations.

The Code does not currently require that large projects phase land disturbance (i.e., grading) to help control dust and surface erosion during rain events. The existing Code indicates that phasing may be required on projects at the discretion of the city engineer; however, having a standard phasing requirement ensures that developers will automatically plan a project in this way, rather than having to adjust after submittal of a preliminary plan. During interviews, staff indicated that large, unphased projects have caused considerable dust and runoff issues in the past.

Adequate temporary site stabilization requirements are not included in the current Code. It does not include a timeframe for using temporary stabilization or require that stockpiles be protected daily.

Low-impact development (LID) techniques are site-scale strategies that use infiltration, evapotranspiration, and use of stormwater to manage runoff on development sites. LID techniques can reduce the impact of built areas and promote the natural movement of water within a watershed. Many LID techniques—such as rain gardens, infiltration basins, bioswales, curb cuts, and permeable pavements–use the infiltration model to manage stormwater. Santa Fe encourages the use of native, drought-tolerant plantings to promote infiltration in LID techniques.

During interviews staff indicated there are significant issues with managing dust and runoff during construction caused by unprotected bare areas and stockpiles.

Finally, the City does not currently specify either in the Code or in any related policy the enforcement escalation procedures for addressing noncompliance recidivism. The draft MS4 permit requires that the City have enforcement escalation procedures in place.

Program Management

City governments have a responsibility to residents to protect natural resources and public property through their programs and practices in an efficient, cost-effective manner. A supported and institutionalized organization structure is necessary to implement a compliant and sustainable stormwater management program. Further, because of the diverse impacts of stormwater in Santa Fe, many departments are involvement in its management, making communication among these departments critical to program success.

PM-1	**The City has a diffuse program management structure that assigns significant stormwater program management responsibility to the River, Watershed, and Trails/ Stormwater Section within the Engineering Division of the Public Works Department and distributes implementation responsibilities across multiple City departments.**

Currently, dedicated stormwater operation and maintenance staff are housed in the Streets and Drainage Division of Public Works. While this division does address some drainage issues within the right-of-way, the draft MS4 permit requires that stormwater management be implemented on all City facilities and on private parcels as well. As demonstrated by the wide variety of staff that participated in the program evaluation, stormwater management responsibilities span many departments (see Figure 1 for an organizational chart which includes all departments which have a stormwater management role). The proper positioning of stormwater staff and clarity of roles within the City organization is critical to ensure necessary management support and interdepartmental coordination.

Distributing water-related compliance and management requirements among a variety of departments may be resulting in permit noncompliance and inefficient use of resources. For example, interviews revealed that both the Land Use Department and the River, Watershed, and Trails/Stormwater section staff are conducting inspections of active development projects that are larger than one acre.

Because the City does not have established level of service (LOS) goals for stormwater management (see Asset and Data Management), existing staff job descriptions do not adequately address stormwater management responsibilities. Based on staff interviews and a review of existing job descriptions, many staff are unclear on their roles in MS4 permit compliance.

PM-2	**Inadequate communication among departments regarding water-related permit requirements could make the City vulnerable to permit noncompliance and could limit partnerships and cooperation that could be financially beneficial to the City.**

The City does not have an internal stormwater management committee or organization chart to identify staff responsible for various permit-required responsibilities. In addition, there is no response tree for stormwater-related issues identified by the public or in the field. For example, interviews indicate that many staff do not know who the appropriate people are to call to remedy stormwater issues that may arise, particularly with regard to arroyo management.

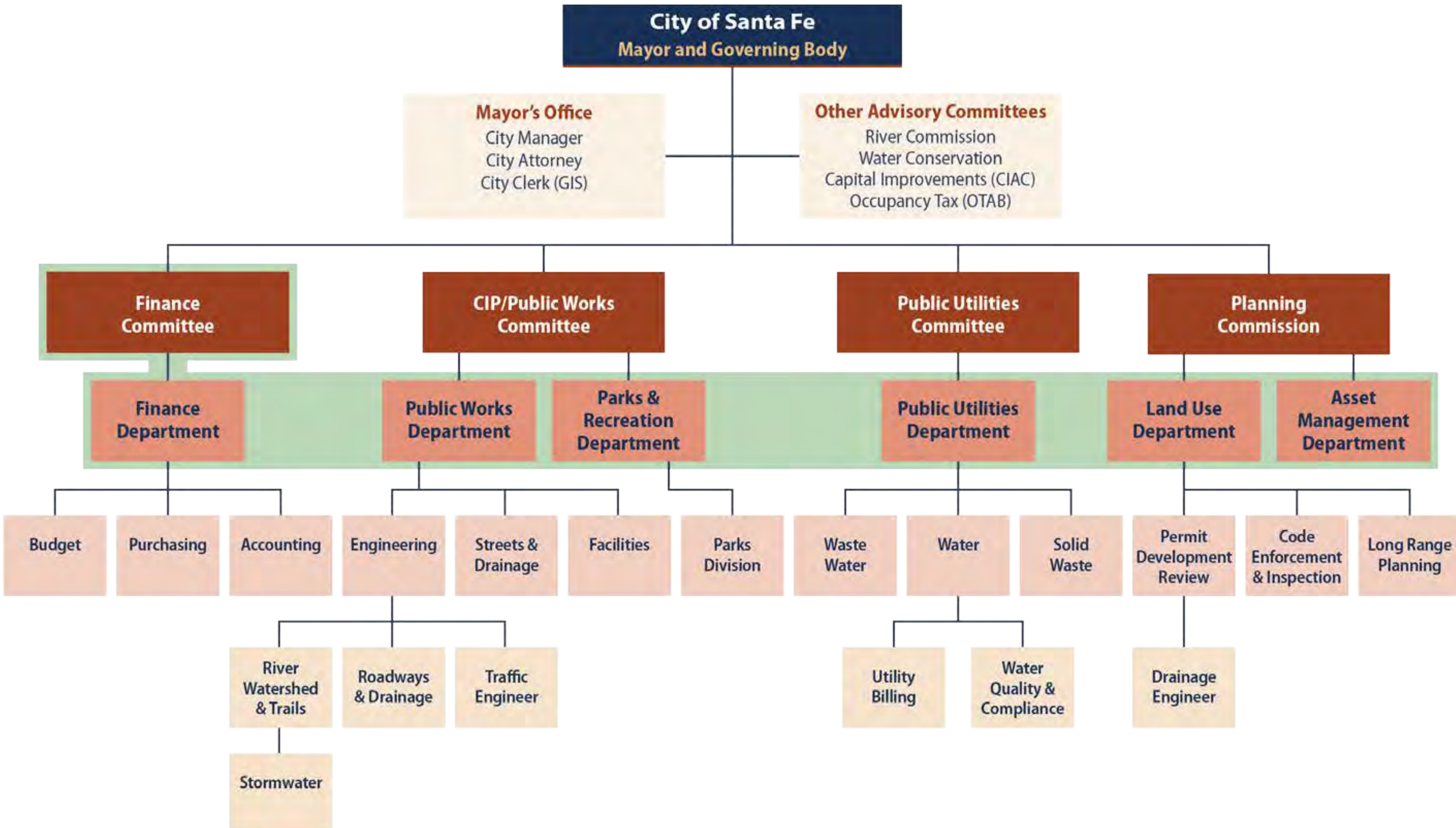


Figure 1 Organizational Chart

Of particular concern is the lack of coordination between stormwater staff and pretreatment staff on regulating pumped groundwater. Currently, the City has no formal process for requiring pumped groundwater to be permitted and discharged to the sanitary sewer unless the discharger samples to confirm no contamination exists.

In addition, stormwater staff are not consistently included in City asset management activities and facilities planning as necessary to ensure permit compliance and efficient use of resources.

Revenues and Expenditures

To ensure that programs are implemented in a cost-effective manner, it is essential that expenditures are planned and tracked and that a stable source of revenue is available to ensure permit compliance.

RE-1	**The present rate of revenue generation by the Stormwater Utility Service Charge Fee ("utility fee") is not sufficient to sustain the current scope of the stormwater program, and the scope of stormwater activities will necessarily expand to achieve regulatory compliance and meet other identified needs.**

Stormwater-related expenditures have varied over recent years (Figure 2). Expenditures budgeted for the current fiscal year ($2,082,930) exceeds the estimated annual revenues of $1,570,000 generated by the Stormwater Utility Service Charge Fee. The Storm Water Fund 21401 has a projected fiscal year-end balance of $973,474. At the current pace of revenues and expenditures, the balance surplus will be fully depleted during FY19/20.

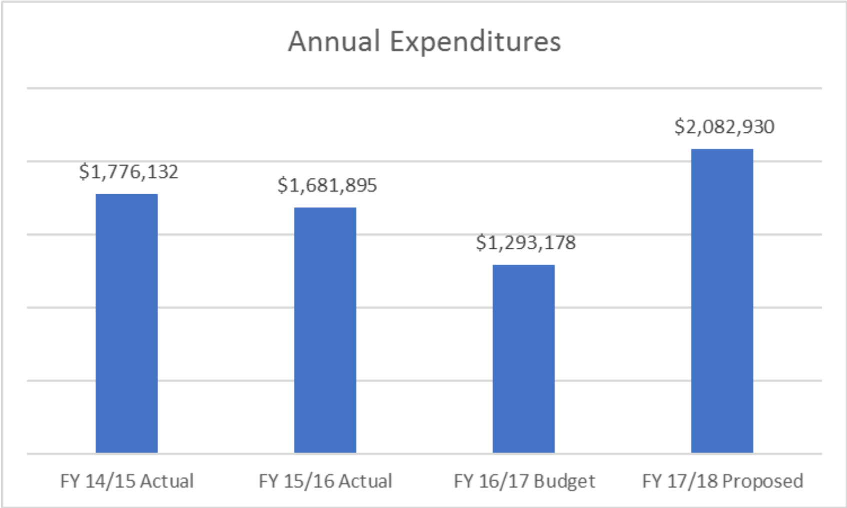


Figure 2 Annual Stormwater Expenditures

While many stormwater assets are built by private developers and accepted by the City as public infrastructure, some are built by the City using the general fund and the utility fee. Storm drain system maintenance is performed by the Streets and Drainage Maintenance Division of Public Works and by the Parks Department. This work involves cleaning storm drainage pipes, culverts, and catch basins; routine repairs and minor capital improvements; vegetation management in arroyos and roadway medians; erosion repairs and sediment management; and storm recovery (clearing debris).

The scope of stormwater-related activities will expand to meet pending regulatory obligations anticipated in the draft MS4 permit and to address other operating and capital needs. (Many of these requirements are described later in this chapter.) These activities will require additional revenues beyond the currently allocated funding resources.

Near-term priority actions that will require additional staffing and capital expense:

Capital Program

- Require stormwater control measures at new City facilities to meet the performance standard specified by the draft MS4 permit and flood control measures to also address water quality. This would affect capital budgets of departments constructing the facilities.

Operations & Maintenance

- Conduct post-construction stormwater facility inspection, maintenance, and operation consistently of City facilities.
- Consistently require and inspect erosion and sedimentation control practices on private development projects.
- Consistently require and inspect post-construction operation and maintenance on private stormwater control measures.
- Complete and maintain mapped inventory of public and private stormwater infrastructure assets.
- Develop and implement formal training on design, installation, and maintenance of post-construction stormwater controls.

Planning & Engineering

- Complete a comprehensive inventory of stormwater infrastructure needed for watershed modeling, siting water quality best management practices, determining monitoring locations, building an asset management program, and documenting maintenance concerns and compliance with MS4 program requirements.
- Complete a detailed impervious cover dataset based on the existing LiDAR data and new high-resolution aerial imagery acquired for support of several stormwater program elements, including watershed and system modeling, developing a runoff-based stormwater utility fee, and stormwater planning.
- Prepare and adopt refined stormwater system criteria addressing water quality, stream stability, sediment transport, and stormwater volume management.
- Update the water quality monitoring program to comply with the draft MS4 permit to both necessitate water quality data acquisition and analysis, and acquire runoff rate and volume measurements to verify watershed-scale modeling and local design parameters.

Greater levels of expenditures will be required to execute the City's obligations under the proposed MS4 permit and to plan and implement projects addressing flooding, erosion, and water quality.

Further, current policies do not provide direction or priorities to fund and implement projects and actions that improve drainage and water quality and do not clearly establish priorities for the expenditure of stormwater fee revenues.

RE-2 **The utility fee rate structure does not provide rate equity among customers, nor does it provide for incentives for beneficial on-site stormwater management practices.**

Utility fee charges are collected through the City's water utility billing system, as set forth in Santa Fe's Code of Ordinances Chapter 13, *Stormwater Utility*. The charges are based on a flat monthly rate (see Table 1), with charges assigned to customers based on the size of the water meter serving the property.

There is little to no nexus between water meter size and a property's contribution of runoff volume, rate, or quality that define a parcel's "demand" for stormwater service. This produces a low level of equity across customer classes and among individual customers. As an example, a parcel occupied by a large parking lot, which does not have a water service, does not receive a charge for the stormwater it generates; whereas a residence with a relatively small footprint is charged a fee.

Further, the present structure of the utility fee is inflexible, with no basis for extending incentives or credits to customers for taking measures to reduce the rate or volume of storm runoff or to improve runoff water quality.

Table 1. Current Stormwater Utility Rate Structure Charges

	Meter Size	Service Charge
Residential	All meters	$3.00
Commercial	5/8-inch	$3.00
	3/4-inch	$4.50
	1 inch	$7.50
	1½ inch	$15.00
	2-inch	$24.00
	3-inch	$46.80
	4-inch	$75.00
	6-inch	$150.00
	8-inch	$240.00

RE-3 **Certain activities of the stormwater program are continuous, ongoing functions and are not being reliably funded to meet City requirements or external regulatory obligations, or to ensure properly functioning infrastructure.**

As noted earlier, the City has occasionally supported selected stormwater projects and activities through other sources beyond the stormwater utility service charge, including the General Fund and outside grants. These are not reliable sources of funding. Activities such as storm sewer system maintenance and operation activities; administration; and reporting, planning, and enforcement activities should be funded through the service charge.

Private Property Stormwater Management

Construction sites can be significant sources of sediment, trash, and chemicals. Land-disturbing activities—land clearing, grading, building demolition, stockpiling, excavating, compaction, and earth moving—expose loose sediment, which increases erosion and sedimentation. In addition, cities are, by their nature, developed areas. They include a high percentage of impervious surfaces—buildings, parking lots, driveways, sidewalks, and roads—that generate much more runoff than when those same areas were open space. Requiring and incentivizing the reduction of new impervious cover on development projects and incorporating less impervious cover in public projects results in less stormwater for cities to manage.

The draft MS4 permit requires the City of Santa Fe to have a program to reduce the discharge of pollutants from active construction sites of one acre or more. In addition, the draft permit requires these same projects to be designed in a way that

minimizes water quality impacts after construction is complete. The following deficiencies were identified during the program evaluations. Both could be considered potential permit violations by USEPA if not properly addressed:

PPSM-1 | **Adequate erosion and sediment control practices are not consistently required on private developments.**

The City does not consistently include standard erosion and sediment control best management practice (BMP) requirements on construction project plan sheets and does not provide erosion and sediment control design guidance to engineers. This can lead to inadequate plans being submitted to the City for review.

The City does not use a standard checklist for review of grading plans. This can lead to inconsistent or inadequate plan review and could result in plans being approved that are not adequate to prevent discharges from construction projects.

The City does not require that drainage plans which detail stormwater control measures be kept on-site. This can make execution of required BMPs challenging for contractors and places an additional burden on City inspectors to explain requirements and to track any proposed or approved redline changes in the field.

Based on interview findings, the City does not consistently require final stabilization or removal of BMPs at the conclusion of projects. This can lead to active erosion after the project is complete.

PPSM-2 | **The City does not adequately require installation, operation, and maintenance of post-construction stormwater control measures on private development projects.**

As described previously in the Legal Authority section of this chapter, the City's current Code does not require development projects to meet water quality or channel protection performance standards for post-construction stormwater.

The City has not adopted design guidance or standards for designers to follow when incorporating stormwater management into site plans and does not consistently require preliminary plan review meetings to discuss stormwater management requirements. Stormwater management planning should occur early in the project development process to ensure proper placement and budgeting for installation and maintenance during construction.

Staff do not use checklists consistently to review site plans for compliance with post-construction requirements.

The City does not consistently require that applicants submit operation and maintenance plans to address stormwater management controls on development projects after construction is complete. The City requires stormwater agreements for some private facilities that are recorded but does not require as-built certifications or maintenance of areas intended for passive harvesting. The Land Use Department does not include ponds or landscaping in warranty inspections for facilities being accepted by the City.

After construction is complete, the City does not consistently inventory or map privately owned stormwater management controls. Developers are not required to submit geographic information system (GIS) mapping data layers for stormwater management controls and infrastructure.

The City does not conduct proactive inspections of private facility stormwater control measures or require property owners to self-inspect. Stormwater control measures must be installed as designed and maintained correctly to operate as intended to protect water quality.

Public Property and ROW Stormwater Management

PPRW-1	**Post-construction stormwater management considerations are not consistently included in planning procedures for new City facilities.**

Facilities planning staff do not consistently involve stormwater staff in facility planning to ensure that adequate erosion control BMPs and post-construction controls are in place.

Stormwater staff are not consistently notified when projects are completed, so often inspections are delayed. It is critical to inspect projects near letting so adequate BMPs can be installed prior to land disturbance.

According to staff interviewed, requests for proposals do not consistently include erosion and sediment control and post-construction elements necessary to ensure that qualified vendors apply. As a result, subsequent contracts for City projects do not include obligations for installing or maintaining adequate erosion and sediment controls or mechanisms for withholding payments if not performed as contracted.

Staff indicated that budgets for erosion control and post-construction stormwater management on public projects can be inadequate, which makes requiring additional plan submittals or implementing different/additional controls during construction difficult. Further, facilities maintenance staff are not consistently included in the planning of facilities; therefore, potential problems associated with future maintenance may not be accounted for during design.

The City has not adopted road specifications or details for designing stormwater management facilities in the rights-of-way and at City facilities that meet the retention standards required by the draft MS4 permit. Further, the City is not currently designing and installing stormwater control measures that meet this standard at new City facilities.

The City does not currently have formal storm sewer infrastructure design criteria or a design manual. According to staff interviewed, however, the City requires all public infrastructure to be designed to carry the peak runoff during a 100-year storm 24-hour storm event, which aligns with the discharge standards currently applied to private development projects (see Santa Fe Code of Ordinances §14-8.2(D)(4)(b)). Applying this standard only addresses prevention of localized flooding during large storm events and does not address water quality, stream stability, sediment transport, or stormwater volume management. This standard also does not support the City's infiltration model of stormwater management.

PPRW-2	**Post-construction stormwater management considerations are not consistently included in capital improvement planning.**

The City is currently not targeting stormwater management capital improvement investments in the most appropriate areas based on results of flood control and water quality modeling and is not prioritizing green infrastructure strategies.

In addition, the draft MS4 permit requires that the City incorporate watershed protection elements into relevant planning documents–including capital improvement project plans–and include water quality criteria in the design of all flood control projects.

Good Housekeeping and Pollution Prevention

GHPP-1	**Staff are not conducting good housekeeping practices consistently at City facilities and during City activities.**

Good housekeeping and safe storage and handling practices are essential at places like corporation yards, fleet maintenance facilities, material storage depots, and police and fire stations to ensure that chemicals, dirt and gravel, and other potential pollutants do not contact rainfall or runoff. Covering stored materials, performing certain activities indoors, and training staff on spill control and clean up are just a few of the ways that cities can keep their facilities clean.

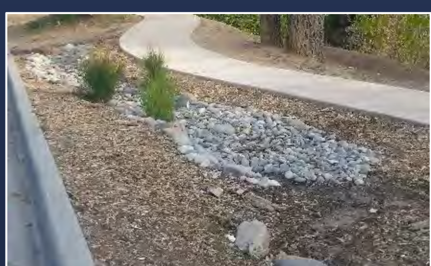
City facilities do not have facility pollution prevention plans or other documentation describing the BMPs being used to control pollution from facilities that house equipment, maintain vehicles, store deicer, and conduct high-priority activities.

Green infrastructure strategies mimic natural processes to infiltrate, evapotranspirate, or use stormwater on a regional scale to protect water quality. Green infrastructure uses plants, soils, and nature itself to manage stormwater and create healthier urban environments. Green infrastructure practices can be used to reduce the need for expensive gray infrastructure—pipes, storage facilities, and treatment systems—because plants and soils soak up, store, and use the rainwater. Green infrastructure can also recharge groundwater. Communities also can use green infrastructure to provide flood protection, cleaner air and water, and more appealing transportation corridors and outdoor spaces. Examples of green infrastructure strategies are green streets, infiltration buffers, managed open space, river-corridor improvements, and wetlands/bosques.

Low impact development (LID) techniques are site-scale strategies which use the same processes to manage stormwater on development sites. LID techniques can reduce the impact of built areas and promote the natural movement of water within a watershed. Many LID techniques—such as rain gardens, infiltration basins, bioswales, curb cuts, and permeable pavements–use the infiltration model to manage stormwater.

Green Streets and Parking

Permeable pavement, bioswales, planter boxes, and trees integrated into street and parking lot designs to soak up and store stormwater and improve the pedestrian experience through shading and traffic calming.



Rain Gardens

Shallow, vegetated areas that collect and absorb runoff from rooftops, sidewalks, and streets using plants and soil. Versatile, attractive features that can be installed in almost any unpaved space. Also known as bioretention or bioinfiltration cells.

Permeable Pavements

Paved surfaces that let water soak into the ground, including pervious concrete, porous asphalt, and permeable interlocking pavers. They are particularly cost-effective where land values are high and where flooding or icing is a problem.

The City does not currently have standard operating procedures (SOPs) aimed at reducing pollutant discharges during activities with the potential to cause pollution such as snow removal, satellite storage of materials, and construction stockpile management.

GHPP-2 | **The City does not consistently include management of stormwater control measures in facility maintenance budgets and procedures.**

The City does not conduct proactive inspections of city-owned stormwater management controls to ensure they are operating as designed. As previously discussed, facilities maintenance staff are not consistently included in planning new facilities to inform designers of potential issues with maintenance of stormwater controls at the beginning of the project. According to staff interviewed, existing facility budgets typically do not include adequate maintenance funding for stormwater management facilities. This leads to lack of maintenance and stormwater management controls not operating as designed.

Currently, the Parks Department is responsible for all maintenance of public facilities and within the rights-of-way. Field staff and management interviewed indicated that the Parks Department currently is not staffed at the numbers or with the skill level necessary to effectively maintain stormwater management controls in medians and on other public lands.

Asset and Data Management

Asset management is maintaining a desired level of service for public assets at the lowest life cycle cost. Lowest life cycle cost refers to the most appropriate cost for rehabilitating, repairing, or replacing an asset. Asset management is implemented through an asset management program and typically includes a written asset management plan.

ADM-1 | **The City does not currently have a management plan for stormwater infrastructure and assets.**

The City of Santa Fe uses multiple asset management programs across the different departments. There are separate asset management needs and software programs for facilities, financials, human resources, utilities, and billing. No single system used by City of Santa Fe staff currently provides the functionality of a GIS interface for data with backend functions for billing, tracking changes, and creating system reports. Further, the City has not established lowest life cycle goals for stormwater management services provided and has not conducted an inventory of stormwater assets. This lack of data makes it impossible to integrate stormwater assets into the existing management structures. The City is currently not properly forecasting stormwater management activities necessary to meet levels of service and ensure adequate funding and staffing.

ADM-2	**The City has inadequate mapping and modeling of public stormwater management assets and the storm sewer system to ensure adequate maintenance and permit compliance.**

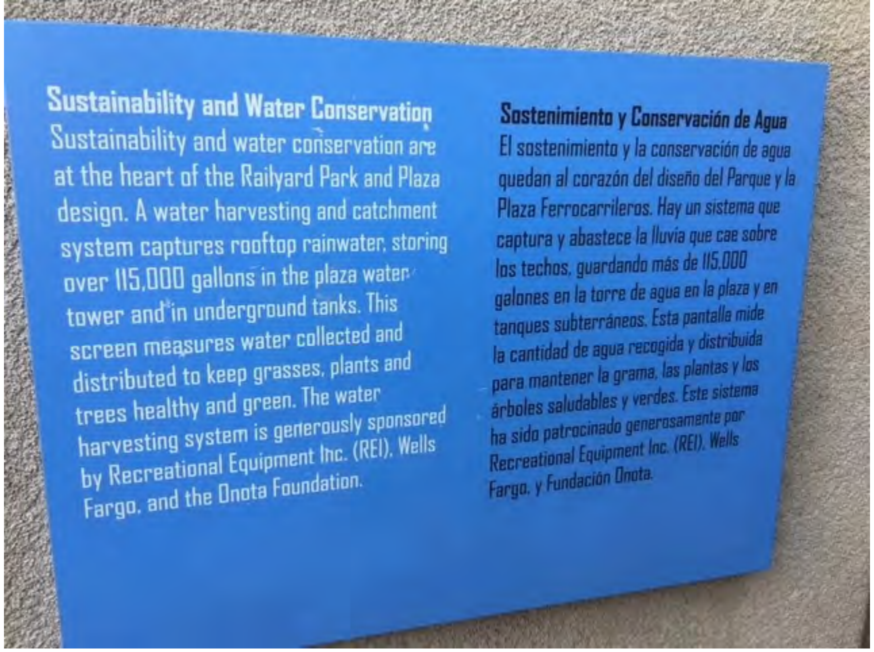
The City's existing data record of stormwater infrastructure does not currently include all storm sewer inlets, underground pipes, manholes, roadway culvert crossings, and outfalls. This information is critical for refined watershed modeling, siting water quality stormwater control measures, determining monitoring locations, building an asset management program, and documenting maintenance concerns and compliance with MS4 program requirements.

ADM-4	**The City is not conducting stream flow or targeted water quality monitoring.**

The draft MS4 permit requires monitoring for pollutants of concern within the City of Santa Fe's boundary. Conducting runoff rate and volume monitoring is also necessary to verify watershed scale modeling and local design standards.

ADM-3	**The City does not currently map or track directly connected impervious cover.**

The draft MS4 permit requires that the City estimate existing impervious cover and directly connected impervious cover (DCIA) and track the changes over time. The City does not have an impervious cover dataset based on new high-resolution aerial imaging required for impervious cover identification. These data also are necessary to create a more equitable discharge fee as discussed in the Revenues and Expenditures section of this chapter.



Education and Training

ET-1	**The City has no formal programs to educate designers, contractors, consultants, or residents on design, installation, and maintenance of private stormwater control measures such as LID practices and erosion and sediment control practices.**

Staff interviewed noted numerous times that some engineering firms were not experienced in the design of stormwater control measures, particularly with LID strategies.

ET-2	**The City has no formal programs to train internal staff on the design, installation, and maintenance of stormwater control measures.**

In addition, Parks Department staff indicated that field crews were not adequately skilled to maintain LID strategies such as bioretention areas.

CHAPTER 4: RECOMMENDED STORMWATER STRATEGIES

Resolution No. 2016-25 Supported Directives:

- Employ and promote green infrastructure in all City infrastructure projects and improvements.
- Examine and implement ways to slow stormwater down, making it less destructive and allowing it to infiltrate better.
- Promote and further the City's urban watershed policy, employing green infrastructure improvements in all Public Works projects (e.g., roads, parks, and trails) to infiltrate stormwater, and use it more productively in parks and public places to decrease irrigation costs and prevent the runoff of fertilizers, waste products, and other contaminants.
- Examine ways in which stormwater can be used productively in Santa Fe.
- Develop a thorough and mapped understanding of the current stormwater system, including existing city drop inlets, storm drains, pipes, and outlet structures that flow directly into the arroyo system and the Santa Fe River.
- Consider how Public Works projects and private developments can create opportunities for an integrated approach to stormwater management.
- Provide recommendations from staff that would coordinate efforts of the above-mentioned departments, commissions, committees, and other entities [Public Works Department, Parks and Recreation Department, Public Utilities Department, City Land Use Department] to maximize opportunities while eliminating duplicative efforts.

Chapter 4: Recommended Stormwater Strategies

This chapter presents eight comprehensive stormwater management recommendations and associated strategies for implementation. They represent proposed updates to the City's policies to support a new model for managing stormwater that would encourage the infiltration of rainwater. In addition, implementation of these strategies will provide residents with valuable benefits as well as ensure long-term program viability and regulatory compliance. Finally, the recommended strategies directly align with and support many of the directives included in Resolution No. 2016-25.

The strategies presented here will serve as a roadmap for institutionalizing a proactive, compliant, and sustainable stormwater management philosophy that will guide decision-makers on a pathway of compliance and resiliency. This chapter outlines strategies that would help Santa Fe achieve this vision.

The recommended strategies are grouped in tables based on the following comprehensive recommendations:

- Revise Code of Ordinances (LA)
- Improve Program Management (PM)
- Create Equitable Rate Structure and Ensure Revenue (RE)
- Strengthen Stormwater Requirements for Private Development (PPSM)
- Integrate Innovative Stormwater Management into City Facilities and ROW (PPRW)
- Practice Good Housekeeping and Pollution Prevention on City Facilities (GHPP)

- Map and Manage Stormwater Infrastructure and Assets (ADM)
- Educate Santa Fe Residents and City staff about Stormwater (ET)

Each action recommended to implement these recommends or “strategies” correspond to associated findings detailed in Chapter 3. Each strategy is identified with a unique alphanumeric identifier. For example, strategy PM-2-1, Create an internal stormwater task force, is the first recommended strategy to address the second finding under Program Management (PM-2): **Inadequate communication among departments regarding water-related permit requirements could make the City vulnerable to permit noncompliance and could limit partnerships and cooperation that could be financially beneficial to the City.**

There are instances in which more than one finding is addressed by a single strategy. In these cases, the finding will refer to a previously described strategy to avoid duplication. High-priority recommendations are highlighted and indexed at the end of this chapter.

LA	LEGAL AUTHORITY
LA-1	**Overall, the Code contains inadequate active construction best management practices, post-construction stormwater management performance standards, and enforcement authority for stormwater management.**
LA-1-1	Revise the Santa Fe Code of Ordinances to include all permit requirement provisions and support, incentivize, and require green infrastructure.
	Santa Fe's existing and proposed MS4 permit requires that the City have adequate legal authority to control stormwater discharges to and from its jurisdiction. Specifically, the permit requires that the City be able to control discharges from active construction projects and new development projects after construction is complete as well as spills, dumping, or illicit discharges of non-stormwater. This Code must also authorize all necessary inspections, surveillance, and monitoring to ensure compliance with the permit. The draft MS4 permit also requires that the City review existing Code to identify and eliminate any impediments to green infrastructure or LID techniques. *The Santa Fe Code of Ordinances regulates land use, water use, infrastructure, and the utilization of fees to pay for stormwater services. Further, the Code must include provisions that authorize the City to require private developments to manage stormwater in a way that protects water quality, conserves water, and limits damage to private property and infrastructure.* *Strategies LA-1-2 through LA-1-10 outlines specific revisions.*
LA-1-2	Require development projects to meet a retention performance standard for post-construction stormwater management.
	The draft MS4 permit requires that this standard be applied to all projects of one acre or larger (Part I.D.5.b.). Applying this standard will support the use of LID techniques on private development projects.
LA-1-3	Require new development projects to treat stormwater to remove sediment prior to discharge to the City's storm sewer.
	This requirement is not included in the current draft MS4 permit; however, reducing the discharge of sediment to the storm sewer will improve water quality in the river and will reduce the City's infrastructure maintenance needs (i.e., catch basins and storm sewer pipes). Sediment loading is a combination of land use, topography, and soil type.

LA	**LEGAL AUTHORITY**
LA-1-4	Specify requirements for the long-term operation and maintenance of stormwater management controls on private development projects in the Code of Ordinances.
	The draft MS4 permit requires that the City have procedures for site inspection and enforcement to ensure proper long-term operation, maintenance, and repair of stormwater control measures.
LA-1-5	Require property owners to proactively inspect stormwater management controls to optimize performance.
	City staff indicated that failing stormwater control measures on private property are a significant administrative and maintenance burden. If controls fail, the City's only recourse is to use City staff and equipment to make the necessary repairs and then bill the property owner. This practice has proved to be inefficient and costly.
LA-1-6	Develop administrative penalties available to City staff to enforce stormwater-related code violations.
	Having only civil or criminal monetary penalty options limits the inspection staff's ability to quickly address noncompliance resulting from illicit discharges.
LA-1-7	Revise the Code to include additional enforcement actions to address stormwater management violations during active construction.
	These enforcement actions are typically quite effective during active construction and are integral to a typical enforcement escalation procedure for construction-related stormwater violations.
LA-1-8	Revise the Code to require that large projects phase land disturbance (i.e., grading) to help control dust and surface erosion during rain events.
	The existing Code indicates that phasing may be required on projects at the discretion of the city engineer; however, having a standard phasing requirement ensures that developers will automatically plan a project in this way, rather than having to adjust after submittal of a preliminary plan. During interviews, staff indicated that large, unphased projects have caused considerable dust and runoff issues in the past.
LA-1-9	Revise the Code to include more prescriptive temporary site stabilization requirements.
	The existing Code does not include a timeframe for using temporary stabilization or require that stockpiles be protected daily. During interviews, staff indicated there are significant issues with managing dust and runoff during construction caused by unprotected bare areas and stockpiles.
LA-1-10	Develop ordinance language or policy that describes enforcement escalation procedures for addressing noncompliance recidivism.
	The draft MS4 permit requires that the City have enforcement escalation procedures in place.

Improve Program Management

PM	**Program Management**
PM-1	**The City has a diffuse program management structure that assigns significant stormwater program management responsibility to the River, Watershed, and Trails/Stormwater Section within the Engineering Division of the Public Works Department and distributes implementation responsibilities across multiple City departments.**
PM-1-1	Establish stormwater management goals and associated levels of service (LOSs) to ensure compliance while protecting water quality, accounting for flood risks, and preparing for the effects of climate change.
	Asset management planning is a popular tool in maintaining LOSs for water and wastewater systems and would be a helpful tool for the City to institutionalize a new stormwater framework. Clear and comprehensive stormwater management goals and associated levels-of-service will also be the foundation for sustainable program budgeting and staffing. (See ADM strategies).
PM-1-2	Based on stormwater levels of service, budgets, and staffing, identify departments and divisions most appropriate to meet baseline LOS and reorganize accordingly.
	Primary stormwater permit compliance responsibility is assigned to the River, Watershed, and Trails Section within the Engineering Division of the Public Works Department. Stormwater operations and maintenance responsibility is shared between the Streets and Drainage Maintenance Division of the Public Works Department and the Parks Division of the Parks and Recreation Department. The Land Use Department is assigned primary stormwater program management and compliance responsibility for all private development projects from planning through construction until accepted by the City. *Stormwater management, by nature, impacts and is impacted by the work done by many different municipal departments; therefore, some distribution of responsibility is appropriate and beneficial. Stormwater management implementation responsibilities in Santa Fe were assigned, however, not based on a proactive plan to cost-effectively achieve compliance and meet service obligations, but rather on reactions to drainage issues and resident complaints and a reliance on the status quo to absorb new responsibilities.*
PM-1-3	As part of the reorganization, evaluate whether key stormwater functions—such as construction inspections—should be consolidated to ensure permit compliance and efficient use of resources.
	While it is critical that compliance requirements are met, the City should eliminate redundancy wherever possible.

PM	PROGRAM MANAGEMENT
PM-1-4	Evaluate the current departmental placement of staff responsible for the stormwater program management structure and ensure they are positioned to access City management and other staff responsible for implementation of critical program elements.
	The creation of a strong management structure with clear LOS objectives and staff roles will institutionalize a framework for effective and compliant implementation of Santa Fe's stormwater management program. Together with elected officials, City management, and the public, stormwater management program leadership—positioned appropriately in the City's organizational hierarchy— can develop objectives that not only comply with regulations, but also integrate a variety of community benefits and support the objectives of other departments. Because of the diverse nature of stormwater management activities that cross multiple departments, it is critical that managers of those departments buy into and support meeting stormwater management objectives with their own LOS goals, standard operating procedures (SOPs), policies, and budgets. Achieving and maintaining this level of commitment requires City leadership—elected officials, department heads, and staff—to acknowledge the importance of meeting stormwater management objectives.
PM-1-5	Create job descriptions for program implementation staff that better define stormwater management roles and align with LOS.
	Staff should be clear as to their role regarding permit compliance and in meeting stormwater services obligations to residents. Having staff without clear roles and responsibilities can impede compliance with federal, state, and local environmental laws.
PM-1-6	Evaluate and integrate appropriate One Water planning principles into the City's wastewater, drinking water, and stormwater programs and Sustainable Santa Fe.
	Applying these principles could help Santa Fe to arrive at better and fiscally-responsible water planning solutions. A One Water planning process would identify projects, programs and policies that will yield sustainable, long-term water supplies for the City and provide greater resiliency to drought conditions and climate change.
PM-2	**Inadequate communication among departments regarding water-related permit requirements could make the City vulnerable to permit noncompliance and could limit partnerships and cooperation that could be financially beneficial to the City.**
PM-2-1	Create an internal stormwater task force.
	City departments responsible for implementing the stormwater program must communicate effectively to ensure that permit requirements are met and to eliminate costly redundancies that can put an undue regulatory burden on residents. A stormwater task force would follow the roadmap outlined in this plan and coordinate long-term permit compliance. The task force will be comprised of staff from—at a minimum—the following departments: Public Works, Land Use, Parks and Recreation, and Public Utilities. *In addition to facilitating communication and ensuring implementation of program elements, the task force could also assist in the development of stormwater management goals, associated LOSs, and assignment of appropriate roles and responsibilities within various departments.* *The task force not only could facilitate necessary internal coordination but also could be used during regional collaboration. Consistent*

PM	PROGRAM MANAGEMENT
	communication between City task force members and Santa Fe County and the New Mexico Department of Transportation will help to facilitate valuable partnerships as well. Sharing of information, data, and lessons learned while implementing new permit requirements will ensure that regional investments provide maximum benefits to the City.
PM-2-2	Develop an internal response tree to quickly address stormwater-related issues identified by the public or in the field.
	After staff roles are more clearly defined, a formal response tree would facilitate timely communication between departments to respond to potential compliance issues in the field. This tree could be used for the Constituent Relationship Manager's Request and Report system.
PM-2-3	Update the City's existing Stormwater Management Program (SWMP) planning document to reflect revised objectives, responsibilities, and organizational structure.
	The City will be required to update the existing SWMP to align with new permit requirements once the proposed permit is issued; however, other program changes made as a result of the strategic planning exercise should be incorporated as well.

The One Water approach envisions managing all water in an integrated, inclusive, and sustainable manner.

RE	REVENUE AND EXPENDITURES
RE-1	**The present rate of revenue generation by the Stormwater Utility Service Charge Fee (“utility fee”) is not sufficient to sustain the current scope of the stormwater program, and the scope of stormwater activities will necessarily expand to achieve regulatory compliance and meet other identified needs.**
RE-1-1	Use asset management planning to forecast anticipated budget needs to meet stormwater management goals and associated LOSs.
	See Strategy ADM-1-1.
RE-1-2	Revise utility fee structure and/or rate to ensure not only support of existing programs but also new staffing and capital expenses anticipated to comply with the draft MS4 permit.
	The City conducted a basic fiscal review, which concluded that the present rate of revenue generation by the Santa Fe utility fee is not sufficient to sustain the current scope of the stormwater program, and the revenue shortfall will widen as the scope of stormwater activities necessarily expands to achieve future regulatory compliance and meet other identified needs (see Chapter 3). While it is possible for the City to supplement the revenue generated by this fee from other sources, having a dedicated and reliable funding mechanism to achieve stormwater levels-of-service, including permit compliance, is the most sustainable funding path.
RE-1-3	Pursue leveraging a portion of the utility fee revenue using capital bonds.
	The City could leverage the fees in a manner similar to that commonly applied to other City capital projects. The City could leverage $500,000 of the annual stormwater fee revenues to service bond debt, and, at current market interest rates, produce the capital project capacities shown in Table 2.
RE-1-4	Evaluate other sources of City revenue – such as development impact fees – to determine viability to support stormwater management program elements.
	Many of Santa Fe’s public stormwater management assets are built during private development projects and then accepted by the City.
RE-1-5	Pursue Clean Water State Revolving Fund (CWSRF) or other alternative funding sources to support qualifying capital projects.
	The USEPA document Government Funding Opportunities for Stormwater Management in Santa Fe *provides many examples of alternative funding sources. For example, the New Mexico Environment Department manages the CWSRF Program, which provides a source of low-cost financing for a wide range of wastewater and stormwater projects that protect surface and ground water.*

RE	REVENUE AND EXPENDITURES
RE-1-5	Develop a policy that establishes criteria and priorities for the expenditure of stormwater fee revenues.
	A policy should be adopted that prioritizes the expenditures to be paid primarily from the stormwater utility service charges. Such policies provide the stability required to carry on programmatic activities. This policy will provide the stability required to carry on programmatic activities. Because of their immediate relationship to the stormwater system and the intent of Santa Fe Code of Ordinances Section 13-1, these activities—MS4 compliance, system maintenance and operation, administration and reporting, planning and programming, and enforcement—are most appropriately funded through the service charge. Other significant stormwater program expenditures that can be funded through service charges, including development and permit review fees, and through capital works.
RE-2	**Utility fee rate structure does not provide rate equity among customers, nor does it provide for incentives for beneficial on-site stormwater management practices.**
RE-2-1	Create nexus between storm sewer system user demand and the rate users pay for the service.
	The City's present fee structure is based on meter size and is efficient and inexpensive to administer (see Table 2). There is little to no nexus, however, between water meter size and a property's contribution of runoff volume, rate, or quality that define a property's "demand" for stormwater services. The best indicator of demand is the presence of impervious cover, and there are various methods for estimating or measuring impervious cover on parcels. *Generally, a rate structure should establish a rational nexus between the services provided and the fee charged, and the rate structure should provide an equitable allocation of costs among customers and customer classes. There are a number of forms of stormwater fee rate structure; however, the more equitable methods are based on a parcel's impervious cover. This ensures that rate payers pay based on services needed (i.e., management of stormwater runoff created by impervious surfaces on their property). A stormwater fee rate structure levied based on a property's contribution of stormwater runoff also can incentivize rate payers to reduce the rate or volume of storm runoff or to improve runoff water quality.* *Implementation of fiscal policies, rate structure updates, and changes in revenue should be planned jointly. There are a variety of rate structure forms that could improve fee equity and provide the necessary revenue; however, more refined structures require impervious cover data that the City does not currently have. Therefore, data acquisition and management system costs as well as the amount of time necessary must be factored into any restructuring decision (see ADM Strategies). Phasing in rate structure changes over time could be beneficial by allowing gradual increases in the rate payer base and fees and accounting for the time and administrative resources necessary to implement more complex data management systems.*

RE	Revenue and Expenditures
RE-2-2	Revise the rate structure to allow for incentives to reduce the rate or volume of runoff or to improve runoff water quality.
	A variety of rate adjustments and credits have been adopted by jurisdictions as means to implement policies, to recognize differing conditions on properties within similar rate classes, or to incentivize beneficial on-site actions. When adopting credits and rate reductions, the City should establish a cap on the allowable compounded credits so as not to undermine the core support of the stormwater program. Some examples are cited below. • *Low-income/senior fixed income. Typically aligned with similar credits for other City charges.* • *Credits for on-site BMPs. This is used to recognized that more recently developed properties might have robust stormwater controls in place, whereas older properties do not control runoff as effectively.* • *NPDES-permitted properties. This credit recognizes that some industrial, commercial, and agricultural properties are permitted and regulated under the NPDES program and are assumed compliant with their permit obligations to control runoff.* *Alternately, the City could elect to provide incentives that do not impact rates. Such credits currently are offered as one-time rebates to underwrite the costs of installing rain barrels, cisterns, and could be expanded to include rain gardens, bio-cells, and similar beneficial actions.*
RE-3	**Certain activities of the stormwater program are continuous, ongoing functions and are not being reliably funded to meet City requirements or external regulatory obligations, or to ensure properly functioning infrastructure.**
RE-3-1	Ensure that essential stormwater management activities are funded via the utility service charge (stormwater fee).
	As noted earlier, the City has occasionally supported selected stormwater projects and activities through other sources beyond the stormwater utility service charge, including the General Fund and outside grants. These are not reliable sources of funding. Activities such as storm sewer system maintenance and operation activities; administration; and reporting, planning, and enforcement activities should be funded through the service charge.

Table 2. Debt Financing Options

Term	Assumed Annual Interest Rate	Capital Project Capacity [a]
10 years	3.0 %	$4.98 million
15 years	3.5%	$7.47 million
20 years	4.0%	$9.95 million

[a] Assumes annual debt service of $500,000.

Rate Structure Forms

Gross Parcel Area

This structure allocates program costs in proportion to the gross area of a land parcel. The data exist to support such a charge in assessor databases, and the administrative costs would be relatively low. Parcels that are not served by the water utility would need to be added to the billing database. There is an equity trade-off when comparing this gross parcel area approach to the current meter size basis, in that gross parcel area does not reflect the nature of development and impervious area on the parcel; whereas, the presence of a meter and the meter size infer the scale of development on the property, albeit in a coarse manner.

Factored Gross Area

Some communities apply an approach based on gross parcel area to which a land-use factor (or runoff factor) is applied to approximate the intensity of development on the parcel and, hence, the runoff it generates. This approach was originally developed to approximate an impervious area method (described further below) when aerial imagery and mapping capabilities were much less robust than today's technologies. This approach can improve on equity between customer classes (e.g., among parcels having similar zoning classifications), but does not offer substantial enhancement over the current meter size basis.

Impervious Surface Area

Using a parcel's impervious area footprint (encompassing rooflines, pavements, and vehicle-traveled gravel surfaces) is the method applied for the most equitable types of rate structures, as it provides a more robust nexus between a land parcel and the volume and rate of runoff. With the availability of high-resolution light detection and ranging (LiDAR) and photo imagery, and GISs for managing parcel data, appropriate charges can be accurately determined for individual parcels.

The nature of impervious area (e.g., parking versus rooftop) and other features (e.g., presence of BMPs) can also be captured to incorporate water quality-based rate factors and rate credits. Often single-family residential properties are grouped into a uniform residential rate or into rate tiers that reflect large distinctions in impervious footprint between residential zoning classifications. Because single-family residential properties comprise most parcels in Santa Fe, this approach can significantly streamline the administrative effort in establishing accounts without compromising equity between highly similar properties.

Stormwater runoff volume

Creating a standard procedure to determine the amount of runoff generated from a lot as compared to the same location before development is the most equitable and accurate. This method would require the City to develop a runoff volume by lot based on the same values used within the stormwater and water quality models developed from this report. This method takes into account both the size of the parcel and the amount of impervious cover on a lot and can account for approved measures onsite that reduce stormwater runoff.

Strengthen Stormwater Requirements for Private Development

PPSM	**PRIVATE PROPERTY STORMWATER MANAGEMENT**
PPSM-1	**Adequate erosion and sediment control practices are not consistently required on private developments.**
PPSM-1-1	Require standard erosion and sediment control BMP requirements on construction project plan sheets.
	This strategy will help ensure adequate plans are being submitted to the City for review and that contractors have access to all information on-site to install practices correctly.
PPSM-1-2	Create a standard checklist for review of grading plans.
	This strategy will support consistent plan review and compliant and effective approved plans.
PPSM-1-3	Require drainage plans detailing stormwater control measures be kept on-site.
	When plans are not kept on-site, installing the required BMPs can be challenging for contractors and places an additional burden on City inspectors to explain requirements and to track any proposed or approved redline changes in the field.
PPSM-1-4	Institute policies that ensure final stabilization or removal of BMPs at the conclusion of projects.
	This strategy will reduce erosion caused by inadequate stabilization by the developer after the project is complete.
PPSM-2	**The City does not adequately require installation, operation, and maintenance of post-construction stormwater control measures on private development projects.**
PPSM-2-1	Require development projects to meet water quality or channel protection performance standards for post-construction stormwater.
	See Strategies LA-1-2 and LA-1-3.
PPSM-2-2	Adopt design guidance or standards for designers to follow when incorporating stormwater management controls into site plans.
	An adopted City design manual that can be used by City staff and private designers will ensure that an approved set of design standards are met for all stormwater control measures proposed and built in Santa Fe. Prior to developing a City-specific manual, the City could use an existing manual—such as the New Mexico Department of Transportation Drainage Design Manual (July 2018) which utilizes regional research controls appropriate for optimal performance in Santa Fe.

PPSM	PRIVATE PROPERTY STORMWATER MANAGEMENT
PPSM-2-3	Require preliminary plan review meetings to discuss stormwater management requirements for all regulated projects.
	Stormwater management planning should occur early in the project development process to ensure proper placement and budgeting for installation and maintenance during construction.
PPSM-2-4	Use checklists consistently to review site plans for compliance with post-construction requirements.
	Using checklists that align with adopted, required design standards will ensure that plans are reviewed consistently.
PPSM-2-5	Require applicants to submit operation and maintenance (O&M) plans to address stormwater management controls on development projects after construction is complete.
	Per the City's MS4 permit, all private stormwater management control facilities must be operated and maintained to ensure proper performance. Requiring O&M plans during the drainage plan approval phase ensures that the applicant incorporates maintenance considerations into the design. Further, an approved O&M plan recorded with the deed will transfer to subsequent property owners and ensure long-term performance.
PPSM-2-6	Include stormwater management controls (e.g., infiltration basins, drainage, and retention ponds) and landscaping in warranty inspections for facilities being accepted by the City.
	Warranty inspections are conducted 12 months after project completion to ensure that all infrastructure accepted by the City is operating correctly. Including stormwater management controls and landscaping used to comply with a retention performance standard in these inspections will prevent the City from accepting controls that are incorrectly designed, installed, or stabilized.
PPSM-2-7	Inventory and map newly built, privately owned stormwater management controls.
	A standardized process can be developed as part of permit closeout. The applicant would submit digital storm drain plans with location, elevation, material, size, and so forth in a prescribed format. Digital/cloud technology could be used to collect new system information directly from the contractor or engineer after construction is complete.
PPSM-2-8	Conduct proactive inspections of private facility stormwater control measures or require property owners to self-inspect.
	The City's existing and draft MS4 permit requires that stormwater control measures be installed as designed and maintained correctly to operate as intended to protect water quality. The City can accomplish this by requiring owners to inspect at some approved frequency and then conducting compliance inspections to confirm measures are being maintained correctly (e.g., annual self-inspections and compliance inspections by the City every 3 years).

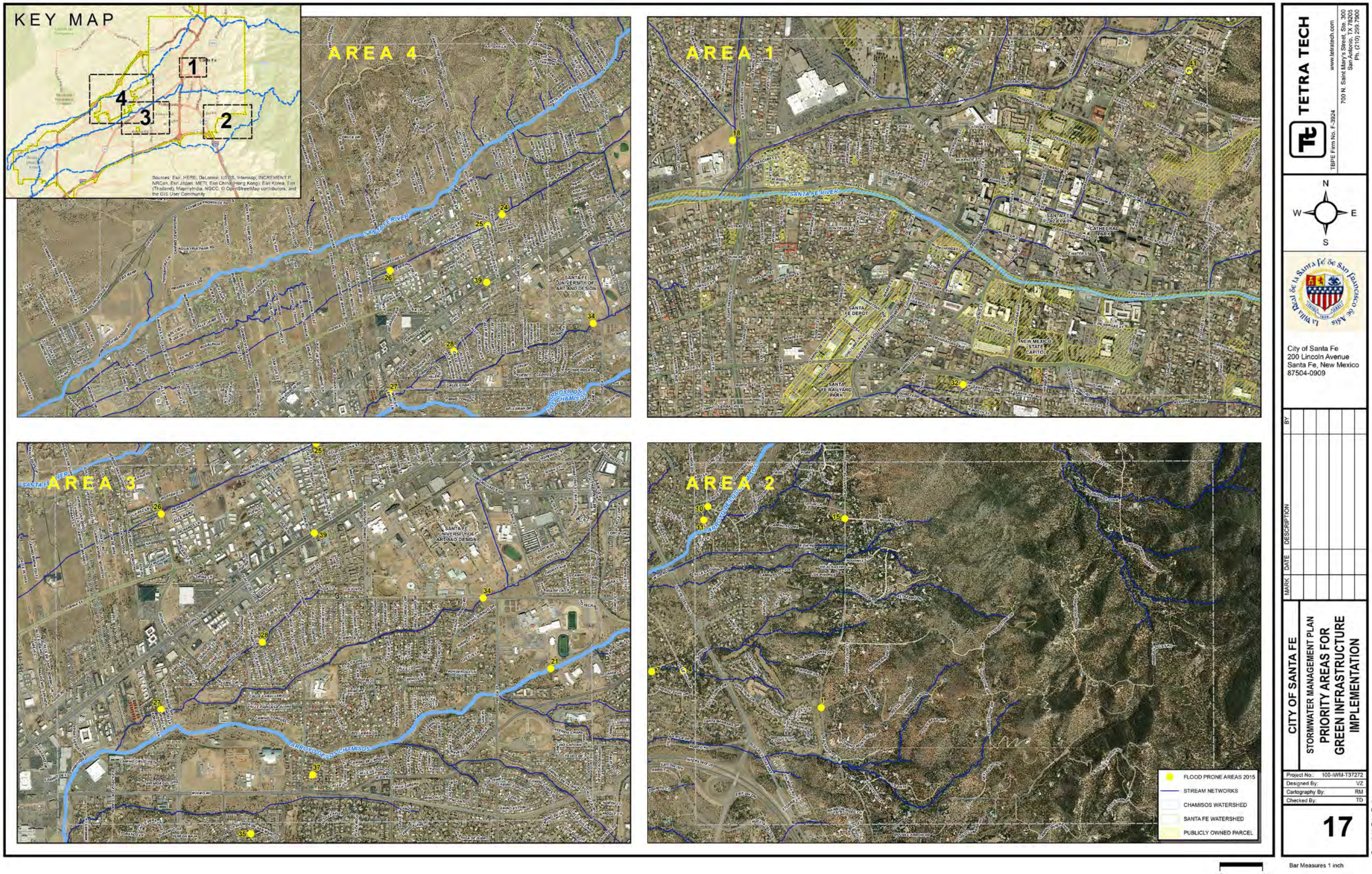
Integrate Innovative Stormwater Management into City Facilities & ROW

PPRW	**PUBLIC PROPERTY AND RIGHT-OF-WAY MANAGEMENT**
PPRW-1	**Post-construction stormwater management considerations are not consistently included in planning procedures for new City facilities.**
PPRW-1-1	Include stormwater staff in facility planning activities to ensure that adequate erosion control BMPs and post-construction controls are included in the design.
	Post-construction stormwater management considerations must be accounted for early in the facility planning process and throughout any subsequent iterations. Including stormwater staff in all phases of the planning will facilitate this integration. The City's regulatory management software can be used to ensure participation by stormwater management staff in the facilities planning processes.
PPRW-1-2	Notify stormwater staff when public facility plans are approved and prior to grading.
	It is critical to inspect projects prior to grading so adequate BMPs can be installed prior to land disturbance.
PPRW-1-3	Develop requests for proposals that include erosion and sediment control and post-construction qualification elements to ensure that qualified vendors apply.
	The inclusion of stormwater provisions in the City's facility planning procurement process can prevent the design and installation of inadequate controls on City projects and associated permit noncompliance.
PPRW-1-4	Include contractual obligations for installing or maintaining adequate erosion and sediment controls and mechanisms for withholding payments if work is not performed in all construction-related City contracts.
	The City needs to have authority to require contractors to comply with all erosion and sediment control and post-construction requirements and maintain access to the enforcement mechanisms that will elicit compliant behavior.
PPRW-1-5	Ensure that budgets for public projects are adequate to fund necessary erosion control and post-construction stormwater management on public projects.
	When initial budget estimates are too low, it is difficult to require additional plan submittals from contracts during the planning phase or to implement alternative controls during construction.

PPRW	PUBLIC PROPERTY AND RIGHT-OF-WAY MANAGEMENT
PPRW-1-6	Adopt specifications or details for designing stormwater management controls in rights-of-way and at City facilities that meet the retention standards required by the draft MS4 permit.
	Practices such as permeable pavement, bioretention, rain gardens, and stormwater landscaping islands can be used to infiltrate water on-site, which can reduce localized flooding and receiving water impacts in the rights-of-way. The USEPA guidebook A Guide to Incorporating Green Infrastructure into Roadway Projects in Santa Fe *provides guidance regarding how best to implement this strategy.*
PPRW-1-7	Design and install stormwater control measures that meet the new post-construction performance standards at new City facilities.
	All City projects that meet the size threshold established in the draft MS4 permit—activities that result in a land disturbance of greater than or equal to one acre—must include stormwater management controls that meet the performance standards described in Strategy LA-1-2. The standards described in Strategy LA-1-3 will help prevent sediment from entering the storm sewer system and causing flooding and maintenance concerns.
PPRW-1-8	Adopt formal storm sewer infrastructure design criteria that address water quality, stream stability, sediment transport, and stormwater volume management.
	The City's existing standard addresses prevention of localized flooding only during large storm events and does not support the City's infiltration model of stormwater management. Using refined and City-specific drainage system design criteria that address water quality and channel erosion will also prevent unintended negative impacts from infrastructure investments.
PPRW-2	**Post-construction stormwater management considerations are not consistently included in capital improvement planning.**
PPRW-2-1	Target new stormwater management capital improvement investments based on flood control and water quality modeling and prioritize investment in green infrastructure strategies.
	The draft MS4 permit requires that the City incorporate watershed protection elements into relevant planning documents, including capital improvement project plans. *As part of the strategic planning effort, the City conducted flood control and water quality modeling. See the Santa Fe River and Arroyo de Los Chamisos Modeling Report for additional technical details.* *Based on this modeling, there are four priority pilot areas for green infrastructure implementation in the City (see Figure 3):* • *Downtown* • *Areas draining to Arroyo Cloudstone and Arroyo Foothill* • *Drainage areas in Arroyo de los Chamisos (North Fork)* • *Areas along Arroyo de los Pinos*

PPRW	Public Property and Right-of-Way Management
PPRW-2-2	Using the flood control model, evaluate all existing flood control structures for water quality treatment retrofit potential.
	The draft MS4 permit requires that the City develop a prioritized schedule for retrofitting existing controls to treat runoff in addition to controlling flood waters.
PPRW-2-3	Apply water quality performance standards to all new flood control capital projects.
	The draft MS4 permit requires that the City apply water quality design criteria (see Strategy LA-1-3 for suggested performance standard) in the design of all flood control capital projects. The City is required to assess impacts and incorporate water quality controls into future flood control projects.
PPRW-2-4	Evaluate all flood control capital projects for suitability to control floatables.
	The draft MS4 permit requires that the City have a floatables control program that includes, as necessary, structural control—particularly in industrial and commercial areas.

Figure 3


KEY MAP
AREA 4
AREA 1
AREA 3
AREA 2
SANTA FE RIVER
ARROYO DE LOS CHAMISOS
FLOOD PRONE AREAS 2015
STREAM NETWORKS
CHAMISOS WATERSHED
SANTA FE WATERSHED
PUBLICLY OWNED PARCEL
TETRA TECH
TBPE Firm No. F-3924
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 226.2922
City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909
MARK DATE DESCRIPTION BY
CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
PRIORITY AREAS FOR GREEN INFRASTRUCTURE IMPLEMENTATION
17
Bar Measures 1 inch
Copyright: Tetra Tech

Practice Good Housekeeping and Pollution Prevention at City Facilities

GHPP-1	**Staff are not conducting good housekeeping practices consistently at City facilities and during City activities.**
PPRW-2-1	Develop facility pollution prevention plans to describe the good housekeeping practices being used to control pollution at City facilities.
	The draft permit specifically requires that the City control pollutants at facilities that store equipment, maintain vehicles, and store deicer or other materials that would constitute a potential pollution source. Covering stored materials, performing certain activities indoors, and training staff on spill control and clean up are a few examples of required good housekeeping practices at City facilities. These practices should be documented in a facility-specific plan and certified by the operating City department.
PPRW-2-2	Develop SOPs to reduce pollutant discharges during City activities that have the potential to cause pollution.
	The draft MS4 permit requires that the City have procedures to control pollutants from activities such as oils management, hazardous materials storage, snow removal, satellite storage of materials, dewatering of sweeper or catch basin cleaning spoils, construction stockpile management, trash, and recyclables.
GHPP-2	**The City does not consistently include management of stormwater control measures in facility maintenance budgets and procedures.**
PPRW-2-1	Consistently include facilities maintenance staff in facility planning and budgeting activities.
	Stormwater control measures will fail without proper maintenance. Improperly maintained controls can cause water quality impacts and property damage at City facilities. Maintenance requirements must be considered during the design phase to ensure that design elements do not interfere with maintenance and that maintenance can occur safely and with available staff. Further, proper, proactive, and regular maintenance will not occur without adequate funding to ensure proactive maintenance. Including maintenance staff in all phases of planning will help avoid problems associated with future maintenance during design.

ADM	ASSET AND DATA MANAGEMENT
ADM-1	**The City does not currently have a management plan for stormwater infrastructure and assets.**
ADM-1-1	Create an asset management plan for stormwater infrastructure and assets.
	A stormwater asset management plan would provide a rational framework for maintaining assets to provide necessary stormwater management services to residents. The planning process would determine the current state of assets (e.g., asset inventory, valuation, condition, and risk) and project long-range asset rehabilitation and replacement requirements. The plan would be driven by the City's stormwater management goals, include appropriate levels of service, and describe the future investments necessary to deliver the committed services. This would be used to refine existing program expenditures and inform rate restructuring and outside funding needs. *Currently the City does not have the data necessary to create a stormwater asset management plan (see Finding ADM-2).* *Strategies ADM-1-2 through ADM-1-5 describe the basic steps necessary to create a stormwater asset management plan.*
ADM-1-2	Define stormwater management asset classes in Santa Fe.
	There are three types of stormwater management assets: human-made hard assets, natural assets, and human-made soft assets. Hard assets are those traditionally managed by the City—with classes such as the storm drain system and stormwater control measures. Natural assets are what the City generally defines as "green infrastructure"—with classes such as parks and open spaces. Soft assets are harder to define but deal with programmatic assets—with classes such as ordinances and internal policies that support or require stormwater management.
ADM-1-3	Develop LOSs for all stormwater asset classes based on adopted stormwater management goals.
	The City would then assign (LOSs to each asset class. These levels-of-service would describe what needs to be done—specific to each asset type—in order to achieve the City's stormwater management goals.
ADM-1-4	Inventory all stormwater assets and conduct a condition assessment.
	Each identified asset needs to be evaluated to determine if the associated LOS are being achieved.

ADM	**ASSET AND DATA MANAGEMENT**
ADM-1-5	Determine actions needed to achieve LOS and prioritize those actions based on the risk associated with the failure of the asset.
	The actions necessary to achieve LOSs will be used to forecast revenue needs and assess overall vulnerability. This exercise will help the City evaluate whether the existing organizational structure, budgets, and staff are adequate to conduct the actions necessary to manage the risks associated with the stormwater assets that are not meeting LOSs.
ADM-2	**The City has inadequate mapping and modeling of public stormwater management assets and the storm sewer system to ensure adequate maintenance and permit compliance.**
ADM-2-1	Collect complete stormwater system data, including results of condition assessment of all assets.
	Complete data includes all street inlets, underground pipes, manholes, roadway culvert crossings, and outfalls. This information is necessary for refined watershed modeling, siting water quality stormwater management controls, determining monitoring locations, building an asset management program, tracking maintenance, and prioritizing projects.
ADM-2-2	Use a GIS-based stormwater data structure to standardize data collection in the City.
	A GIS-based tool is the most beneficial for collecting, developing, and maintaining the stormwater system asset management data. No single system within Santa Fe, however, currently provides the functionality of a GIS interface for data with backend functions for billing, tracking changes, and creating system reports.
ADM-2-3	Investigate options for using the asset management tool currently used by the Public Utilities Department for water transmission and distribution assets for stormwater assets.
	Asset management can be performed only with an accurate asset inventory. To effectively manage public assets, you need to know what they are and where they are located. The Public Utilities Department currently uses Cityworks©, a GIS-based asset management tool, for water transmission and distribution assets. This tool could be augmented to support stormwater asset management functions as well.
ADM-3	**The City does not currently map or track directly connected impervious cover.**
ADM-3-1	Develop a detailed impervious cover GIS dataset.
	A detailed impervious cover dataset based on existing LiDAR data and new aerial imagery can be used to better refine the flood control and water quality models and to develop a more equitable stormwater utility fee rate structure (see RE Strategies). In addition, the draft MS4 permit requires that the City begin tracking and reporting directly connected impervious area and impervious area. The permit does not require that the City map impervious cover, but only estimate it; however, mapping changes in impervious cover will allow the City to more precisely predict and manage impacts from increased impervious cover.

ADM	Asset and Data Management
ADM-4	**The City is not conducting stream flow or targeted water quality monitoring.**
ADM-4-1	Develop a monitoring program based on critical water quality areas identified during modeling.
	The proposed MS4 permit requires monitoring for pollutants of concern. Targeting monitoring in high-priority areas can help the City implement pollutant-specific stormwater management activities and gather data that can be used to further refine the existing model. Gathering additional data will increase confidence in model estimates of sediment and nutrient loading.
ADM-4-2	Conduct stream flow monitoring.
	Monitoring runoff rate and volume in key watersheds will help verify existing and future watershed-scale modeling and infrastructure design standards. The flood control and water quality models developed during strategic planning are largely uncalibrated because of limited data.

Directly Connected Impervious Area (DCIA) means the portion of impervious area with a direct hydraulic connection to the storm sewer system or a waterbody via continuous paved surfaces, gutters, pipes, and other impervious features.

ET	EDUCATION AND TRAINING
ET-1	**The City has no formal programs to educate designers, contractors, consultants, or residents on design, installation, and maintenance of private stormwater control measures such as LID practices and erosion and sediment control practices.**
ET-1-1	Develop an outreach and education strategy appropriate for target audiences.
	A formal strategy would include appropriate messaging for all target audiences and description of the most effective delivery methods (e.g., web page updates, formal trainings, and industry meeting outreach). The strategy could be informed by resident surveys to insure a need-based program response.
ET-1-2	Create a brand for the stormwater program(s) in Santa Fe.
	Creating a logo, message and "voice" for the stormwater management program will improve the City's ability to disseminate related messaging to residents in a consistent and effective manner.
ET-2	**The City has no formal programs to train internal staff on the design, installation, and maintenance of stormwater control measures.**
ET-2-1-1	Develop a training plan for relevant City staff—designers, plan reviewers, inspectors, and maintenance crews—that ensures staff are qualified to design, inspect, and maintain stormwater control measures, particularly LID practices.
	The draft MS4 permit requires that implementation staff be adequately trained in how to design, review, and inspect practices. Having well-trained staff will ensure that stormwater assets operate as necessary and that private facilities will not cause a future maintenance burden.

High Priority Strategies Index

Legal Authority

- Revise the Santa Fe Code of Ordinances to include all permit requirement provisions and support, incentivize, and require green infrastructure.
- Require development projects to meet a retention performance standard for post-construction stormwater management.
- Require new development projects to treat stormwater to remove sediment prior to discharge to the City's storm sewer.
- Specify requirements for the long-term operation and maintenance of stormwater management controls on private development projects in the Code of Ordinances.
- Require property owners to proactively inspect stormwater management controls to optimize performance.
- Revise the Code to include additional enforcement actions to address stormwater management violations during active construction.
- Develop ordinance language or policy that describes enforcement escalation procedures for addressing noncompliance recidivism.

Program Management

- Establish stormwater management goals and associated levels of service (LOSs) to ensure compliance while protecting water quality, accounting for flood risks, and preparing for the effects of climate change.
- Based on stormwater levels of service, budgets, and staffing, identify departments and divisions most appropriate to meet baseline LOS and reorganize accordingly
- Evaluate the current departmental placement of staff responsible for stormwater program management structure and ensure they are positioned to access City management and other staff responsible for implementation of critical program elements.
- Create an internal stormwater task force.
- Develop an internal response tree to quickly address stormwater-related issues identified by the public or in the field.

Revenue and Expenditures

- Use asset management planning to forecast anticipated budget needs to meet stormwater management goals and associated LOSs.
- Revise utility fee structure and/or rate to ensure not only support of existing programs but also new staffing and capital expenses anticipated to comply with the draft MS4 permit.

- Pursue leveraging a portion of the utility fee revenue using capital bonds.
- Pursue Clean Water State Revolving Fund (CWSRF) or other alternative funding sources to support qualifying capital projects.
- Develop a policy that establishes criteria and priorities for the expenditure of stormwater fee revenues.
- Create nexus between storm sewer system user demand and the rate users pay for the service.

Private Property Stormwater Management

- Require development projects to meet water quality or channel protection performance standards for post-construction stormwater.
- Adopt design guidance or standards for designers to follow when incorporating stormwater management controls into site plans.
- Require applicants to submit operation and maintenance (O&M) plans to address stormwater management controls on development projects after construction is complete.

Public Property and Right-of-Way Management

- Include stormwater staff in facility planning activities to ensure that adequate erosion control BMPs and post-construction controls are included in the design.
- Ensure that budgets for public projects are adequate to fund necessary erosion control and post-construction stormwater management on public projects.
- Adopt specifications or details for designing stormwater management controls in rights-of-way and at City facilities that meet the retention standards required by the draft MS4 permit.
- Design and install stormwater control measures that meet the new post-construction performance standards at new City facilities.
- Adopt formal storm sewer infrastructure design criteria that address water quality, stream and arroyo stability, sediment transport, and stormwater volume management.
- Target new stormwater management capital improvement investments based on flood control and water quality modeling and prioritize investment in green infrastructure strategies.
- Using the flood control model, evaluate all existing flood control structures for water quality treatment retrofit potential.

Practice Good Housekeeping and Pollution Prevention at City Facilities

- Develop facility pollution prevention plans to describe the good housekeeping practices being used to control pollution at City facilities.

Asset and Data Management

- Create an asset management plan for stormwater infrastructure and assets.
- Collect complete stormwater system data, including results of condition assessment of all assets.
- Investigate options for using the asset management tool currently used by the Public Utilities Department for water transmission and distribution assets for stormwater assets.

Education and Training

- Develop a training plan for relevant City staff—designers, plan reviewers, inspectors, and maintenance crews—that ensures staff are qualified to design, inspect, and maintain stormwater control measures, particularly LID practices.

Compendium to the Stormwater Management Strategic Plan

City of Santa Fe, New Mexico

TABLE OF CONTENTS

A. Santa Fe and Arroyo de los Chamisos Modeling Report

B. Modeling Exhibits

C. Water Quality Memo

D. Asset Management Memo

E. External Stakeholder Summary & Exhibits

F. Stormwater Financial Memo

G. Code of Ordinance Proposed Revisions

H. Regulatory Considerations Checklist

A. SANTA FE RIVER AND ARROYO DE LOS CHAMISOS MODELING REPORT

Santa Fe River and Arroyo de Los Chamisos Modeling Report

#100-IWM-T37272
July 26, 2018

PRESENTED TO

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

PRESENTED BY

Tetra Tech
502 W. Cordova Rd.
Suite C
Santa Fe, NM 87505

P +1-505-982-0584
tetratech.com

Prepared by:

Sam Sarkar 07/26/2018
Civil Engineer

Vahid Zarezadeh, PhD
Environmental Engineer

Reviewed by: Troy Dorman

Troy Dorman, PhD, PE 07/26/2018
Director

TABLE OF CONTENTS

1.0 INTRODUCTION 3

2.0 DATA PREPARATION 3

2.1 Watershed Delineation and Stream Definition 3

2.2 Subcatchment Naming Convention 5

2.3 Land Use, Soil, and Curve Number Map 6

2.4 Stormwater Conveyance System 13

3.0 HYDROLOGIC AND HYDRAULIC MODELING 15

3.1 Precipitation data 15

3.2 Rainfall-runoff generation 15

3.3 XPSWMM model 16

4.0 WATER QUALITY MODELING 18

4.1 LSPC Model Development 18

5.0 RESULTS AND DISCUSSION 19

5.1 XPSWMM MODEL 19

5.1.1 Model Calibration 19

5.1.2 Slope Analysis 20

5.1.3 Velocity Analysis 22

5.1.4 Peak Flow Analysis 24

5.1.5 Culvert Capacity Analysis 26

5.2 LSPC MODEL 29

5.2.1 Hydrology Simulation 29

5.2.2 Water Quality Simulation 33

6.0 PRIORITY AREAS FOR GREEN INFRASTRUCTURE IMPLEMENTATION 37

7.0 FUTURE MODEL ENHANCEMENTS 39

8.0 STORMWATER PROGRAM RECOMMENDATIONS 39

9.0 BIBLIOGRAPHY 41

LIST OF TABLES

Table 1. Source of the naming for tributaries. 5
Table 2. Runoff curve numbers for urban areas (USDA, 1986). 7
Table 3. Land use classification of parcels data. 8
Table 4. land use coding based on the classes. 8
Table 5. Residential areas classification based on their size. 9

Table 6. Design storm values for Santa Fe area (inches) ... 15
Table 7. Typical values of Cp (iSWM, 2010). ... 15
Table 8. Curve Number and Slope classification. ... 16
Table 9. Reservoirs in Headwaters Santa Fe River watershed. ... 16
Table 10. 100-year flow comparison between FEMA and XPSWMM data. ... 19
Table 11. Designed conduit dimensions to convey 10-year storm event. ... 27
Table 12. Simulated average annual sediment, total nitrogen and total phosphorus loads for the Santa Fe River and Arroyo de Los Chamisos LSPC models. ... 33

LIST OF FIGURES

Figure 1. Headwaters Santa Fe River and Arroyo de Los Chamisos Watersheds, subcatchments, and stream networks. ...4
Figure 2. Soil map for headwaters Santa Fe River and Arroyo de Los Chamisos watersheds. ... 10
Figure 3. Land use map for headwaters Santa Fe River and Arroyo de Los Chamisos watersheds. ... 11
Figure 4. Curve number map for headwaters Santa Fe River and Arroyo de Los Chamisos watersheds. ... 12
Figure 5. Location of data points (surveyed and collected) for pipes and culverts. ... 14
Figure 6. Stream networks selected for hydraulic modeling inside XPSWMM. ... 17
Figure 7. Average slope in reach segments. ... 21
Figure 8. Maximum velocity in reach segments. ... 23
Figure 9. Maximum flow per acre of each subcatchment. Flow Comparison locations are shown by star and listed in the above table. ... 25
Figure 10. Location of surcharged pipes and culverts for 10-year and 100-year storm events and areas with reported flooding issues. ... 28
Figure 11. Simulated water balance for the Arroyo de Los Chamisos and Santa Fe River LSPC models. ... 30
Figure 12. Simulated streamflow duration for the Santa Fe River and Arroyo de Los Chamisos. ... 31
Figure 13. Ratio of LSPC simulated surface runoff to precipitation for the Santa Fe River and Arroyo de Los Chamisos watersheds. ... 32
Figure 14. LSPC simulated annual average sediment load for the Santa Fe River and Arroyo de Los Chamisos watersheds. ... 34
Figure 15. LSPC simulated annual average runoff phosphorus load for the Santa Fe River and Arroyo de Los Chamisos watersheds. ... 35
Figure 16. LSPC simulated annual average runoff nitrogen load for the Santa Fe River and Arroyo de Los Chamisos watersheds. ... 36
Figure 17. Priority areas for GI implementation. ... 38

APPENDICES

APPENDIX A. SURVEYED DATA OF STORMWATER COLLECTION SYSTEM IN HEADWATERS SANTA FE WATERSHED ... 42

APPENDIX B. SURVEYED DATA OF STORMWATER COLLECTION SYSTEM IN ARROYO DE LOS CHAMISOS WATERSHED ... 45

APPENDIX C. ELEVATION-AREA-STORAGE DATA FOR MCCLURE RESERVOIR ... 47

APPENDIX D. ELEVATION-AREA-STORAGE DATA FOR NICHOLS RESERVOIR ... 49

GLOSSARY

EPA – United States Environmental Protection Agency

GIS – Geographic Information System

HEC-HMS – US Army Corps of Engineers Hydrologic Engineering Center Hydrologic Modeling System

HEC-RAS – US Army Corps of Engineers Hydrologic Engineering Center River Analysis System

LSPC – Loading Simulation Program C

MS4 – Municipal Separate Storm Sewer System

SWMM – Stormwater Management Model

XPSWMM – A commercially available interface to the SWMM modeling system produced by XP Software

EXECUTIVE SUMMARY

This report contains the updates to the Santa Fe River and Arroyo de Los Chamisos Drainage Master Plans that were completed in 1997 and 1998 respectively. The report provides the background on development of new EPA SWMM based flood event models and LSPC based water quality models of the two watersheds. In addition, recommendations for new data collection efforts, modeling, stormwater program implementation and monitoring are provided.

As described in the scope of work, Tetra Tech has adopted a modeling approach to aid in the update of the drainage management plan for the Santa Fe River and Arroyo de Los Chamisos watersheds. Two major considerations for the modeling were flood control and water quality. Subtask 2.4 of the project describes building stormwater and flood management, and water quality models for assessing flooding conditions, erosion, and pollutant loading in the Santa Fe River and Arroyo de Los Chamisos watersheds. Pre-processing of data provided by the city was accomplished using ArcMap, and XPSWMM and LSPC models were built based on the existing and field collected data. The models were used to update the Santa Fe Watershed Plan previously developed in the late 1990's.

Based on the outputs of the XPSWMM and LSPC models, and the Arroyo Threat Assessment Report (Santa Fe Watershed Assocoation, 2016), Tetra Tech recommends four priority pilot areas for Green Infrastructure (GI) implementation:

1. The drainage areas in the City of Santa Fe downtown area are of highest priority.
2. The areas draining to the Arroyo Cloudstone and Arroyo Foothill are also of concern because of high cumulative sediment and nutrient loading from upstream subcatchments.
3. The drainage areas in Arroyo de Los Chamisos (North Fork) are currently experiencing flooding issues during storm events.
4. The areas near the mouth of the Santa Fe River are recommended for GI implementation. High runoff, sediment, and nutrient loads are predicted for some subcatchments.

The list below summarizes the team's recommendations based on the current modeling effort and ties the recommendations to other stormwater program efforts where synergies exist or where the information developed would serve multiple purposes.

- Stormwater System Infrastructure Collection – Priority 1
    - The City's record of stormwater infrastructure needs a comprehensive program to identify all street inlets, underground pipes, manholes, roadway culvert crossings and outfalls. This information is necessary for refined watershed modeling, siting water quality BMPs, determining monitoring locations, building an asset management program, and documenting maintenance concerns and compliance with MS4 program requirements.
- Detailed impervious cover database – Priority 2
    - A detailed impervious cover dataset based on the existing LiDAR data and a new high-resolution aerial image acquired for the purpose of impervious cover identification is recommended for use across several areas of the stormwater program. The detailed dataset can be used to better refine the LSPC and XPSWMM models, develop a parcel by parcel equitable stormwater utility fee (based either on impervious cover area or stormwater runoff generated per parcel), plan future expansion of the city by limiting impervious cover in sensitive areas) and identify unpermitted or unreported buildings and development across the city.
- Refine stormwater system criteria for water quality and sediment transport – Priority 1
    - The City's current stormwater criteria requires all infrastructure to meet the 100-year storm. This causes a singular focus on flood events and doesn't recognize the concerns of water quality, stream stability, sediment transport, and stormwater volume management. In concert with forthcoming water quality based requirements, the City's stormwater management criteria should

be expanded to address culvert design, stable channel design, and sediment transport to reduce flooding, maintenance and future erosion issues.

- Include stream flow monitoring in water quality monitoring program – Priority 3
    - The proposed MS4 permit requires monitoring for pollutants of concern with the City of Santa Fe's boundary. The monitoring program should address both the need for water quality information and the need for additional runoff rate and volume measurements to verify watershed scale modeling and local design parameters. The LSPC watershed models developed under this work assignment are largely uncalibrated because of limited monitoring data to aid in the parameterization of the model. The model performance for hydrology and water quality should be reviewed in the future based on streamflow and water quality monitoring data. Such an exercise will increase confidence on model estimates of sediment and nutrient loading.

The SWMM models developed in this report are intended for use by planners, designers, and agency staff who need to assess the impacts or benefits of proposed changes in the watershed. SWMM models are readily adapted to many modeling scenarios and information can be exchanged with other freely available models such as HEC-HMS and HEC-RAS.

1.0 INTRODUCTION

As described in the scope of work, Tetra Tech has adopted a modeling approach to aid in the update of the drainage management plan for the Santa Fe River and Arroyo de Los Chamisos watersheds. Two major considerations for the modeling were flood control and water quality. Subtask 2.4 of the project describes building stormwater and flood management, and water quality models for assessing flooding conditions, erosion, and pollutant loading in the Santa Fe River and Arroyo de Los Chamisos watersheds. Pre-processing of data provided by the city was accomplished using ArcMap, and XPSWMM and LSPC models were built based on the existing and field collected data. The models were used to update the Santa Fe and Arroyo de Los Chamisos Watershed Plan previously developed in the late 1990's. In the following sections, the steps taken to prepare or gather required data in support of model development, and results for stormwater and water quality modeling are summarized.

2.0 DATA PREPARATION

2.1 WATERSHED DELINEATION AND STREAM DEFINITION

The headwaters Santa Fe River (HUC ID: 130202010102, Area: 54.37 mi2) and Arroyo de Los Chamisos (HUC ID: 130202010103, Area: 26.20 mi2) watersheds are in Region 13 (Rio Grande Region) of the USGS Hydrologic Unit Map (Seaber, Kapinos, & Knapp, 1987). Watershed delineation and stream definition was based on the database provided by the City of Santa Fe and other publicly available data. An approximately 2 ft. resolution digital elevation model (DEM) data provided by Santa Fe County was available for the whole watershed and was generally used as the basis for watershed analyses. Contour lines generated from the LiDAR data acquired from Santa Fe County were used to aid in the delineation of subcatchment boundaries and identify areas susceptible to water-ponding or culverts located under highways/streets. An approximately 0.5 ft. resolution aerial image (dated 2014) was geo-referenced and used as background to identify ambiguous features that are not visible in the DEM or LiDAR data. It should be noted that Google Maps (https://www.google.com/maps) shows that some areas have experienced development/urbanization since 2014. However, in the absence of updated elevation/DEM data for these newly developed areas, it was assumed that the best source of information is provided by the combination of DEM, LiDAR, and aerial image.

A stream network shapefile (provided by the City of Santa Fe) and National Hydrography Dataset (NHD) data for the watersheds were used to guide stream network definition and connectivity of reaches. Delineation of subcatchments were generally based on the existing Drainage Management Plans for the Santa Fe River and Arroyo de Los Chamisos watersheds (City of Santa Fe, 1997; 1998). Subcatchment boundaries were however edited based on the LiDAR based contours and the DEM as deemed necessary. Newly developed properties and additional annexation areas were added to the models as well as reach connections to underground culverts and conduits to better represent contributing areas. A site visit was also performed to define (and refine) boundaries between some subcatchments that were not obvious in the DEM/contour data or street/satellite imagery. ***Figure 1*** represents watershed boundaries, delineated subcatchments, and stream definition for both watersheds used in the models.

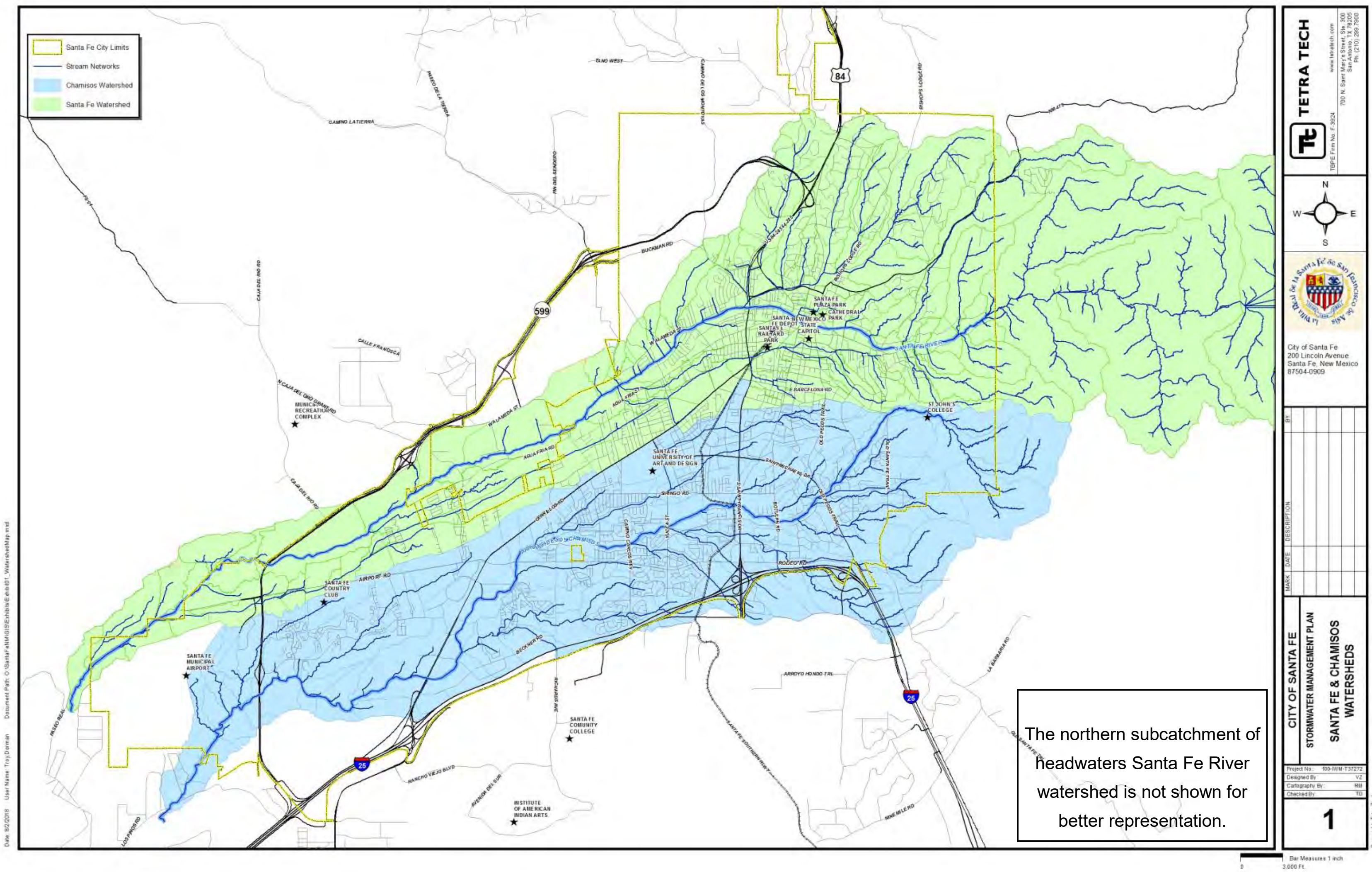


Figure 1. Headwaters Santa Fe River and Arroyo de Los Chamisos Watersheds, subcatchments, and stream networks.

2.2 SUBCATCHMENT NAMING CONVENTION

To establish a unique identifier for each individual subcatchment, the USGS Hydrologic Unit Code (HUC) numbering system was adopted. HUC 12 IDs are available for both Santa Fe River and Arroyo de Los Chamisos watersheds but further sub-classification is not available. The 12-digit numbering system for Santa Fe watershed is provided below as an example.

13: Region: Rio Grande

02: Sub-Region: Elephant Butte

02: Account Unit: Rio Grande-Elephant Butte

01: Cataloging Unit: Rio Grande-Santa Fe

01: Watershed: Santa Fe River

02: Subwatershed: Headwaters Santa Fe River

The HUC 12 IDs therefore represent the Headwaters Santa Fe River and Arroyo de Los Chamisos watersheds but not their subcatchments. Each individual tributary and subcatchment were therefore given HUC 14 and 16 IDs based on the *Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD)* (USGS & USDA, 2013). In the HUC 16 numbering system, the HUC 12 ID is followed by tributary ID (13th and 14th digits) and then the subcatchment ID (15th and 16th digits). Each tributary was also assigned a name based on the effective FEMA Digital Flood Insurance Rate Map data, USDA Hydrography dataset (where available), or nearest street (***Table 1***) to facilitate identification.

Table 1. Source of the naming for tributaries.

<table>
<tr><th colspan="2">Headwaters Santa Fe River</th><th colspan="2">Arroyo de Los Chamisos</th></tr>
<tr><th>Tributary Name</th><th>Source</th><th>Tributary Name</th><th>Source</th></tr>
<tr><td>Arroyo Barranca</td><td rowspan="10">FEMA Data</td><td>Arroyo de Los Amigos</td><td rowspan="5">FEMA Data</td></tr>
<tr><td>Arroyo de La Piedra</td><td>Arroyo de Los Chamisos</td></tr>
<tr><td>Arroyo Del Rosario</td><td>Arroyo de Los Chamisos (North Fork)</td></tr>
<tr><td>Arroyo Mascaras</td><td>Arroyo En Medio</td></tr>
<tr><td>Arroyo Ranchito</td><td>NE Arroyo de Los Pinos</td></tr>
<tr><td>Arroyo Saiz</td><td>Arroyo de La Paz</td><td rowspan="5">Stormwater Management Plan (City of Santa Fe, 1998)</td></tr>
<tr><td>Arroyo Torreon</td><td>Arroyo de Los Pintores</td></tr>
<tr><td>Canada Ancha</td><td>Cloudstone Arroyo</td></tr>
<tr><td>Canada Rincon</td><td>Foothill Arroyo</td></tr>
<tr><td>Santa Fe River</td><td>Sawmill Arroyo</td></tr>
</table>

Headwaters Santa Fe River		Arroyo de Los Chamisos	
Tributary Name	Source	Tributary Name	Source
Acequia de Los Pinos	USDA Hydrography Dataset	Sheriff's Arroyo	
Camino Carlos Real	Street closest to stream	Mesa Del Oro	Street closest to stream
Vista de Cristo		Jaguar Drive	
Calle Don Jose		N Arroyo Chamisos Urban Trail	
El Ranch Rd		Governor Miles Road	
Arroyo de Las Cruces Road		Camino Carlos Rey (Street)	
Camino de Chelly		Nizhoni Drive	
San Jose Ave		Camino Lado	
Agua Fria Road		Old Pecos Trail	
Airport Road		Calle de Sebastian	
Arroyo Tenorio		Conejo Dr	
Canyon Road		Old Santa Fe	
Camino Pequeno			
Los Arboles Drive			
Alamo Dr			
Avenida Rincon			

2.3 LAND USE, SOIL, AND CURVE NUMBER MAP

Urban Hydrology for Small Watersheds (USDA, 1986), often referred to as TR-55, represents simplified procedures for calculation of different hydrological components in small urban areas. To estimate runoff from storm events, the SCS curve number method is a broadly accepted method that relates runoff volume to rainfall depth and water abstractions in the area. The Curve Number (CN) is the most important parameter in the SCS method. CN ranges between 0 to 100 and relates land use and soil types to a number that represents potential for runoff generation. The higher a CN, the more runoff generation during storm events. TR-55 has developed several tables that estimates CN values based on the hydrologic soil group (A, B, C, or D) and land use (urban, agricultural, etc.). ***Table 2*** represents runoff curve numbers for urban areas based on the cover type and hydrological soil group. Impervious covers such as parking lots, rooftops, and streets have high CN values (80-

100), while other areas that have more pervious surfaces like residential lots and desert urban areas have lower CN values which is an indicator of less runoff generation potential.

Table 2. Runoff curve numbers for urban areas (USDA, 1986).

Cover description		hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94

The existing parcels file (available from the Santa Fe County Assessor's Office) has a column labeled "Property_C" which specifies the classification of each parcel in the city. However, the land use classification specified in the parcels file is more aligned with tax purposes and does not classify lots and parcels in a way that can be readily refined for hydrologic modeling. In addition, several thousand parcels in Santa Fe ranging from a few hundred square feet to tens of acres are missing any type of property classification.

To prepare the parcels file for estimating CN values, large unclassified lots were first compared with areal imagery or National Land Cover Dataset (NLCD) to identify land use class. However, there are many small unclassified lots and visual inspection was not possible for all of them. Any unclassified lot smaller than 3 acres was therefore assumed as residential. Other types of classes that were not aligned with hydrologic purposes (such as CITY or EXEM) were converted to the closest class that matched the nature of their activity. The parcels were reclassified into the following classes: Commercial, Forest, Industrial, Open space (good and poor condition), Residential, and Road (***Table 3***). Each land use class was subsequently assigned a unique code ***Table 4***. Residential 1 to 6 classes are defined based on their size and are classified as shown in ***Table 5*** (recommended method by TR-55).

Table 3. Land use classification of parcels data.

Property Classification	Land Use Class
Vacant (VAC)	Open Space (Poor)
Common Areas (COMA)	
Open Space (OPEN)	Open Space (Good)
Parks (PARK)	
Single Residential (SRES)	Residential
Multi Residential (MRES)	
Residential Lot (LOTR)	
CRES	
CITY and EXEM	Other classes based on their usage
Unclassified	
Commercial (COMM)	Commercial

Table 4. land use coding based on the classes.

Land Use Class	Land Use Code
Residential1	1
Residential2	2
Residential3	3
Residential4	4
Residential5	5
Residential6	6
Commercial	7
Forest	8
Industrial	9
Open Space (Good)	10
Open Space (Poor)	11
Road	12

Note - Forest class was chosen based on the "*Woods (good condition)*" in TR-55 for northern areas in both watersheds.

Table 5. Residential areas classification based on their size.

Residential Class	Reported Areas in TR-55 (acre)	Suggested Areas (acre)
Residential1	1/8 or less	1/8 or less
Residential2	1/4	1/8 to 1/4
Residential3	1/3	1/4 to 1/3
Residential4	1/2	1/3 to 1/2
Residential5	1	1/2 to 1
Residential6	2 or more	1 or more

The Soil Survey Geographic Database (SSURGO) contains physical and chemical properties associated with soils covering most of the Continental US produced by the National Cooperative Soil Survey (NRCS, Soil Survey Staff, 2017). SSURGO data was used to classify most soils in the study area except areas upstream of McClure Reservoir in Headwaters Santa Fe River watershed that did not have SSURGO coverage. For those areas, the Digital General Soil Map of the United States (STATSGO2) (NRCS, Soil Survey Staff, 2017) data was used to create a combined soil map (***Figure 2***). The land use coverage (***Figure 3***) was eventually used in conjunction with combined soils dataset to generate curve numbers for each subcatchment (***Figure 4***). Also, TR-55 has average percent of impervious cover for each of the urban districts that are listed in ***Table 2*** and ***Figure 4***.

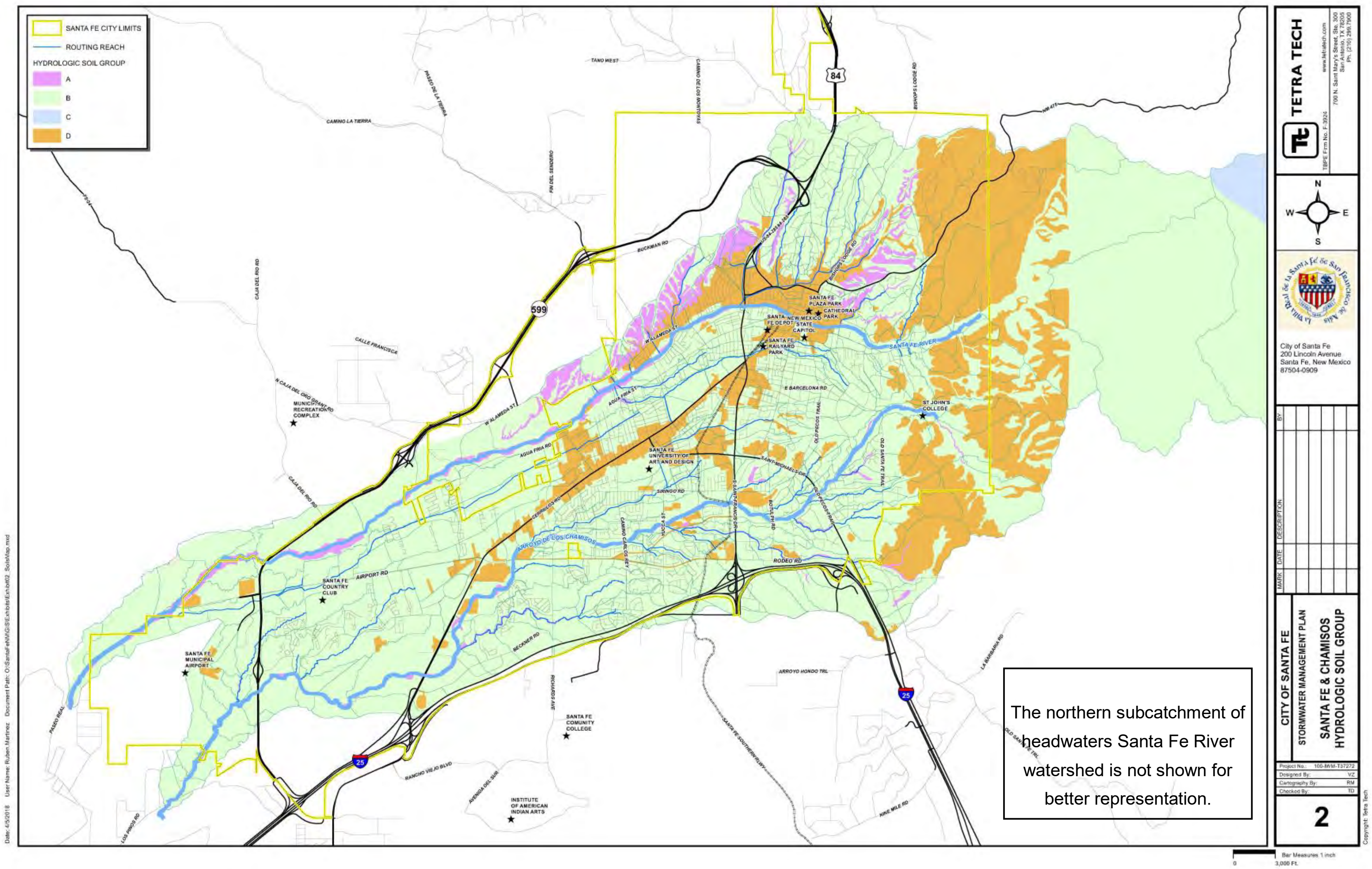


Figure 2. Soil map for headwaters Santa Fe River and Arroyo de Los Chamisos watersheds.

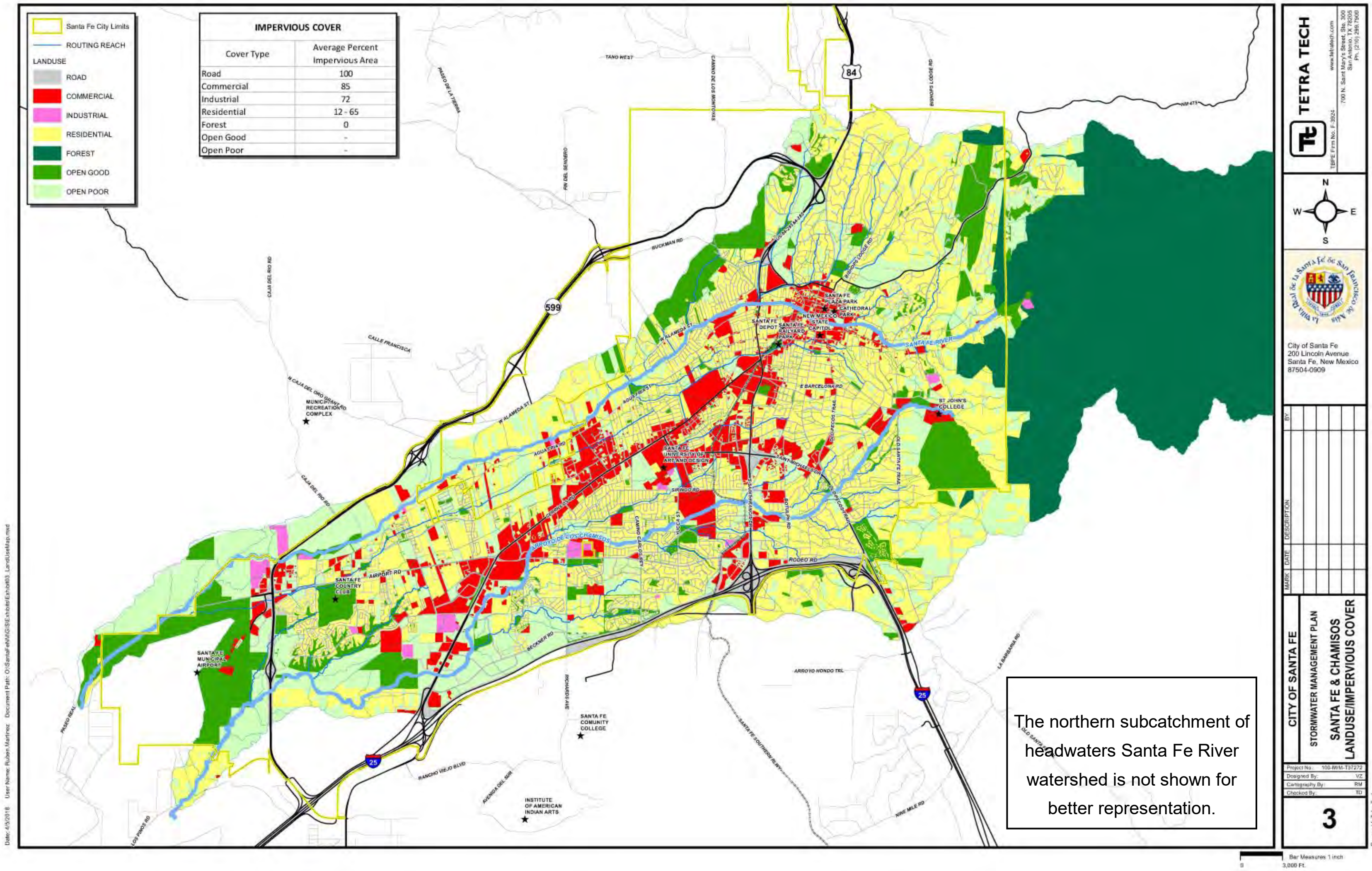


Figure 3. Land use map for headwaters Santa Fe River and Arroyo de Los Chamisos watersheds.

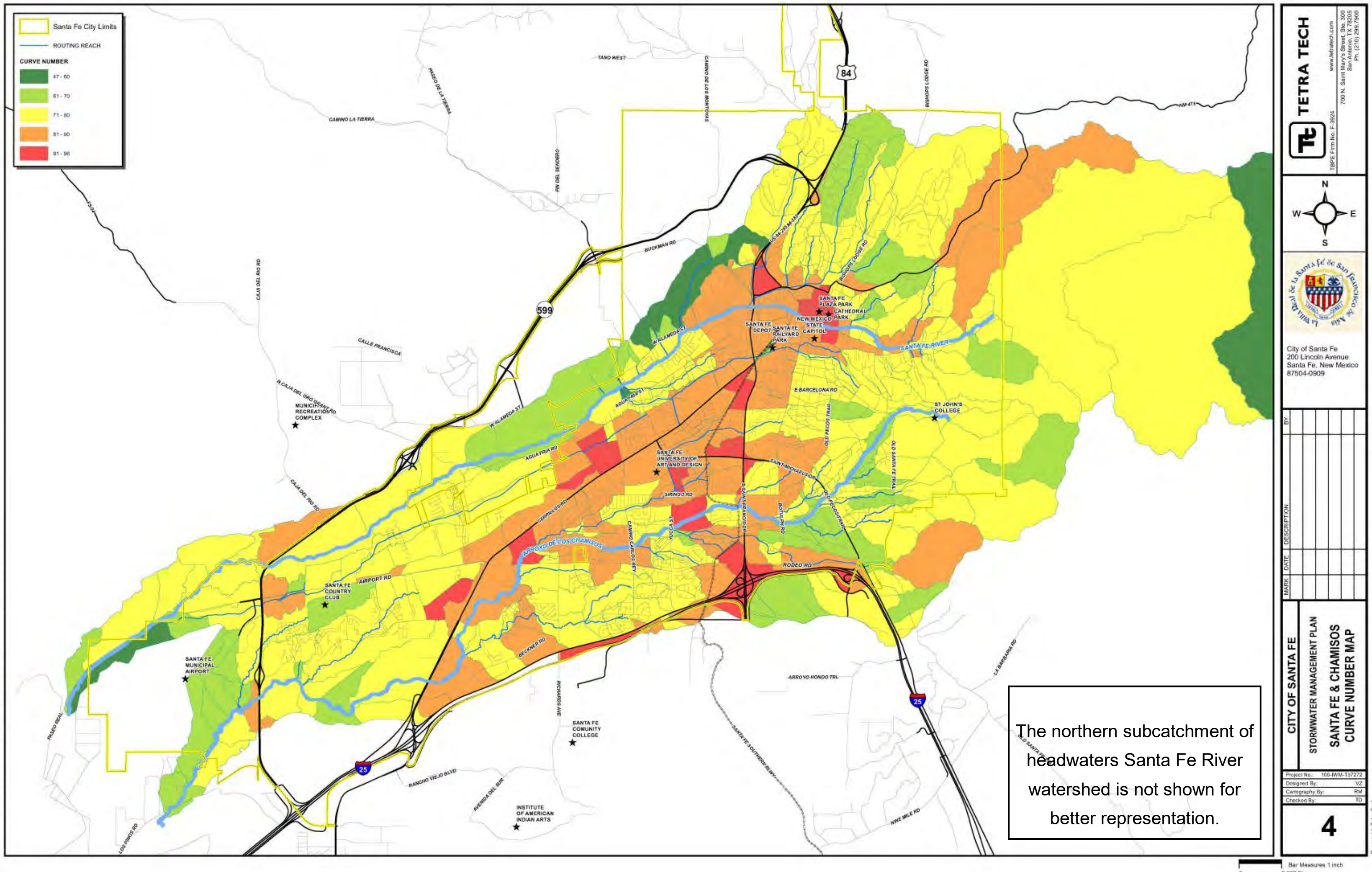


Figure 4. Curve number map for headwaters Santa Fe River and Arroyo de Los Chamisos watersheds.

2.4 STORMWATER CONVEYANCE SYSTEM

To assess the capacity of the current stormwater collection system, accurate data regarding size and type of culverts and conduits are necessary, and is of vital importance in stormwater modeling. Data associated with some culverts were available in *Drainage Management Plan* reports (City of Santa Fe, 1997; 1998) but others were missing. City staff indicated that most improvements identified in the drainage management plans were complete so the proposed culvert sizing table was used to assign the culvert size within the model. The database made available to Tetra Tech by the City of Santa Fe, consists of many shapefiles associated with stormwater infrastructure but they do not cover the entire watershed and attribute tables are often lacking size, material type, and length information necessary for modeling.

Two separate site surveys were therefore completed by Tetra Tech staff to collect information regarding the type and sizes of main roadway crossing culverts located in the watersheds, and upstream and downstream pictures were taken to assess the condition of culverts. ***Figure 5*** shows the location of both surveyed and collected data and ***Appendix A*** and ***Appendix B*** summarize collected information - culvert location, material, size, and number of barrels. The GIS datasets collected for this study will be submitted as part of a separate data deliverable of the storm drainage system

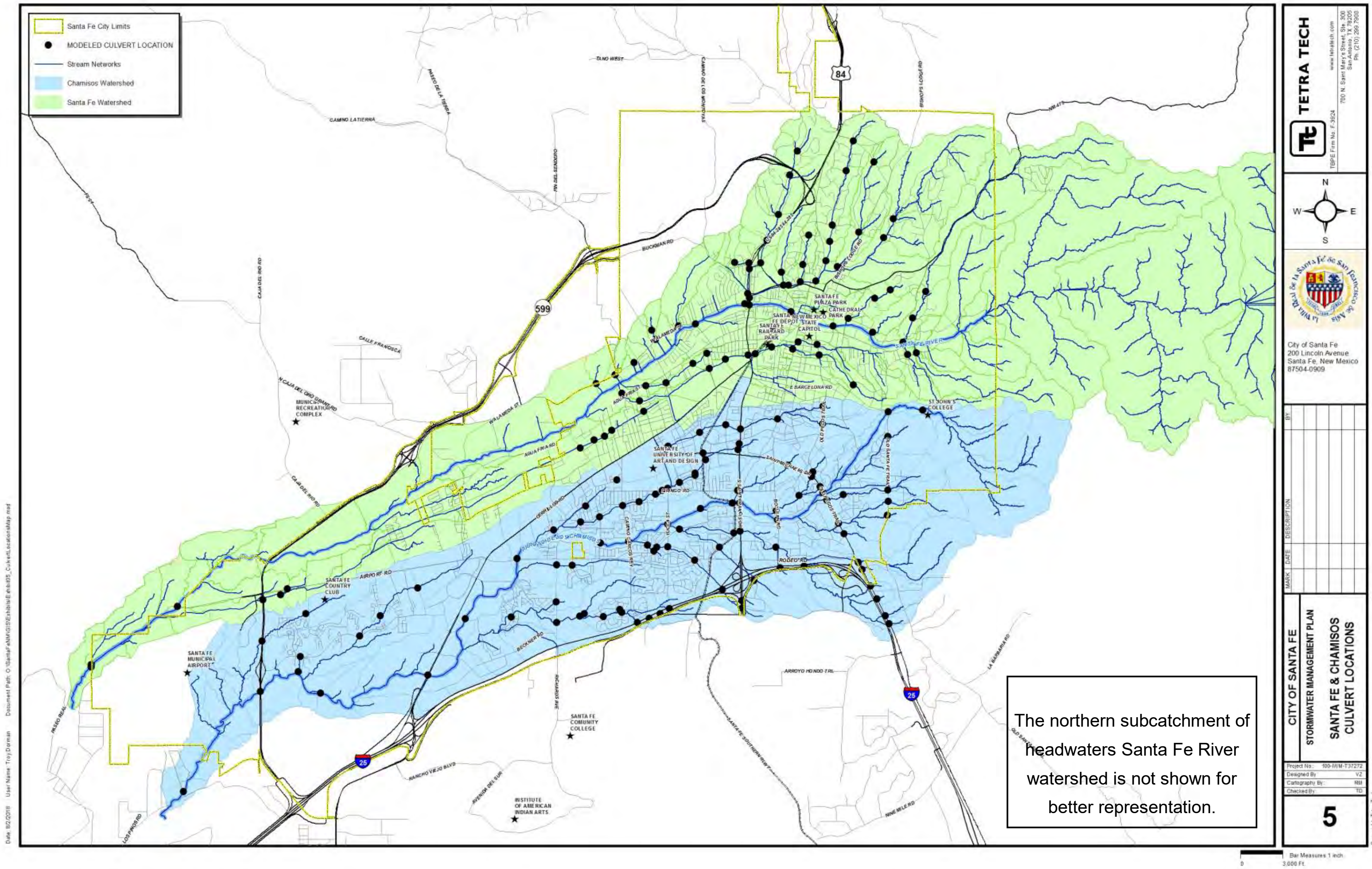


Figure 5. Location of data points (surveyed and collected) for pipes and culverts.

3.0 HYDROLOGIC AND HYDRAULIC MODELING

3.1 PRECIPITATION DATA

Precipitation data for the modeling was extracted from NOAA Atlas 14 online server for the area of City of Santa Fe (NOAA, 2011). The 10-year and 100-year design storms for a 24-hour duration were selected for modeling purposes and entered into the model as the source of rainfall (***Table 6***). These design storms are typically used for sizing culvert and storm drain systems as well as mapping floodplains.

Table 6. Design storm values for Santa Fe area (inches)

Duration	Average recurrence interval (years)	
	10	100
24 hour	2.15	3.16

3.2 RAINFALL-RUNOFF GENERATION

Snyder's unit hydrograph (Snyder, 1938) was selected as the rainfall-runoff routing method. It is a synthetic unit hydrograph based on a study of ungauged watersheds in the Appalachian Highlands in US. More importantly, there are relationships in this method to estimate the unit hydrograph parameters from watershed characteristics. Area of the subcatchments (in acres), lag time (tp), and storage coefficient (Cp) are the parameters required for unit hydrograph generation in XPSWMM. Lag time was calculated based on the CN lag method for each subcatchment (NRCS, National Engineering Handbook, 1972). Initial Cp values were adopted based on the development condition and average slope of the basin using the information in ***Table 7***.

Table 7. Typical values of Cp (iSWM, 2010).

Typical Drainage Area Characteristics	C_p
Undeveloped Areas w/ Storm Drains	
Flat Basin Slope (less than 0.50%)	0.55
Moderate Basin Slope (0.50% to 0.80%)	0.58
Steep Basin Slope (greater than 0.80%)	0.61
Moderately Developed Area	
Flat Basin Slope (less than 0.50%)	0.63
Moderate Basin Slope (0.50% to 0.80%)	0.66
Steep Basin Slope (greater than 0.80%)	0.69
Highly Developed/Commercial Area	
Flat Basin Slope (less than 0.50%)	0.70
Moderate Basin Slope (0.50% to 0.80%)	0.73
Steep Basin Slope (greater than 0.80%)	0.77

To categorize development and slope condition of each subcatchment in order to match the classes in ***Table 7***, a methodology was applied based on the average CN and Slope of each subcatchment. Development condition was identified based on CN value and steepness was calculated based on average Slope value for each subcatchment (***Table 8***).

Table 8. Curve Number and Slope classification.

Development Classification	Curve Number Value		Slope Classification	Slope Value
Undeveloped	CN < 65		Flat	Slope < 0.1
Moderately Developed	65 ≤ CN < 80		Moderate	0.1 ≤ Slope < 0.2
Highly Developed	CN ≥ 80		Steep	Slope ≥ 0.2

3.3 XPSWMM MODEL

XPSWMM is listed as a "*Nationally Accepted Hydrologic and Hydraulic*" model in FEMA's website (FEMA, 2018). It handles hydrologic and hydraulic modeling based on a collection of nodes, links, and rivers. Subcatchment data are directly served to nodes which handle routing and hydrology tasks (XPSWMM, 2014). For hydraulic modeling of the stream network, well-defined channels were selected for importing into the XPSWMM model which includes the majority of FEMA floodplains (***Figure 6***). In the upstream subcatchments, the longest flow paths including shallow channel sections were represented in the hydrologic analysis of Time of Concentration. Representative cross-sections were selected to define the shape of natural channels and the associated roughness for hydraulic modeling and hydrologic routing. Data were imported directly into XPSWMM from HEC-RAS software. The hydraulic cross-sections are not intended for mapping floodplains but rather to get a general sense of the shape, velocity, and erosivity of the major reaches.

There are two reservoirs located at the headwaters of the Santa Fe River watershed and both are incorporated into the XPSWMM model. They control streamflow from mountainous areas and allow the City of Santa Fe to capture and manage its water resources for water supply. ***Figure 6*** shows the location and ***Table 9*** summarizes basic information for each reservoir. It should be noted that there was another reservoir (Two-mile) downstream of Nichols reservoir but it was breeched in 1994 due to potential failure of the dam (Lewis & Borchert, 2009). ***Appendix C*** and ***Appendix D*** represent Elevation-Area-Storage information used for modeling the reservoirs inside XPSWMM model (Lewis & Borchert, 2009).

Table 9. Reservoirs in Headwaters Santa Fe River watershed.

Reservoir name	Longitude	Latitude	Establishment year	Capacity (ac-ft)
McClure	-105.831	35.689	1926	3255.6
Nichols	-105.877	35.691	1943	684.2

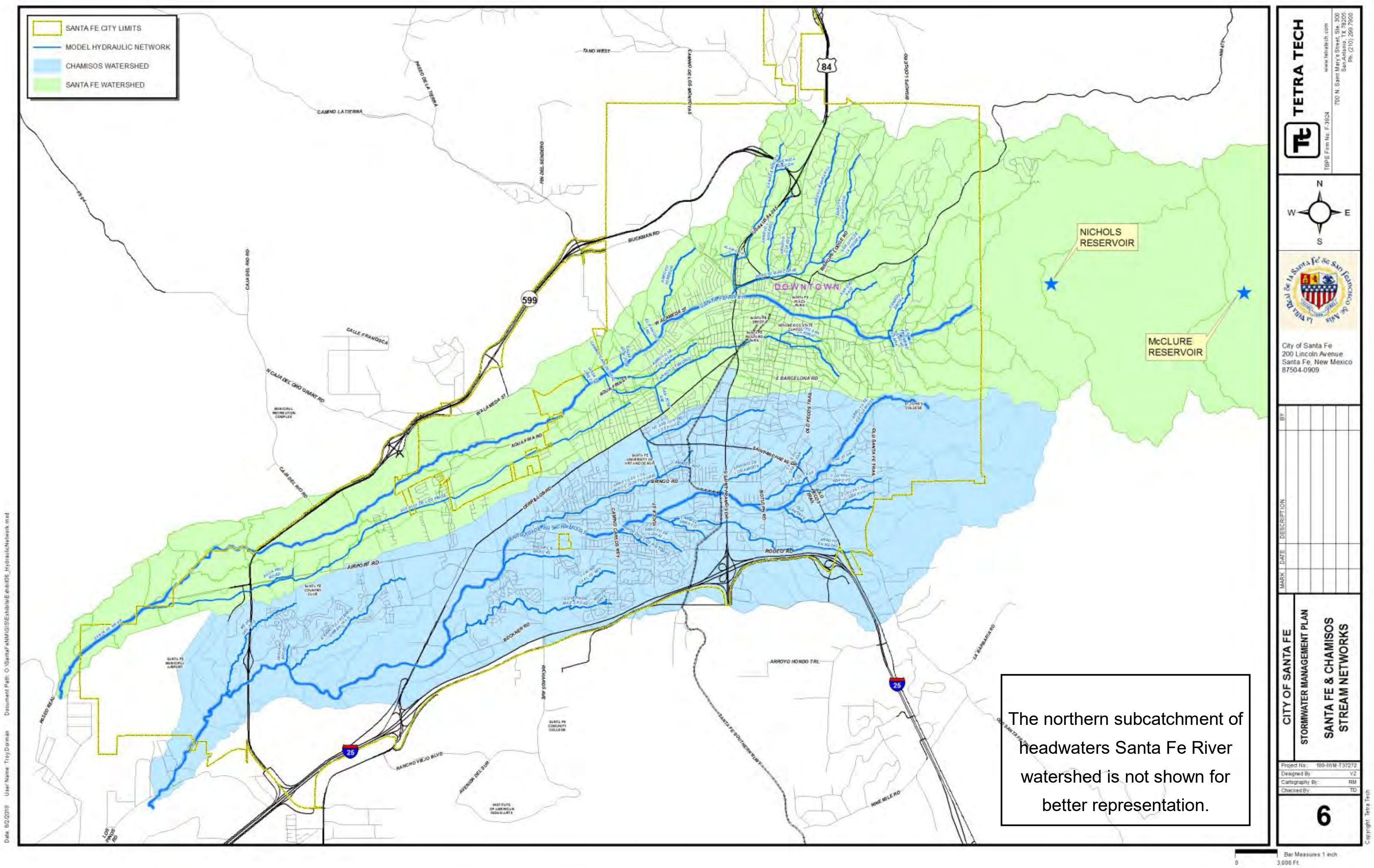


Figure 6. Stream networks selected for hydraulic modeling inside XPSWMM.

4.0 WATER QUALITY MODELING

4.1 LSPC MODEL DEVELOPMENT

LSPC watershed models were developed for the Santa Fe River and Arroyo de Los Chamisos watersheds to establish existing levels of sediment and nutrient loading at the subwatershed scale. The LSPC model for the Arroyo de Los Chamisos watershed consists of 180 subwatersheds while the Santa Fe River watershed is comprised of 176 subwatersheds. Each subwatershed in an LSPC model is comprised of smaller entities known as deluids. A deluid is the identification number assigned to the smallest landuse units in an LSPC model for which all physical processes like infiltration, runoff generation, sediment and nutrient load generation are simulated. A deluid is a unique combination of properties like land cover, soil properties, geology, slope, etc. The deluids in the Santa Fe River and Arroyo de Los Chamisos LSPC models are based on a combination of land cover and HSG. Loads generated by the deluids in a subwatershed are routed through the associated stream and downstream reaches at the model simulation time-step (hourly in this case). The LSPC models for the watersheds are setup for hourly simulation of hydrology, sediment and nutrients from 1/1/2005 to 12/31/2017.

LSPC is a hydrologic model and not a hydraulic model. Reach segments in an LSPC model are represented as one-dimensional fully mixed reactors which maintain mass balance but do not explicitly conserve momentum. The simulation of hydrographs in response to storm events in the model is dictated by Functional Tables (FTables) or depth-area-volume-discharge relationships. FTables in the models are based on physiographic region-specific regression relationships against drainage area (Bieger et al., 2015). The following equations were used for bankfull width (Wm, in meters) and bankfull depth (Ym, in meters) based on drainage area (DA, in square kilometers) we used in the LSPC for automated generation of FTables during runtime.

$$W_m = 2.56(DA)^{0.351}$$

$$Y_m = 0.38(DA)^{0.191}$$

It should be noted that FTable details primarily have an impact on the shape of a storm hydrograph but not the total flow volume.

Gridded products have been used to develop meteorological time-series forcings for the watershed models. Precipitation in the models is based on daily gridded PRISM (Parameter-elevation Relationships on Independent Slopes Model) data disaggregated to an hourly time-step using NLDAS (North American Land Data Assimilation System) version 2 gridded data. PRISM because of a finer spatial resolution is expected to provide better estimates of rainfall in these watersheds compared to NLDAS which are coarser. Other meteorological forcings (air temperature, solar radiation, wind speed and dew point temperature) are based on hourly gridded NLDAS data. Potential evapotranspiration in the model is based on the Penman Pan method with a pan evaporation coefficient appropriate for this region of the US.

5.0 RESULTS AND DISCUSSION

5.1 XPSWMM MODEL

5.1.1 Model Calibration

The hydrologic and hydraulic results of the XPSWMM modeling were compared to the effective FEMA model results for Headwaters Santa Fe River and Arroyo de Los Chamisos watersheds (***Table 10*** and ***Figure 9***). The results were reasonable and compare well with the USGS gage data and Regional Regression equations used to develop the FIS #35049CV001B dated December 4, 2012 (FEMA, 2012). The City of Santa Fe requires all stormwater systems to meet the 100-year storm event design criteria. As a result, all storm evens up to the 100-year would be expected to have similar model parameters and calibration comparisons.

Table 10. 100-year flow comparison between FEMA and XPSWMM data.

Location	Longitude	Latitude	100-yr Flow FEMA FIS (cfs)	100-yr Flow XPSWMM (cfs)
Headwaters Santa Fe River Watershed				
Canada Ancha at Confluence with Santa Fe River	-105.917	35.681	1,150	978
Santa Fe River at The Confluence of Arroyo Mascaras	-105.955	35.688	4,190	4,286
Santa Fe River at approximately 0.46 mile downstream of Alejandro Street	-105.985	35.673	4,390	5,587
Santa Fe River at the Confluence of Arroyo Calabasas	-106.117	35.610	5,930	5,915
Arroyo de Los Chamisos Watershed				
Arroyo de Los Amigos at Confluence with Arroyo de Los Chamisos	-105.958	35.65	600	404
Ne Arroyo de Los Pinos at Upstream of St. Michaels Drive	-105.976	35.66	570	604
Arroyo de Los Chamisos – North Fork	-106.006	35.642	1,800	1,674
Above Confluence with Arroyo Hondo (Cross Section 0A)	-106.095	35.588	4,400	4,898

Model calibration is the process of modifying effective model parameters to match model results with measured data. In order to calibrate model parameters (specially Cp), measured streamflow data are required at the outlet or certain locations of watersheds. Four USGS streamflow gauges are located at the upstream of headwaters Santa Fe River watershed (before and after reservoirs) but since their drainage area are mountainous with woods in good condition, it is not necessarily representative of urban areas (which contain most of the subcatchments). Currently, there are no streamflow measurements in either watershed that are appropriate for calibration. Adjacent watersheds were explored to find subcatchments with similar characteristics in order to calibrate model parameters using their data but no streamflow gauge was found in urbanized areas that could represent development condition in subcatchments. Since flow comparison of XPSWMM model with FEMA data provides reasonable results and no other type of data is available for calibration, we determined that the XPSWMM model is calibrated and ready to be used for further analysis.

5.1.2 Slope Analysis

Digital Elevation Model data was used to calculate the slope of each individual reach segment that has been modeled inside XPSWMM. The output of this analysis identifies reach segments and culverts with low slope that are vulnerable for sediment deposition and pipe clogging during storm events. ***Figure 7*** represents slope analysis results for modeled reach segments and displays them as assorted colors. Comparing results of slope analysis with ***Figure 10*** reveals that most of flood reported locations and pipe surcharges happen in areas with low to moderate slope. Mountainous regions with high slopes located at the upstream of both watersheds drain stormwater faster to flat areas and result in culvert surcharge or flooding when culverts are undersized or plugged. Arroyo Cloudstone, Arroyo Foothills (south-east of Arroyo de Los Chamisos watershed), and Arroyo Mascaras (north of Santa Fe Downtown) are examples of this issue. Also, the Arroyo Threat Assessment Report (Santa Fe Watershed Assocoation, 2016) listed these Arroyo as high priority areas for channel improvement and infrastructure damage.

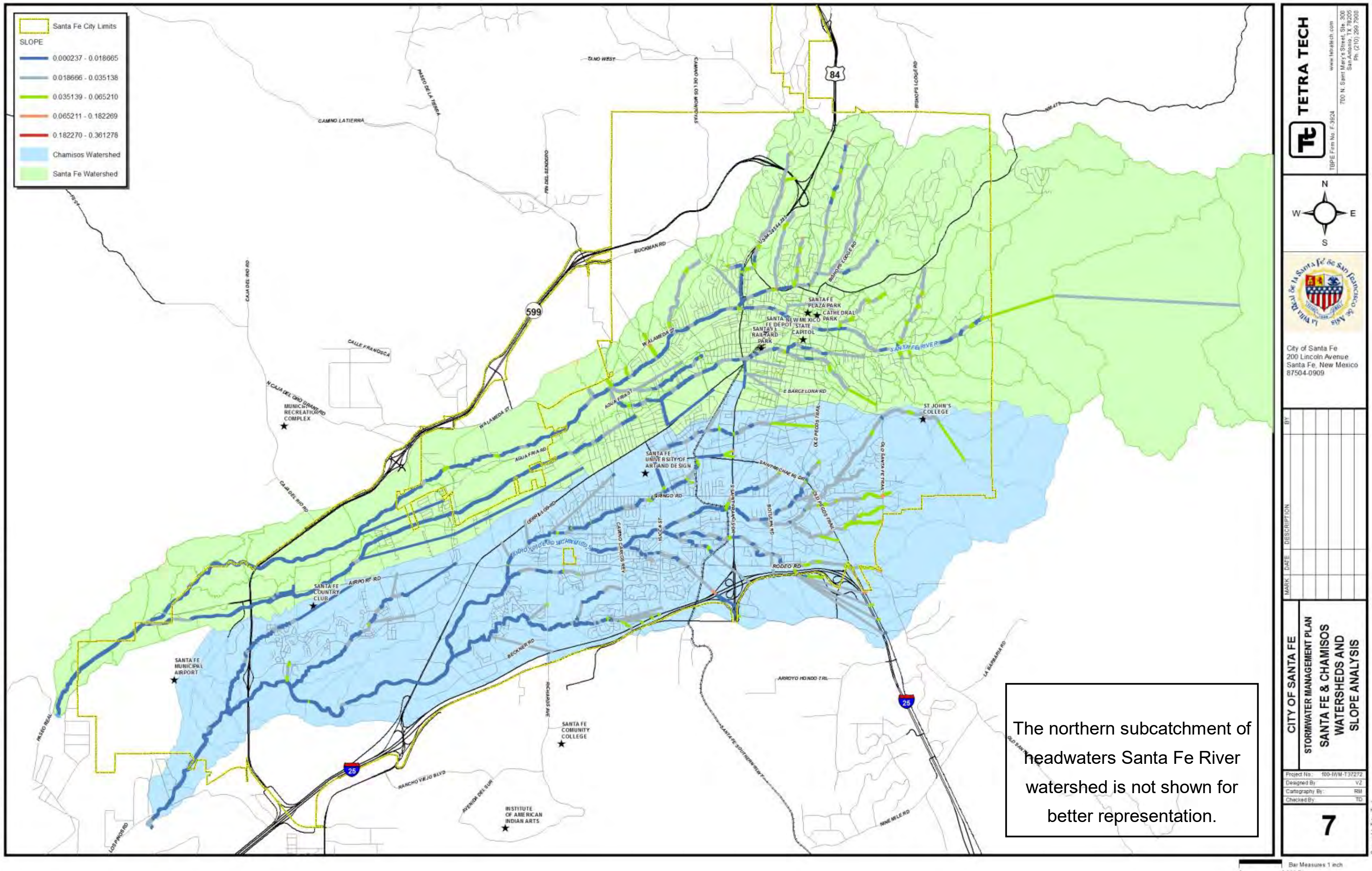


Figure 7. Average slope in reach segments.

5.1.3 Velocity Analysis

The XPSWMM model was run for the 100-year storm event precipitation and velocity profile was generated for each of the reach segments. ***Figure 8*** represents maximum velocity in reach segments. It ranges from 0.01 to 46 ft/s which depends on the slope and geometric characteristics of the reach cross-section. Areas with high velocity are potential for erosion and scour of bridge piers.

Overlaying maximum velocity with slope map reveals valuable information regarding channelization of some reaches. In the high slope areas, higher velocity values are expected but there are some culverts that have moderate or flat slope with high velocity. This issue is due to decreasing cross-section area and forcing flow to pass through the culvert which causes upstream flooding and increased velocity downstream, leading to higher erosion potential. In addition, culverts that have a flat slope or multiple openings at the same elevation cause lower flows to spread out and drop sediments. The combination of factors will create deposition and plugging upstream of a culvert and accelerate erosion downstream of the culvert even during frequent smaller events that produce runoff several times per year.

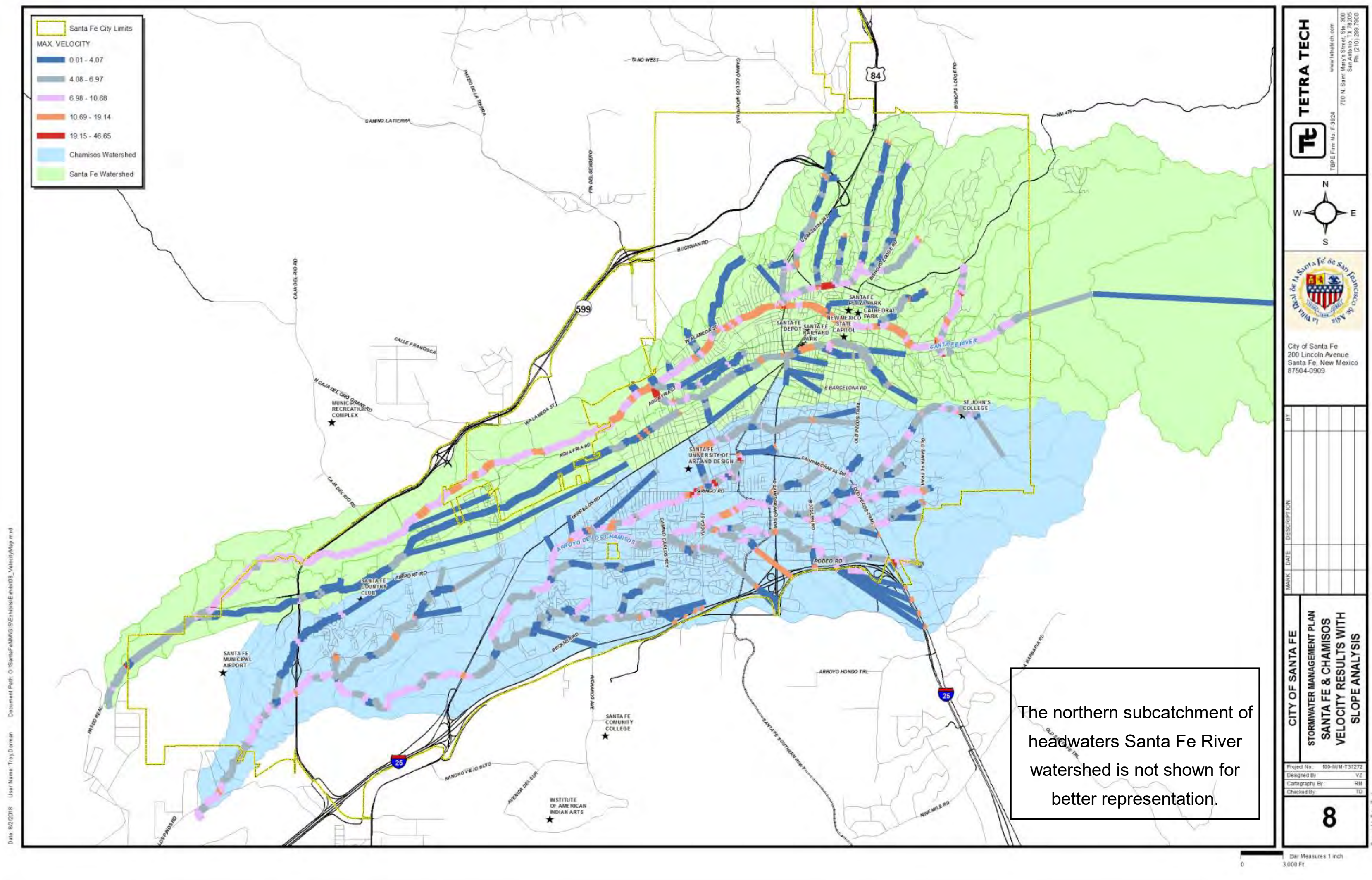
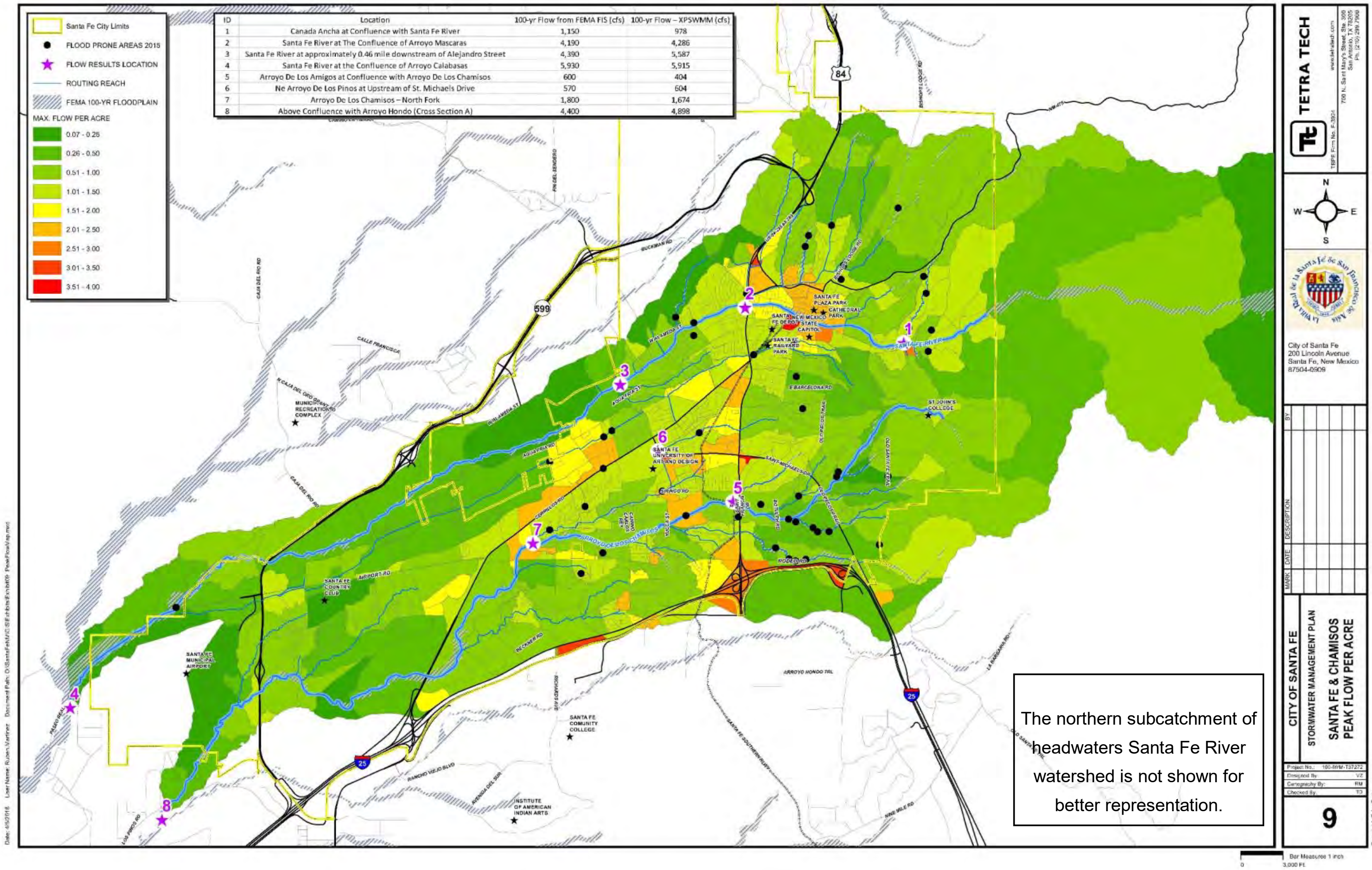


Figure 8. Maximum velocity in reach segments.

5.1.4 Peak Flow Analysis

Each of the subcatchments generates a hydrograph during rainfall-runoff routing and drains to the outlet. In the Snyder's unit hydrograph method, it is a function of lag time and storage coefficient that incorporates other characteristics of the watershed into these two parameters. A useful comparison of watersheds can be made, by dividing the peak of the hydrograph by subcatchment area, to reveal the potential of each subcatchment for generating high flows. ***Figure 9*** represent maximum flow per acre of each subcatchment. Most subcatchments with high flow are located in the highly urbanized part of the watersheds and in the vicinity of highways or major roads. This result is highlighted in the Curve Number map (***Figure 4***) where areas around Downtown Santa Fe, Cerrillos Rd., and S. Saint Francis Dr. have the highest Curve Number values that leads to higher runoff potential during storm events. These areas show a high potential for sediment transport due to high flow and increased erosion. Urbanization and impervious cover create additional runoff above baseline natural conditions which results in increased stream channel erosion.

Overlaying XPSWMM results for slope, velocity, and peak flow reveals that areas around Downtown Santa Fe are generating a high amount of peak flow and velocity while slope is low to moderate. On the other hand, since these areas have flat slope and are mostly channelized, velocities are increased, leading to higher risk for erosion. The Arroyo Threat Assessment report (Santa Fe Watershed Assocoation, 2016) mentioned Arroyo Mascaras (north of Downtown Santa Fe) as the highest potential for infrastructure damage and has recommended measures for channel stabilization.



ID	Location	100-yr Flow from FEMA FIS (cfs)	100-yr Flow – XPSWMM (cfs)
1	Canada Ancha at Confluence with Santa Fe River	1,150	978
2	Santa Fe River at The Confluence of Arroyo Mascaras	4,190	4,286
3	Santa Fe River at approximately 0.46 mile downstream of Alejandro Street	4,390	5,587
4	Santa Fe River at the Confluence of Arroyo Calabasas	5,930	5,915
5	Arroyo De Los Amigos at Confluence with Arroyo De Los Chamisos	600	404
6	Ne Arroyo De Los Pinos at Upstream of St. Michaels Drive	570	604
7	Arroyo De Los Chamisos – North Fork	1,800	1,674
8	Above Confluence with Arroyo Hondo (Cross Section A)	4,400	4,898

Figure 9. Maximum flow per acre of each subcatchment. Flow Comparison locations are shown by star and listed in the above table.

5.1.5 Culvert Capacity Analysis

Culverts and pipes that were incorporated into the XPSWMM model were analyzed to determine if they convey the 100-year design flow without surcharge. Surcharge occurs when the flow rate exceeds pipe capacity, which results in upstream flooding and even roadway closures when the water overtops the road surface. A list of reported areas with flooding issues was made available to Tetra Tech by City of Santa Fe. However, frequency of associated storm event, exact location of river tributary that flooding occurred, and the source of incoming water were not identified in the list. In cases where a specific culvert could not be determined from the reported flood issue, Tetra Tech staff selected the closest model each or main roadway crossing culvert for assessment. ***Figure 10*** presents the locations of surcharged pipes and culverts during 10-year and 100-year design storms, as well as flood prone areas reported by the City of Santa Fe. A 10-year storm is the minimum required frequency for design of roadside ditches and inlets (NMDOT, 2016). Based on the results, there are a total 17 culverts in both watersheds that are under sized for the 10-year storm event. The predicted number of surcharged culverts increased to 43 when the 100-year storm event was analyzed. Most of the locations are within reported flood prone areas which indicates the neighborhoods are having problems with undersized culverts or culvert blockage.

In order to identify minimum pipe and culvert size to convey flow without surcharge, XPSWMM was used to given iterative runs to with 10-year storm event to design new dimensions for undersized pipes and culverts. When a surcharge condition is encountered (flow exceeds full flow capacity), XPSWMM automatically increases the diameter of circular pipes or width of rectangular culverts in fixed increments until the structure is no longer surcharged. Conduits that are neither circular nor rectangular will be converted to circular if they need to be resized. Although, XPSWMM provides an estimate of the culvert size to convey the 10-year flow, a detailed analysis of each structure based on surveyed inverts and road elevations would be necessary to develop a final design. The results presented in the ***Table 11*** are useful for budgeting and initial project scoping for a Capital Improvements Program. The first 17 locations are in the Santa Fe River watershed and the last five are in the Arroyo de Los Chamisos Watershed.

Table 11. Designed conduit dimensions to convey 10-year storm event.

	Original			Designed		
Location	Height	Width	Barrels	Height	Width	Barrels
Old Santa Fe Trail and Arroyo Tenorio St.	1.5	6	1	1.5	8	1
Arroyo Mascaras at Rosario Blvd	3.33	5.42	2	3.33	5.42	3
El Camino Real at Airport Rd	4	4	2	4	4	4
Arroyo Mascaras at W Alameda St	6	10	7	6	10	8
Old Santa Fe Trail and Pino Rd	2	6	1	2	6	3
Paseo de Peralta and W Santa Fe Ave	3	4	1	3	6	1
Paseo de Peralta and W Santa Fe Ave	3	4	1	3	5	1
Galisteo St and W Booth St	3	4	1	3	5	1
Felipe St	2.75	4.08	3	2.75	4.08	5
Agua Fria St and Camino de Chelly	8	8	1	9	9	1
Santa Fe River at E Alameda St	4	10	1	4	10.5	1
Santa Fe River at E Alameda St	4	10	1	4	12	1
Acequia de Los Pinos at Maez Rd	2	4	1	2	5	1
Acequia de Los Pinos at Harrison Rd	2	2	2	2	2	4
Santa Fe River at Calle Debra	6	21	1	6	38	1
Acequia de Los Pinos at Clark Rd	1.55	1.55	1	1.8	1.8	5
Acequia de Los Pinos at Siler Rd	2	2	2	2	2	8
Pinos at Liano St.	3	3	3	3	3	5
Culvert at Governor Miles Rd.	2	2	1	2	2	4
Pinos at Practilliano Dr.	3.5	7.5	2	3.5	7.5	4
Pinos at Camino Carlos Rey	4	8	2	4	8	3
Culvert at Camino Carlos Rey	3	3	1	3	3	4

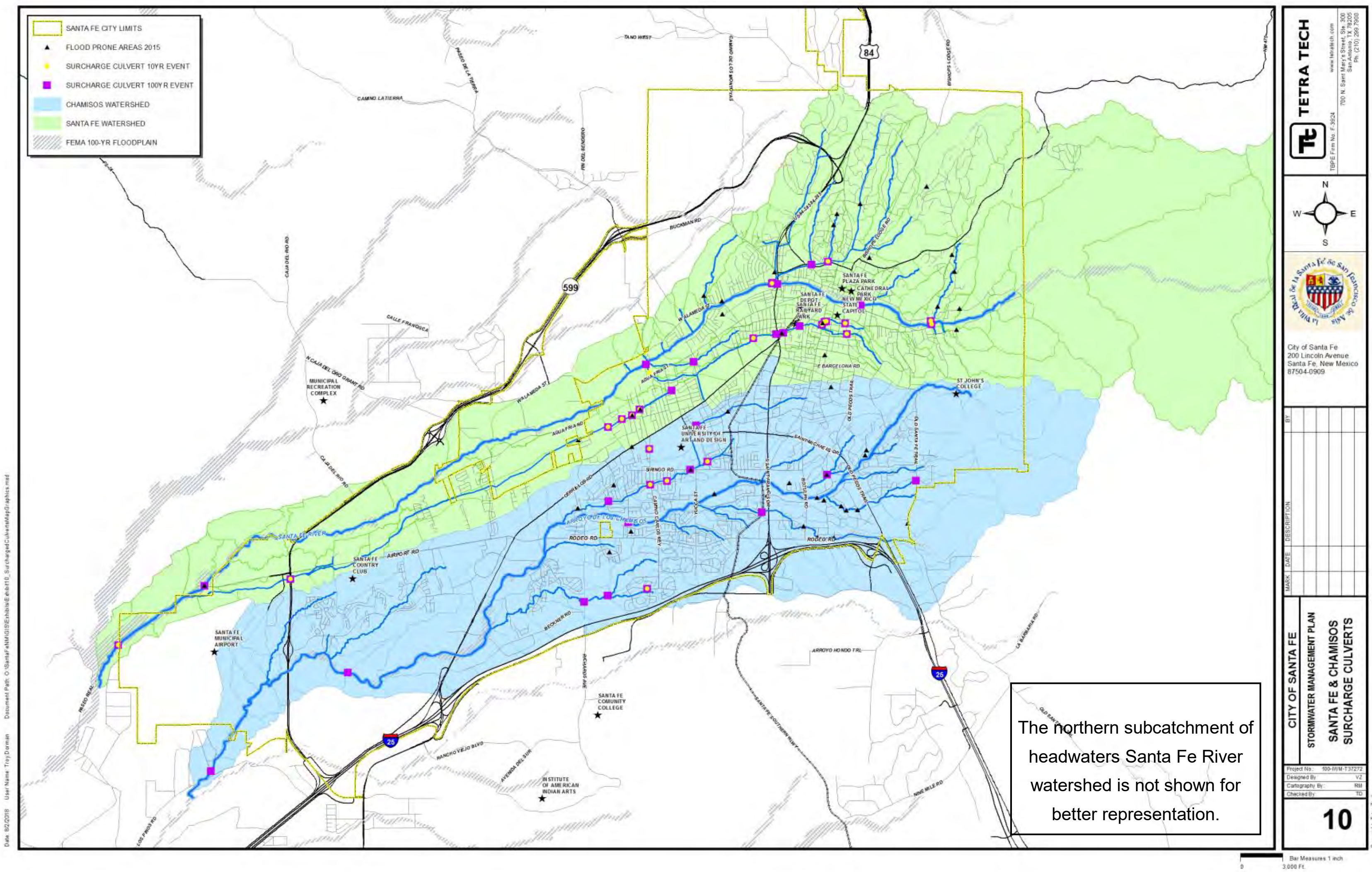


Figure 10. Location of surcharged pipes and culverts for 10-year and 100-year storm events and areas with reported flooding issues.

5.2 LSPC MODEL

5.2.1 Hydrology Simulation

As noted above, both watersheds generally lack streamflow and water quality data to enable comprehensive calibration and validation of the watershed models. Parameterization of the LSPC models was therefore based on prior HSPF (Hydrologic Simulation Program - FORTRAN) models for this region (Moltz et al., 2009; Butcher et al., 2013).

The simulated water balance for the Santa Fe River and Arroyo de Los Chamisos watersheds are shown in

Figure 11. Evapotranspiration is expected to be the largest part of the water balance and is approximately 85% of the precipitation, and in a similar range (of 80% to 99%) reported for this region by Sanford and Selnick (2013). The ratio of LSPC simulated average annual surface runoff to precipitation is shown at the subcatchment scale in ***Figure 13***. As expected, this ratio is generally higher for the more urbanized areas (with high imperviousness) of the watersheds. The flow duration curve for combined daily simulated streamflow from Santa Fe River and Arroyo de Los Chamisos (***Figure 12***) shows that the simulated streamflow generally ranges from 100 cfs to less than 1 cfs.

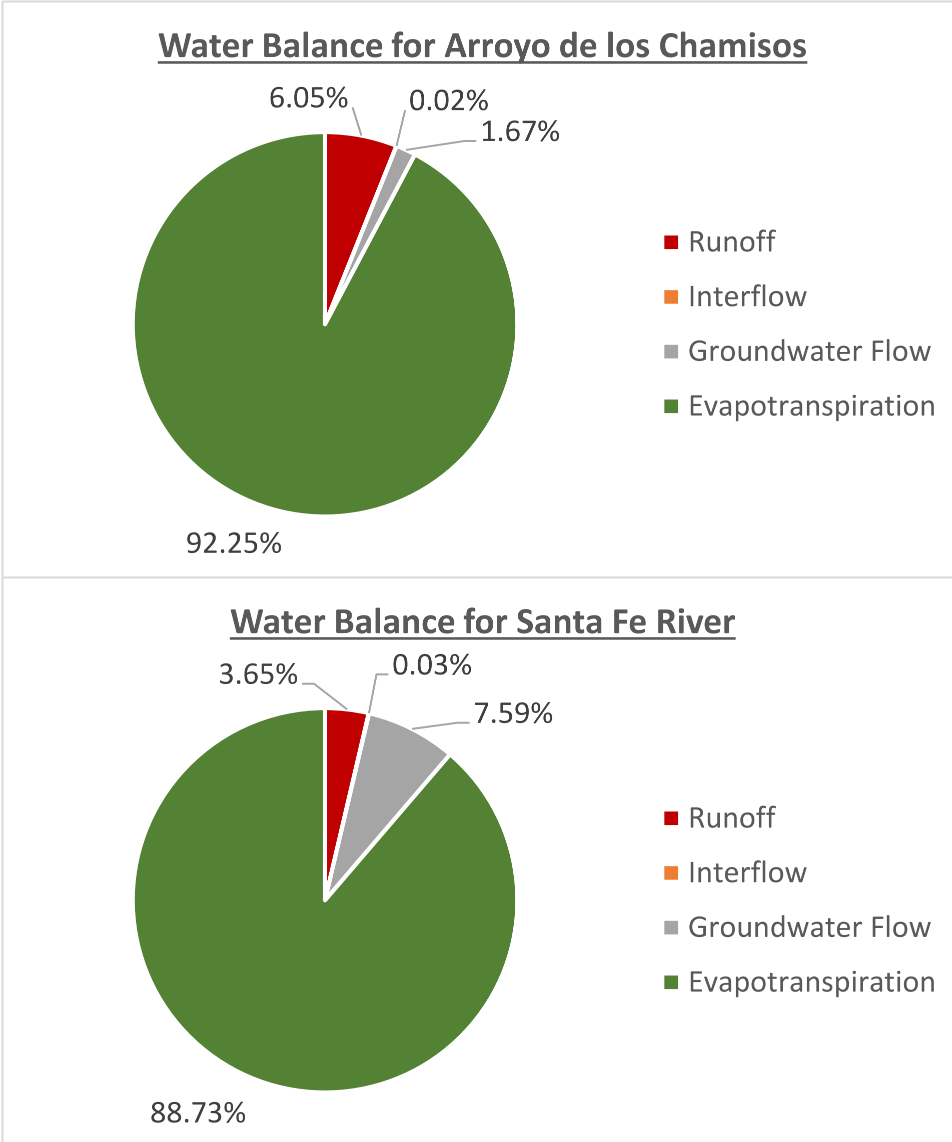


Figure 11. Simulated water balance for the Arroyo de Los Chamisos and Santa Fe River LSPC models.

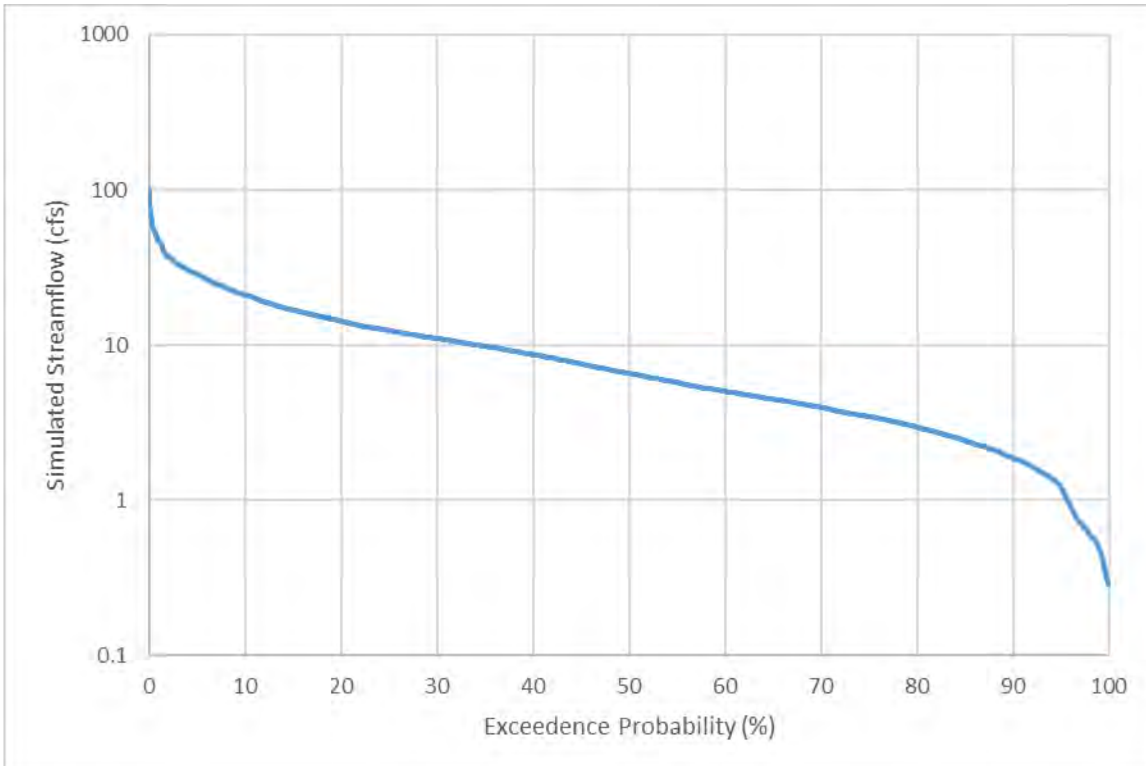


Figure 12. Simulated streamflow duration for the Santa Fe River and Arroyo de Los Chamisos.

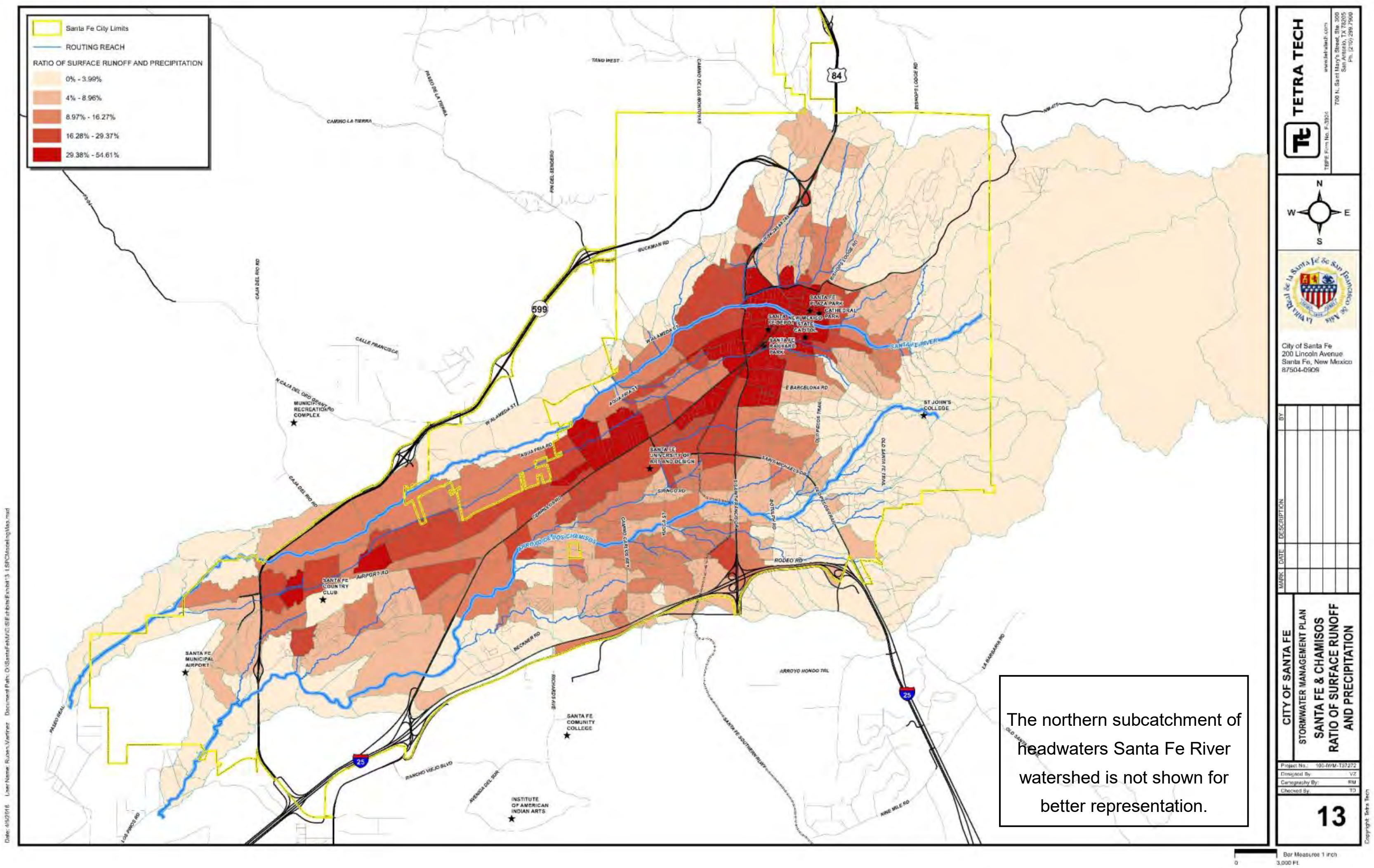


Figure 13. Ratio of LSPC simulated surface runoff to precipitation for the Santa Fe River and Arroyo de Los Chamisos watersheds.

5.2.2 Water Quality Simulation

Given limited water quality monitoring, at this time the sediment and nutrient loads predicted by the LSPC models are the best estimates of non-point source pollutant loading in the watershed. As and when more data are available, the watershed models should be re-evaluated for water quality simulation. Simulated annual average sediment, total nitrogen and total phosphorus loads simulated by the LSPC models are summarized in ***Table 12***.

Table 12. Simulated average annual sediment, total nitrogen and total phosphorus loads for the Santa Fe River and Arroyo de Los Chamisos LSPC models.

Constituent	Santa Fe River	Arroyo de Los Chamisos
Sediment (tons/yr)	2,341.7	555.1
Total Phosphorus (lbs/yr)	342.0	103.8
Total Nitrogen (lbs/yr)	5,868.5	689.5

Simulated non-point runoff associated sediment and nutrient loads at the subcatchment scale are shown in ***Figure 14*** to ***Figure 16***. The sediment and nutrient load show the same trend as runoff with higher loading rates predicted for subcatchments with higher levels of urbanization and imperviousness. Some subcatchments in the south-east part of the Arroyo de Los Chamisos watershed show high sediment and phosphorus loading rates despite being not as heavily urbanized as the rest of the watershed. The high loads are likely linked to poor soil conditions in this region of the Arroyo de Los Chamisos watershed.

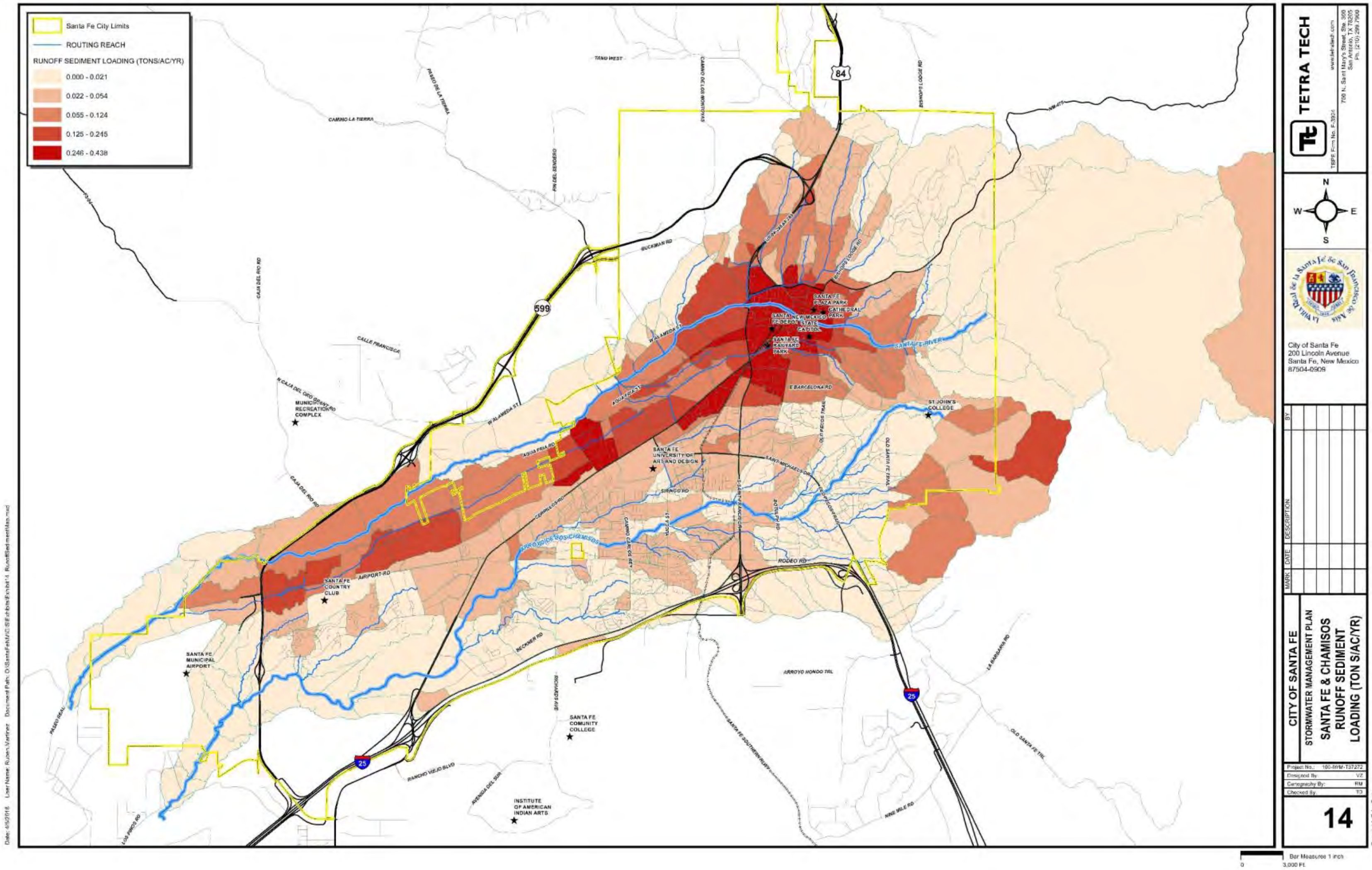


Figure 14. LSPC simulated annual average sediment load for the Santa Fe River and Arroyo de Los Chamisos watersheds.

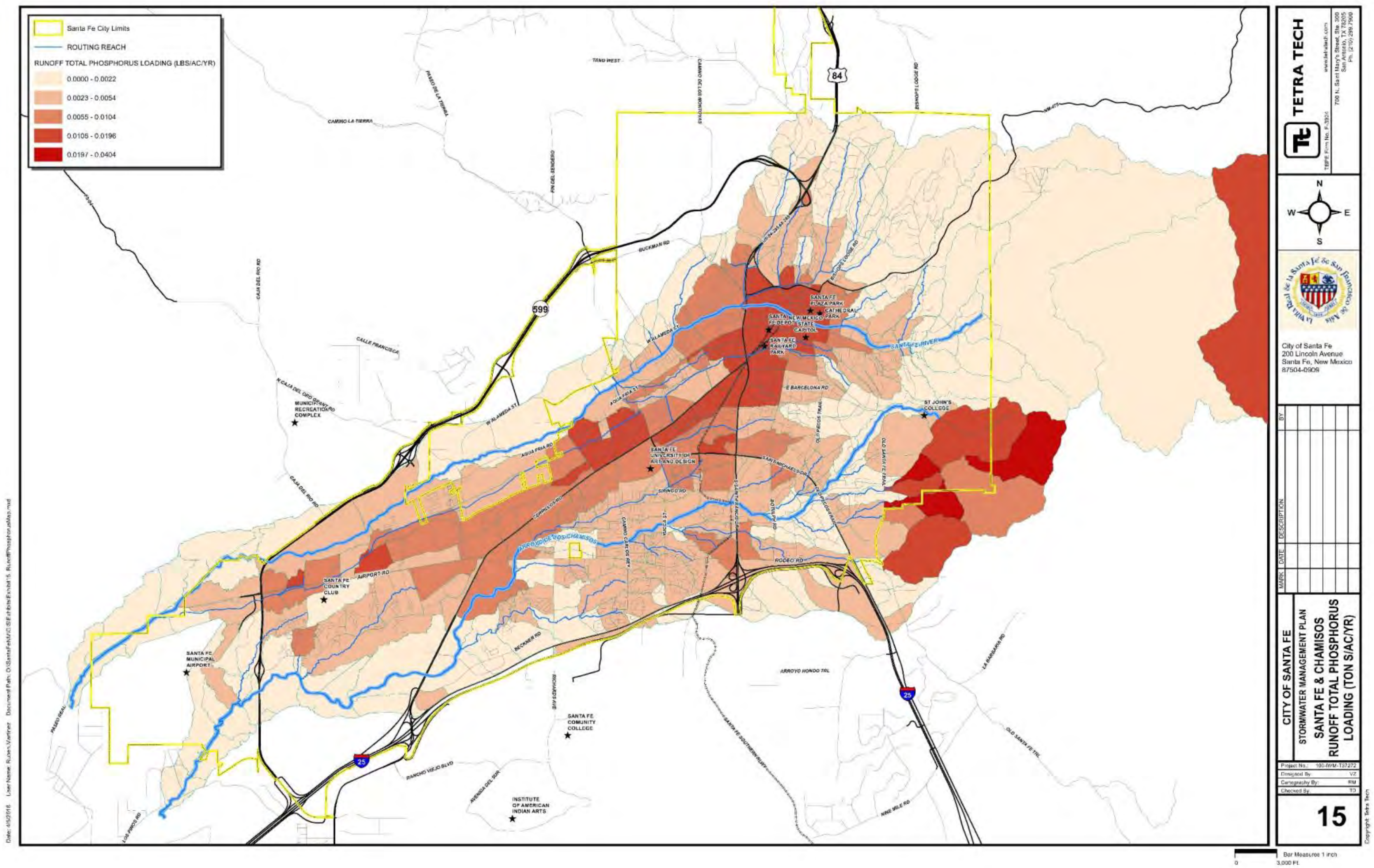


Figure 15. LSPC simulated annual average runoff phosphorus load for the Santa Fe River and Arroyo de Los Chamisos watersheds.

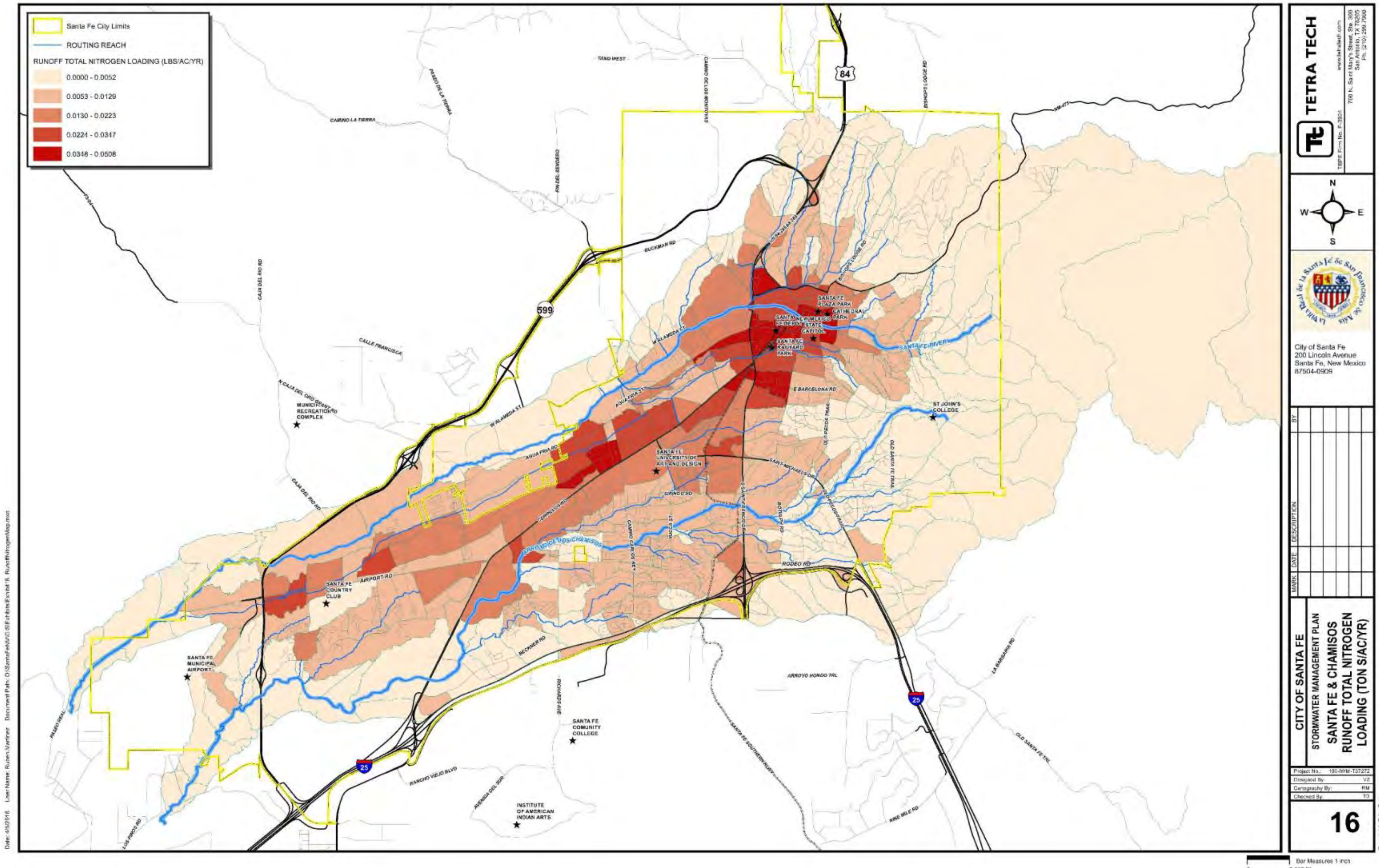


Figure 16. LSPC simulated annual average runoff nitrogen load for the Santa Fe River and Arroyo de Los Chamisos watersheds.

6.0 PRIORITY AREAS FOR GREEN INFRASTRUCTURE IMPLEMENTATION

Based on the outputs of the XPSWMM and LSPC models, and the Arroyo Threat Assessment Report (Santa Fe Watershed Assocoation, 2016), Tetra Tech recommends four priority pilot areas for Green Infrastructure (GI) implementation (***Figure 17.*** Priority areas for GI implementation.

):

1. The subcatchments in the City of Santa Fe downtown area are of highest priority. High peak flow rates, runoff volumes, sediment and nutrient loads, and pipe surcharges are simulated for these areas and flooding issues have been reported frequently. Some subcatchments in this area drain to the Arroyo Mascaras, parts of which have been rated as “high” infrastructure damage/risk in the Arroyo Threat Assessment Report.

2. The subcatchments draining to the Arroyo Cloudstone and Arroyo Foothill are also of concern because of high cumulative sediment and nutrient loading from upstream subcatchments. Also, downstream of these Arroyo have been reported as flood prone areas and based on the hydraulic modeling, some culverts are likely to surcharge during 100-year events. In addition, sections of the Arroyo Cloudstone are already identified as “high” infrastructure damage/risk.

3. The subcatchments in Arroyo de Los Chamisos (North Fork) are currently experiencing flooding issues during storm events. Although the Arroyo Threat Assessment Report generally rates the infrastructure in this region as “good”, the modeling results elaborate that some culverts are likely undersized for conveyance of 10-year and 100-year events. Sediment and nutrient loads predicted for this area are also moderately high.

4. Lastly, the areas near the mouth of the Santa Fe River are recommended for GI implementation. High runoff, sediment and nutrient loads are predicted for some subcatchments. Given the high velocity values along the Santa Fe River, it has high potential for erosion too. Also, culvert capacity analysis suggests that some culverts are likely under-sized for conveyance of 10-year and 100-year events and flooding have been a reported issue, especially in Acequia de Los Pinos.

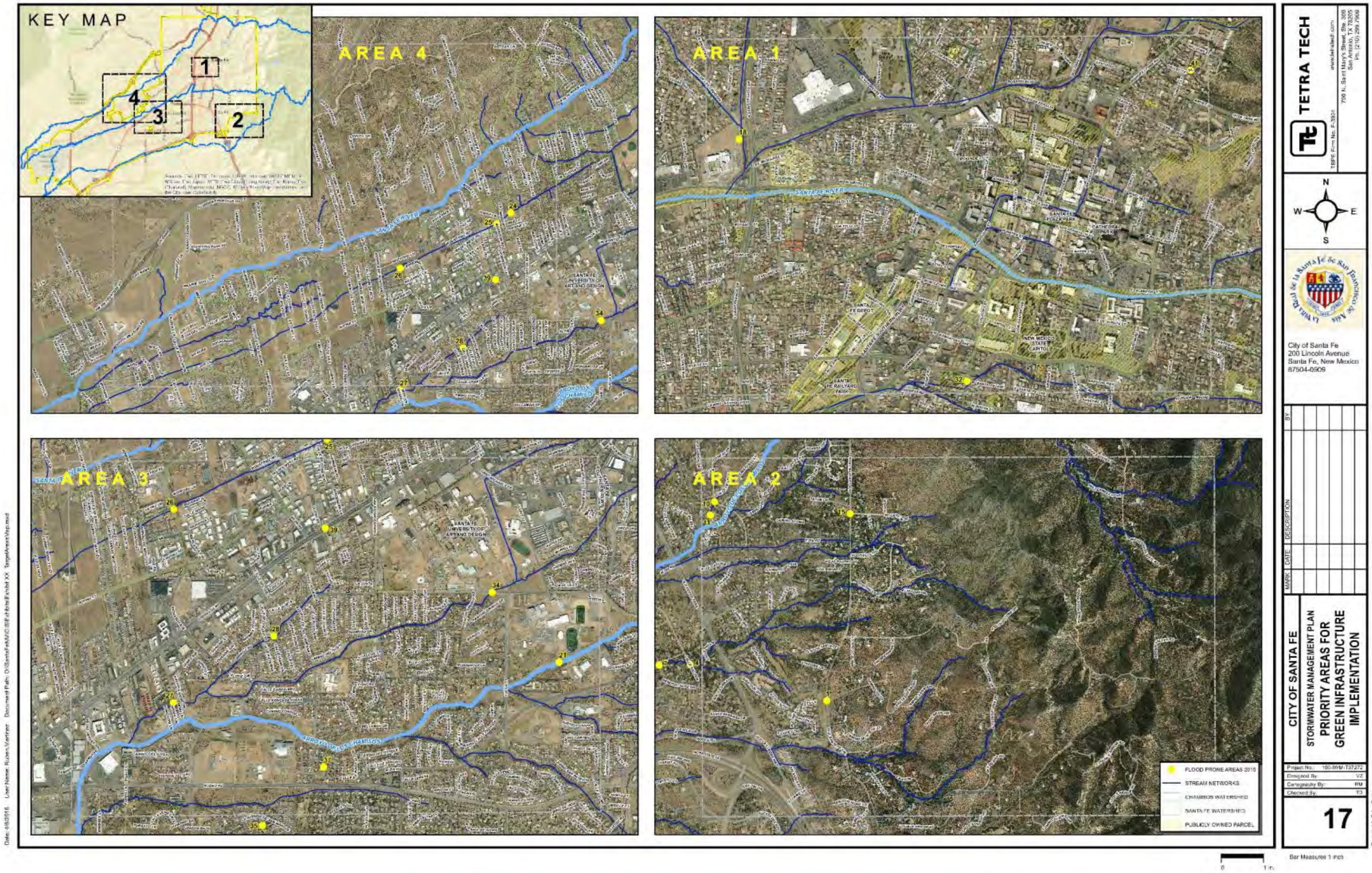


Figure 17. Priority areas for GI implementation.

7.0 FUTURE MODEL ENHANCEMENTS

The LSPC watershed models developed under this work assignment are largely uncalibrated because of limited monitoring data to aid in the parameterization of the model. The model performance for hydrology and water quality should be reviewed in the future based on streamflow and water quality monitoring data. Such an exercise will increase confidence on model estimates of sediment and nutrient loading.

Since urban areas are the focus of non-point pollution in these watersheds a more detailed impervious coverage dataset should be developed for the study area. Such an enhanced impervious coverage dataset should also be used to improve the representation of urban areas in the XPSWMM and LSPC models

Lastly watershed models are most useful in providing existing pollutant loads and also for evaluation of best management practices (BMPs) to mitigate increased volume pollution. LSPC is well-designed to link to the SUSTAIN model to evaluate the impacts of BMPs on pollutant loads and associated costs. The watershed model at this time provides relative estimates of subcatchments that have high sediment and nutrient loading rates. Targeted application of BMPs using the LSPC-SUSTAIN linked model may be readily evaluated for some of these problematic subcatchments for cost effective pollution abatement.

8.0 STORMWATER PROGRAM RECOMMENDATIONS

A high-level review of the model development process and model results presented in this report provides insights into the City of Santa Fe's broader stormwater program. As described above the modeling is useful for identifying areas where urbanization, watershed characteristics and transportation features are resulting in flood prone areas. In combination with the Santa Fe Watershed Association's arroyo assessment, the model results help identify stream segments that are experiencing accelerated erosion and will result in higher maintenance and repair costs for the City. The model also indicates hotspots for water quality concerns that can be addressed as part of the upcoming Phase II MS4 permit implementation. However, there are a few model refinements that would allow a more detailed look within the watersheds and provide better certainty on the level of water quality enhancements. In addition, there are specific design criteria that are recommended to address water quality and flooding issues. The list below summarizes the team's recommendations based on the current modeling effort and ties the recommendations to other stormwater program efforts where synergies exist or where the information developed would serve multiple purposes.

- Stormwater system infrastructure collection – Priority 1
    - The City's record of stormwater infrastructure needs a comprehensive program to identify all street inlets, underground pipes, manholes, roadway culvert crossings and outfalls. This information is necessary for refined watershed modeling, siting water quality BMPs, determining monitoring locations, building an asset management program, and documenting maintenance concerns and compliance with MS4 program requirements.
- Detailed impervious cover database – Priority 2
    - A detailed impervious cover dataset based on the existing LiDAR data and a new high-resolution aerial image acquired for the purpose of impervious cover identification is recommended for use across several areas of the stormwater program. The detailed dataset can be used to better refine the LSPC and XPSWMM models, develop a parcel by parcel equitable stormwater utility fee (based either on impervious cover area or stormwater runoff generated per parcel), plan future expansion of the city by limiting impervious cover in sensitive areas) and identify unpermitted or unreported buildings and development across the city.
- Refine stormwater system criteria for water quality and sediment transport – Priority 1
    - The City's current stormwater criteria requires all infrastructure to meet the 100-year storm. This causes a singular focus on flood events and doesn't recognize the concerns of water quality,

stream stability, sediment transport, and stormwater volume management. In concert with forthcoming water quality based requirements, the City's stormwater management criteria should be expanded to address culvert design, stable channel design, and sediment transport to reduce flooding, maintenance and future erosion issues.

- Include stream flow monitoring in water quality monitoring program – Priority 3
    - The proposed MS4 permit requires monitoring for pollutants of concern with the City of Santa Fe's boundary. The monitoring program should address both the need for water quality information and the need for additional runoff rate and volume measurements to verify watershed scale modeling and local design parameters.

9.0 BIBLIOGRAPHY

Butcher, J., A. Parker, S. Sarkar, S. Job, M. Faizullabhoy, P. Cada, J. Wyss, R. Srinivasan, P. Tuppad, D. Debjani, A. Donigian, J. Imhoff, J. Kittle, B. Bicknell, P. Hummel, P. Duda, T. Johnson, C. Weaver, M. Warren, and D. Nover. 2013. *Watershed Modeling to Assess the Sensitivity of Streamflow, Nutrient, and Sediment Loads to Potential Climate Change and Urban Development in 20 U.S. Watersheds*. EPA/600/R-12/058F. National Center for Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, Washington, DC. Final, Sept. 30, 2013. http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=256912.

City of Santa Fe. (1997). *Drainage Management Plan for Santa Fe River Watershed.*

City of Santa Fe. (1998). *Drainage Management Plan for Arroyo de Los Chamisos Watershed.*

FEMA. (2012). *Flood Insurance Study for Santa Fe County, New Mexico and Incorporated Areas.* Federal Emergency Management Agency.

FEMA. (2018, 4 2). *Hydraulic Numerical Models Meeting the Minimum Requirement of National Flood Insurance Program*. Retrieved from Federal Emergency Management Agency: https://www.fema.gov/hydraulic-numerical-models-meeting-minimum-requirement-national-flood-insurance-program#

iSWM. (2010). *integrated Stormwater Management.* North Central Texas Council of Governments. Retrieved from http://iswm.nctcog.org/Documents/technical_manual/Hydrology_4-2010.pdf

Lewis, A., & Borchert, C. (2009). *Santa Fe River Studies: Reservoir Storage.* City of Santa fe. Retrieved 10 6, 2017, from www.santafenm.gov/document_center/document/760

NMDOT. (2016). *New Mexico Department of Transportation Design Manual.* Retrieved from http://dot.state.nm.us/content/dam/nmdot/Infrastructure/DesignManual/NMDOT_Design_Manual.pdf

NOAA. (2011). *Precipitation-Frequency Atlas of the United States.* National Oceanic and Atmospheric Administration. National Weather Service.

NRCS. (1972). National Engineering Handbook.

NRCS. (2017, 11 29). *Soil Survey Staff*. (United States Department of Agriculture) Retrieved from Natural Resources Conservation Service: https://websoilsurvey.nrcs.usda.gov/

Santa Fe Watershed Assocoation. (2016). *Arroyo Threat Assessment Surveys of 15 Major Arroyo in the Santa Fe River Watershed.* Santa Fe: Public Works Department, City of Santa Fe.

Seaber, P., Kapinos, F., & Knapp, G. (1987). *Hydrologic Unit Maps.* U.S. Geological Survey, Water Supply Paper 2294.

Snyder, F. (1938). Synthetic Unit Hydrographs. *Transactions of the American Geophysical Union*, *19*, pp. 447-454.

USDA. (1986). *Urban Hydrology for Small Watersheds.* Conservation Engineering Division, Natural Resources Conservation Service.

USGS, & USDA. (2013). *Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD).* Natural Resources Conservation Service. Retrieved from https://pubs.usgs.gov/tm/11/a3/

XPSWMM. (2014). *XPSWMM Reference Manual.* Innovyze.

APPENDIX A. SURVEYED DATA OF STORMWATER COLLECTION SYSTEM IN HEADWATERS SANTA FE WATERSHED

Name	Lat.	Long.	Material	Shape	Height [ft]	Width [ft]	# Barrels
Santa Fe River at Calle Debra	35.618	-106.112	CMP	Arch	6	20	1
Santa Fe River at Calle Debra	35.618	-106.112	CMP	Round	3	3	2
Santa Fe River at Calle Debra	35.618	-106.112	CMP	Oval	2	3	3
Santa Fe River at Paseo Real	35.630	-106.092	CMP	1/2 Round	6	12	7
Acequia de Los Pinos at Clark Rd	35.662	-105.991	CMP	Round	2	2	1
Acequia de Los Pinos at Siler Rd	35.660	-105.995	CMP	Round	2	2	2
Acequia de Los Pinos at Harrison Rd	35.663	-105.989	Concrete	Oval	1.5	2.5	2
Acequia de Los Pinos at Maez Rd	35.664	-105.987	Concrete	Oval	2.5	4.5	1
Acequia de Los Pinos at Osage Ave	35.668	-105.979	CMP	Arch	2.5	4.5	1
W Alameda St	35.673	-105.991	Concrete	Round	5	5	2
W Alameda St and Camino Carlos Rael	35.675	-105.986	CMP	Round	5	5	2
W Alameda St and Calle Nopal	35.677	-105.982	Stone & Concrete	Square	2.25	6	1
N El Rancho Rd and Paseo de Las Vistas	35.684	-105.978	Concrete	Square	1 to 2	6	1
W Alameda St and N El Rancho Rd	35.682	-105.977	Concrete	Square	4.75	8	1
El Camino Real at Airport Rd	35.631	-106.071	CMP	Round	4	4	2
Agua Fria St and Camino de Chelly	35.671	-105.985	Concrete	Round	8	8	1
Osage Ave and San Ildefonso Rd	35.670	-105.980	Concrete	Square	5	8	2
Cristobal Colon and Agua Fria St	35.677	-105.968	CMP	Arch	4	6	1

Name	Lat.	Long.	Material	Shape	Height [ft]	Width [ft]	# Barrels
Baca St and Hickox St	35.679	-105.964	CMP	Arch	2.25	4.5	1
Velarde St and Agua Fria St	35.673	-105.974	CMP	Round	3	3	1
Agua Fria St and Camino Solano	35.673	-105.979	CMP	Arch	4	6	1
Baca St and Potencia St	35.676	-105.964	CMP	Arch	3	5	2
Felipe St	35.678	-105.960	CMP	Arch	2.5	4	3
S St Francis Dr and Mercer St	35.679	-105.954	CMP	Round	4.5	4.5	2
Cerrillos Rd and Don Diego Ave	35.680	-105.949	Concrete	Round	3.5	3.5	1
Galisteo St and W Booth St	35.680	-105.944	Concrete	Square	3	5	1
Old Santa Fe Trail and Arroyo Tenorio St.	35.679	-105.937	Concrete	Square	1 to 1.5	6	1
Camino Corrales and Garcia St	35.673	-105.929	Concrete	Square	5.5	10	1
Old Santa Fe Trail and Pino Rd	35.681	-105.938	Concrete	Square	2.5	6	1
Paseo de Peralta and W Santa Fe Ave	35.681	-105.942	Concrete	Square	3	4	1
Santa Fe River and Camino Alire	35.685	-105.967	Concrete	Bridge	15	65	1
Gregg Ave and Michelle Dr	35.697	-105.958	CMP	Arch	4.5	7	1
Alamo Dr and N St Francis Dr	35.697	-105.954	Concrete	Square	4	6	1
Arroyo Mascaras at Las Mascaras St	35.690	-105.954	Concrete	Square	6	10	5
Canada Rincon at Camino Francisca	35.714	-105.944	CMP	1/2 Round	4	8	2
Canada Rincon at Avenida Rincon	35.706	-105.947	CMP	Round	4	4	7
Vera Dr and Los Lovatos Rd	35.696	-105.941	CMP	Arch	3	5.5	2
Arroyo Ranchito at Murales Rd	35.696	-105.933	CMP	Arch	3.25	4.5	2
Arroyo Barranca at Chula Vista St	35.715	-105.931	CMP	Round	6	6	1

Name	Lat.	Long.	Material	Shape	Height [ft]	Width [ft]	# Barrels
Arroyo de La Piedra at Cam Chamisa	35.702	-105.922	CMP	Round	6	6	5
Santa Fe River at Guadalupe St	35.687	-105.944	Concrete	Bridge	15	45	1
Arroyo Saiz at E Palace Ave	35.686	-105.930	Concrete	Square	6	15.5	1
Arroyo Saiz and Avenida Primera S	35.690	-105.924	CMP	Round	4	4	1
Santa Fe River at Paseo de Peralta	35.684	-105.934	Concrete	Bridge	10	45	1
Arroyo Saiz at Avenida Primera S	35.691	-105.920	CMP	Round	3.5	3.5	1
E Palace Ave and Los Lobatos Rd	35.683	-105.925	Concrete	Square	4	10	1
Upper Canyon Rd and Canyon Rd	35.679	-105.916	Concrete	Round	5	5	1
Upper Canyon Rd and Apodaca Hill St	35.679	-105.914	Stone & Concrete	Trapezoid	8	12 to 18	1
Alarid St and Mercer St	35.679	-105.953	CMP	Round	3	3	2
Arroyo Del Rosario at Griffin St	35.695	-105.946	CMP	Round	3.5	3.5	3
Arroyo Barranca at Loma Entrada	35.701	-105.935	CMP	Arch	6	16	1
Culvert at Los Arboles Dr	35.702	-105.940	CMP	Round	3	3	1

APPENDIX B. SURVEYED DATA OF STORMWATER COLLECTION SYSTEM IN ARROYO DE LOS CHAMISOS WATERSHED

Name	Lat.	Long.	Material	Shape	Height [ft]	Width [ft]	# Barrels
Culvert at Veterans Memorial Hwy	35.62	-106.07	CMP	Round	4.5	4.5	2
Culvert on Chamisos Trib.	35.62	-106.06	CMP	Round	3	3	1
Culvert at Jaguar Dr.	35.62	-106.06	CMP	Round	5	5	1
Chamisos at Las Cuatro Milpas	35.61	-106.06	Concrete	Square	8	6	1
Chamisos at Governor Miles Rd.	35.63	-106.02	Concrete	Square	10	10	8
Pinos at Kachina Ridge Dr.	35.64	-106.00	CMP	Round	7	7	4
Chamisos at Urban Trail	35.65	-105.97	CMP	Pipe Arch	14	26	1
Chamisos at Rail Road	35.65	-105.96	Steel, concrete, wood	Bridge	~16	~35	-
Chaparral at E Sawmill Rd.	35.64	-105.95	CMP	Round	6	6	6
Culvert at Jaguar Dr.	35.62	-106.05	CMP	Round	7	7	2
Culvert at Dancing Ground Rd.	35.63	-106.01	CMP	Pipe Arch	5.5	7	7
Culvert at Pueblos Del Sol Park	35.63	-105.99	Concrete	Square w filled corners	2.5 to sand	16	1
Culvert at Governor Miles Rd.	35.63	-105.99	CMP	Round	2	2	1
Culvert at Nizhoni Dr.	35.63	-105.98	Concrete	Square w filled corners	5 to dirt	16	1
Culvert at Calle Tecolote	35.65	-105.94	CMP	Round	2	2	3
Culvert at St. Michael's Dr.	35.65	-105.94	CMP	Round	4	4	1
Chamisos at Paseo de Angel N	35.59	-106.09	CMP	Pipe Arch	7.5	26	2

Name	Lat.	Long.	Material	Shape	Height [ft]	Width [ft]	# Barrels
Culvert at South Meadows Rd.	35.63	-106.03	CMP	Pipe Arch	5	7.5	4
Culvert at Governor Miles Rd.	35.63	-105.99	CMP	Round	4	4	1
Culvert at Paseo Del Sol W	35.63	-106.06	CMP	Round	5	5	1
Culvert at Ravine Rd.	35.63	-105.99	CMP	Round	4	4	3
Chamisos at La Rambla	35.67	-105.91	CMP	Pipe Arch	7 to sand	14	1
Chamisos at Botulph Rd.	35.65	-105.95	Concrete	Square	4 to sand	10	4
Culvert at Botulph Rd.	35.65	-105.95	Concrete	Square	5.5 to sand	12	1
Pintores at W Zia Rd.	35.64	-105.98	Concrete	Round	2.5	2.5	4
Sheriff's at Paseo de Los Pueblos	35.64	-106.00	CMP	Round	3.5	3.5	2
Foothill at Calle Cacique	35.65	-105.93	CMP	Round	7	7	1
Foothill at Old Santa Fe Trail	35.65	-105.92	CMP	Pipe Arch	5	7	1

APPENDIX C. ELEVATION-AREA-STORAGE DATA FOR MCCLURE RESERVOIR

Elevation (ft)	Area (acres)	Capacity (ac-ft)
7782	0.02	0.05
7786	0.2	0.61
7790	0.57	2.46
7794	1.28	6.78
7800	3.55	23.21
7804	5.14	42.14
7806	6.02	54.18
7810	8.33	85.18
7814	10.03	123.66
7816	11.14	145.94
7820	13.54	197.71
7824	16.13	259.62
7826	18.11	295.84
7830	21.73	379.39
7834	24.84	475.57
7836	26.52	528.62
7840	30.45	646.27
7842	32.45	711.18
7844	34.64	780.46
7846	37.06	854.57
7848	39.24	933.05
7850	41.4	1015.85
7852	43.77	1103.39
7854	46.24	1192.86

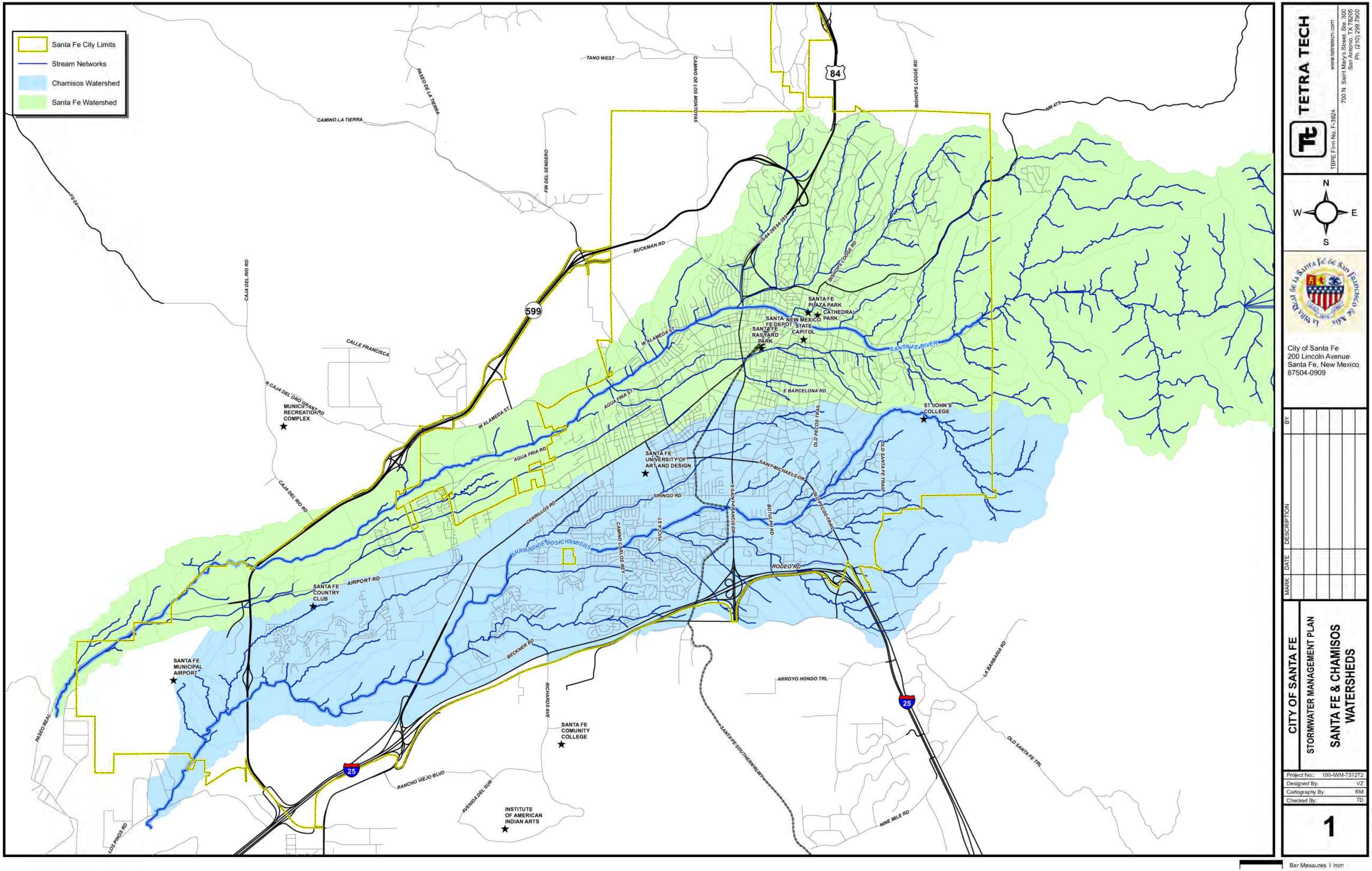
Elevation (ft)	Area (acres)	Capacity (ac-ft)
7856	48.66	1293.18
7858	51.25	1395.69
7860	54.24	1504.17
7862	57.59	1619.36
7864	59.78	1738.92
7866	61.18	1861.28
7868	62.63	1986.54
7870	64.29	2115.13
7872	66.24	2247.61
7874	68.06	2383.72
7876	69.83	2523.37
7878	71.58	266.53
7880.16 (Previous Spillway)	73.49	2825.26
7882	74.28	2963.65
7884	76.8	3117.25
7885.79 (Current Spillway)	77.63	3257.45
7886	78.34	3273.93
7888	79.91	3433.75
7890	81.5	3596.76
7892	83.15	3763.01

APPENDIX D. ELEVATION-AREA-STORAGE DATA FOR NICHOLS RESERVOIR

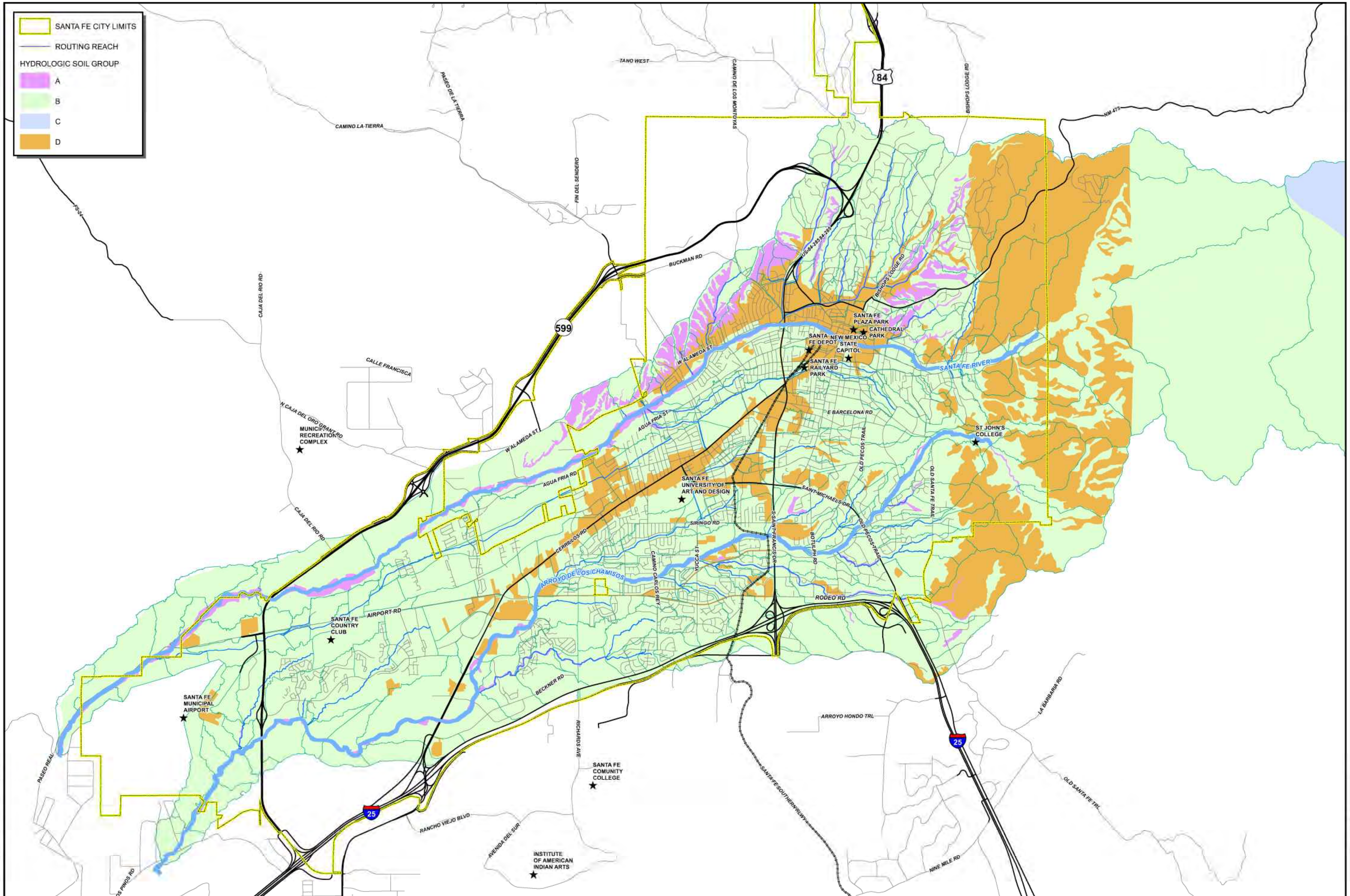
Elevation (ft)	Area (acres)	Capacity (ac-ft)
7424	0	0
7426	0.1	0
7428	0.3	0.4
7430	0.6	1.3
7432	0.93	2.8
7434	1.34	5
7436	1.84	8.1
7438	2.5	12.3
7440	3.29	18.1
7442	4.13	25.5
7444	5.02	34.7
7446	5.93	45.6
7448	6.85	58.4
7450	7.9	73.0
7452	9.01	90.0
7454	9.98	109.0
7456	10.94	129.9
7458	12.01	152.8
7460	13.21	177.9
7462	14.56	205.6
7464	15.8	236.2
7466	16.95	268.9
7468	18.23	304.0
7470	19.69	341.8

Elevation (ft)	Area (acres)	Capacity (ac-ft)
7472	21.34	382.7
7474	22.99	427.1
7476	24.65	474.7
7478	26.44	525.7
7480	28.14	580.5
7482	29.63	638.3
7483 (Spillway)	30.36	668.3
7484	30.92	699.0
7486	32.04	761.9
7488	33.15	827.1
7490	34.22	894.5
7492	35.26	964.0
7494	36.25	1035.6

B. MODELING EXHIBITS



Date: 8/2/2018 User Name: Troy.Dorman Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit01_WatershedMap.mxd



TETRA TECH
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900
TBPE Firm No. F-3924

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN

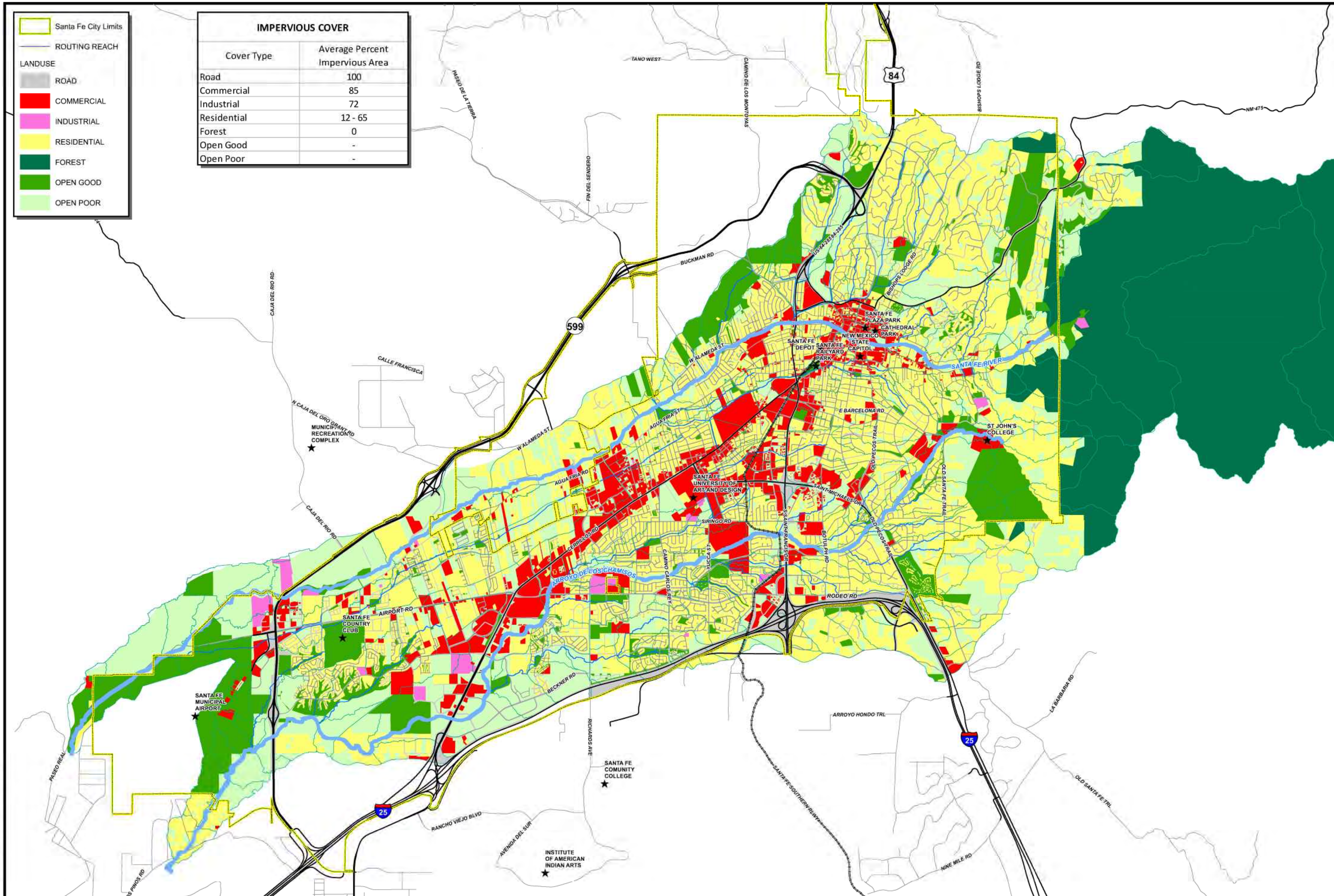
SANTA FE & CHAMISOS HYDROLOGIC SOIL GROUP

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

2

Bar Measures 1 inch
0 3,000 Ft.

Date: 4/5/2018 User Name: Ruben.Martinez Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit02_SoilsMap.mxd



IMPERVIOUS COVER

Cover Type	Average Percent Impervious Area
Road	100
Commercial	85
Industrial	72
Residential	12 - 65
Forest	0
Open Good	-
Open Poor	-

TETRA TECH
TBPE Firm No. F-3924
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900

N W E S

La Villa Real de la Santa Fé de San Francisco de Asis

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

CITY OF SANTA FE

STORMWATER MANAGEMENT PLAN

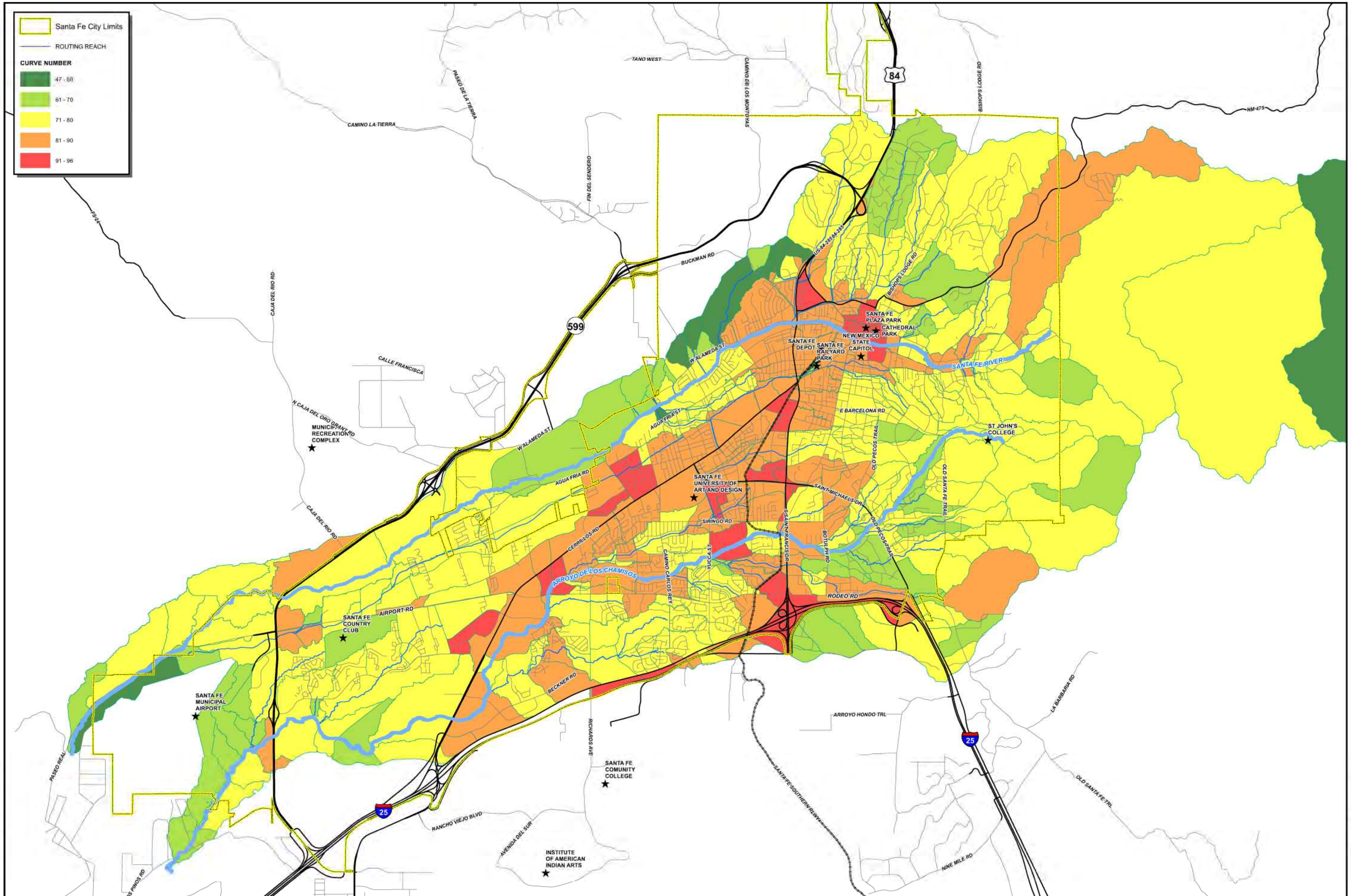
SANTA FE & CHAMISOS LANDUSE/IMPERVIOUS COVER

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

3

Bar Measures 1 inch
0 3,000 Ft.

Date: 4/5/2018 User Name: Ruben Martinez Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit03_LandUseMap.mxd



TETRA TECH
TBPE Firm No. F-3924
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900

N W E S

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

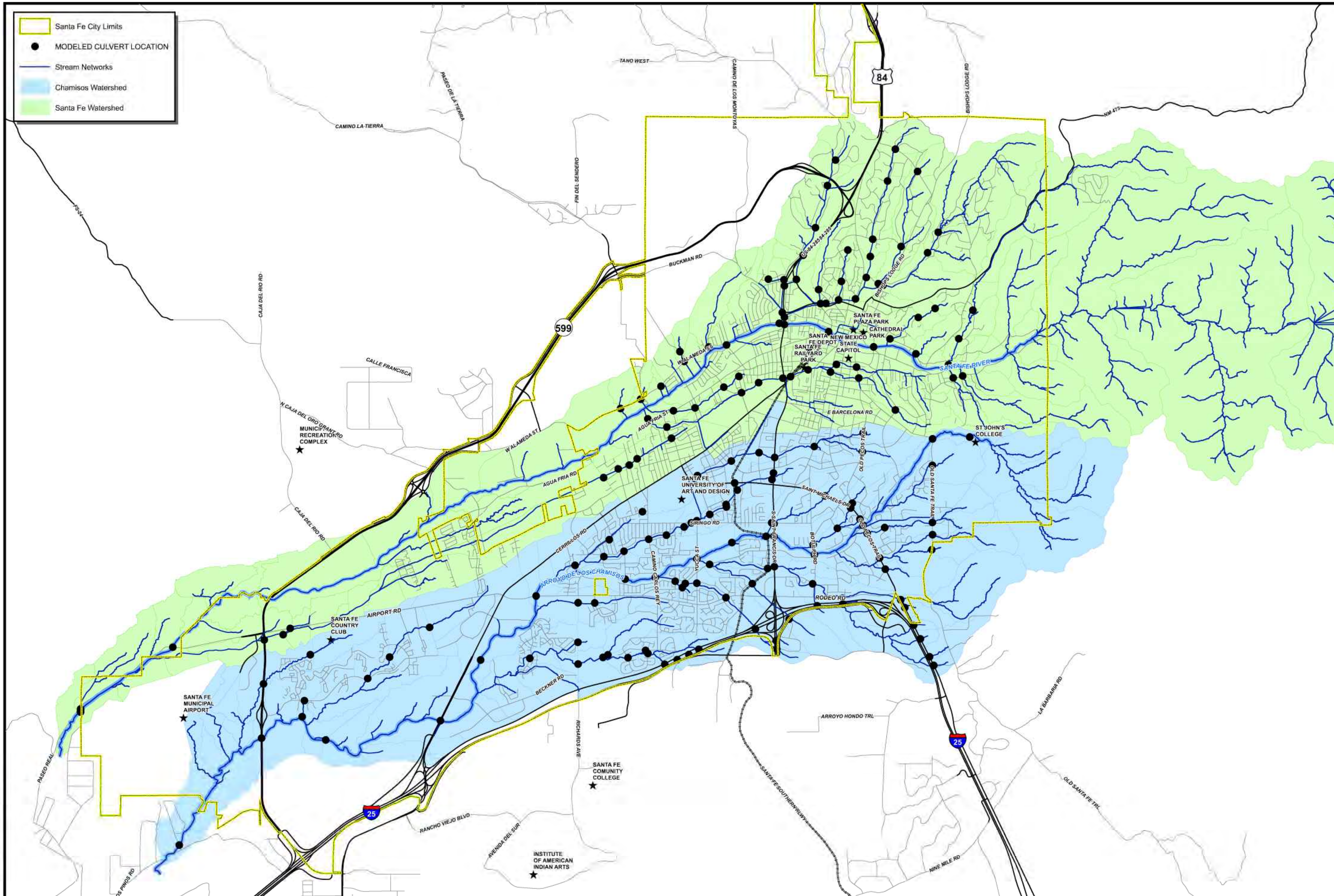
CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
SANTA FE & CHAMISOS CURVE NUMBER MAP

Project No.: 100-IWM-T37272
Designed By: VZ
Cartography By: RM
Checked By: TD

4

Date: 4/5/2018 User Name: Ruben Martinez Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit04_CurveNumberMap.mxd

Bar Measures 1 inch
0 3,000 Ft.



Date: 8/2/2018 User Name: Troy Dorman Document Path: O:\SantaFeNMGIS\Exhibits\Exhibit05_CulvertLocationsMap.mxd

TETRA TECH

TBPE Firm No. F-3924

www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph: (210) 299.7900

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

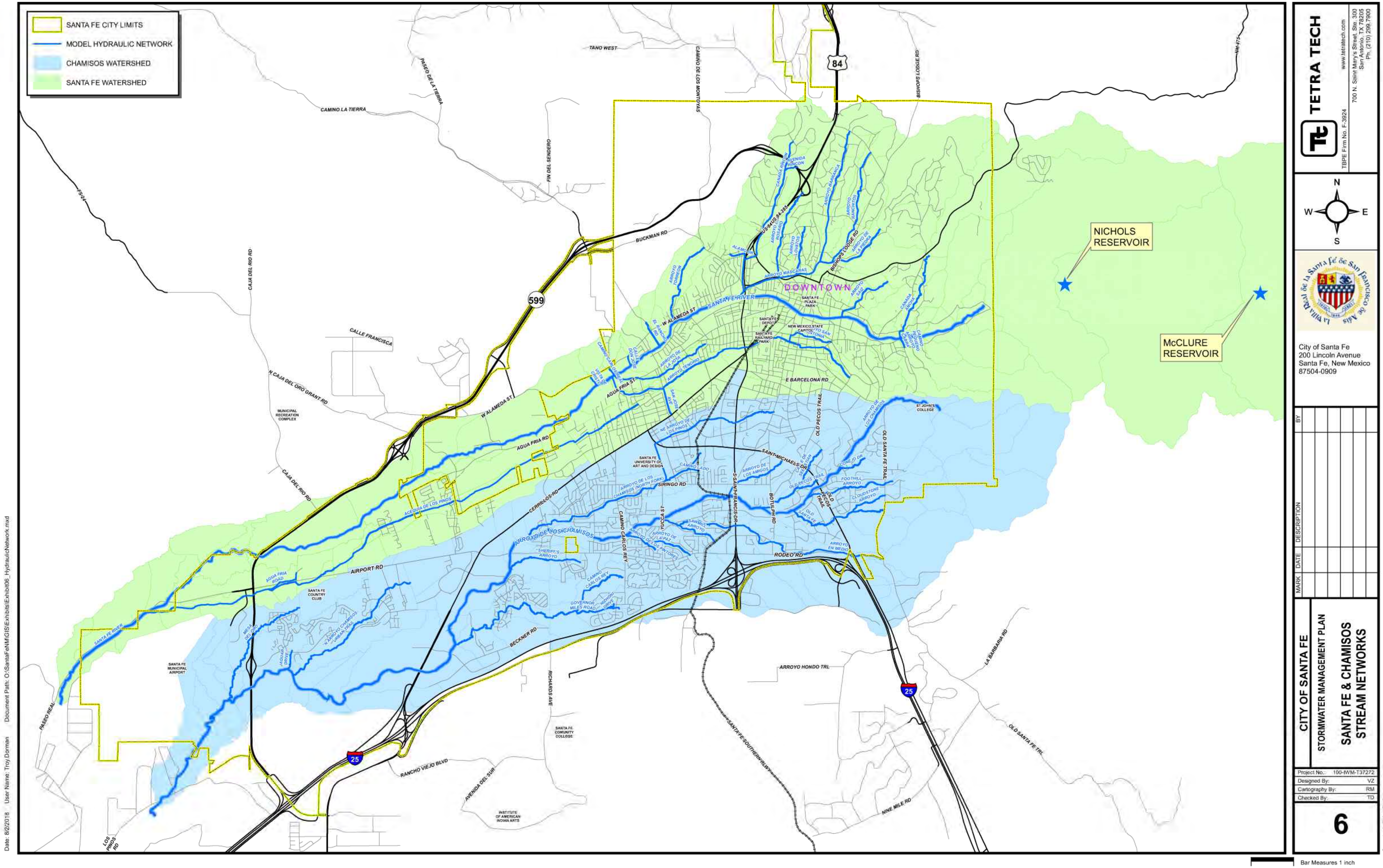
MARK	DATE	DESCRIPTION	BY

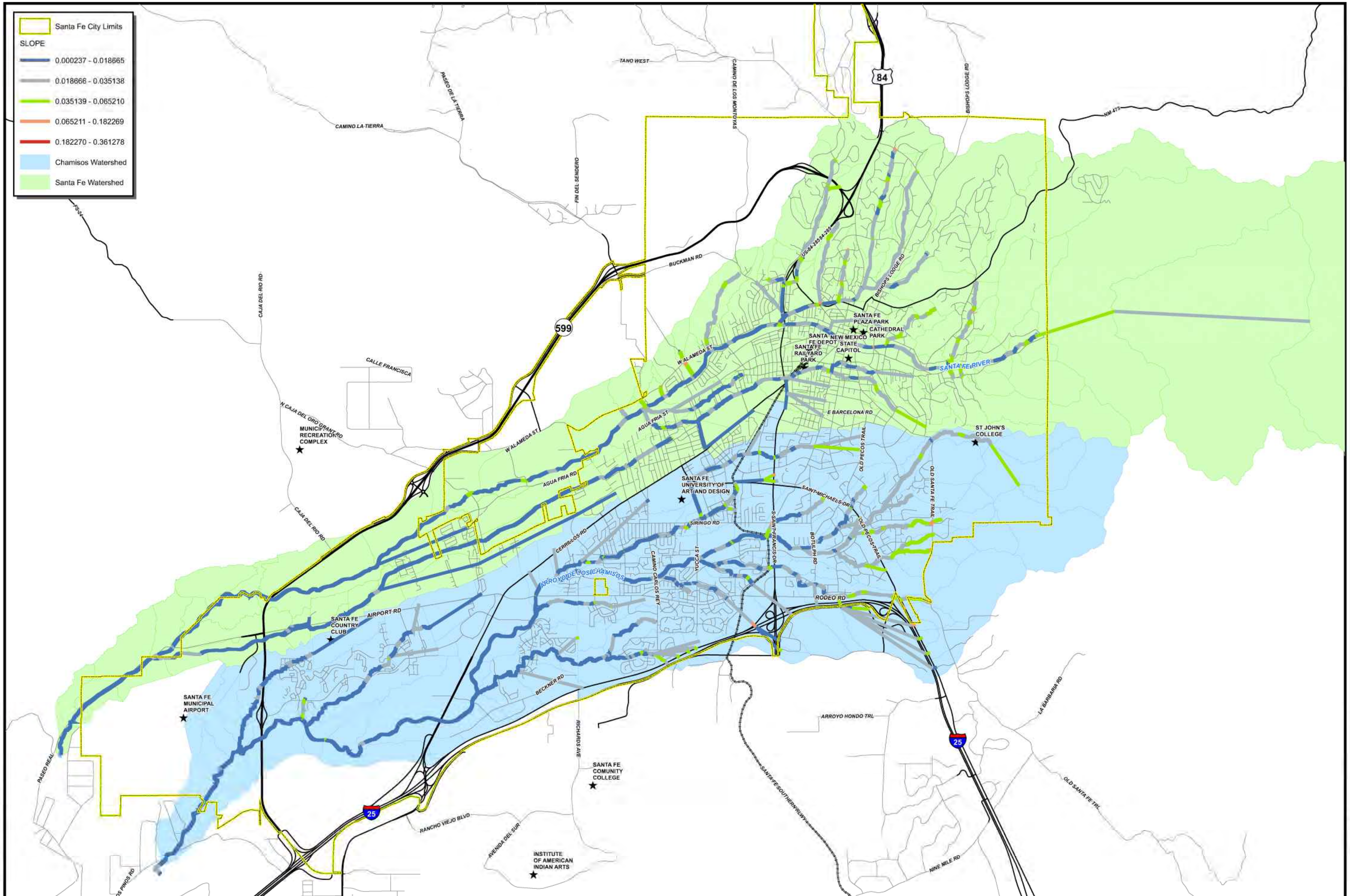
CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN

SANTA FE & CHAMISOS CULVERT LOCATIONS

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

5


SANTA FE CITY LIMITS
MODEL HYDRAULIC NETWORK
CHAMISOS WATERSHED
SANTA FE WATERSHED
NICHOLS RESERVOIR
McCLURE RESERVOIR
DOWNTOWN
SANTA FE RIVER
ARROYO DE LOS CHAMISOS
TETRA TECH
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900
TBPE Firm No. F-3924
N
W
E
S
City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909
MARK
DATE
DESCRIPTION
BY
CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
SANTA FE & CHAMISOS
STREAM NETWORKS
Project No.: 100-IWM-T37272
Designed By: VZ
Cartography By: RM
Checked By: TD
6
Copyright: Tetra Tech
Bar Measures 1 inch
0
3,000 Ft.
Date: 8/2/2018
User Name: Troy.Dorman
Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit06_HydraulicNetwork.mxd



TETRA TECH
TBPE Firm No. F-3924
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900

N
W E
S

La Villa Real de la Santa Fé de San Francisco de Asís

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

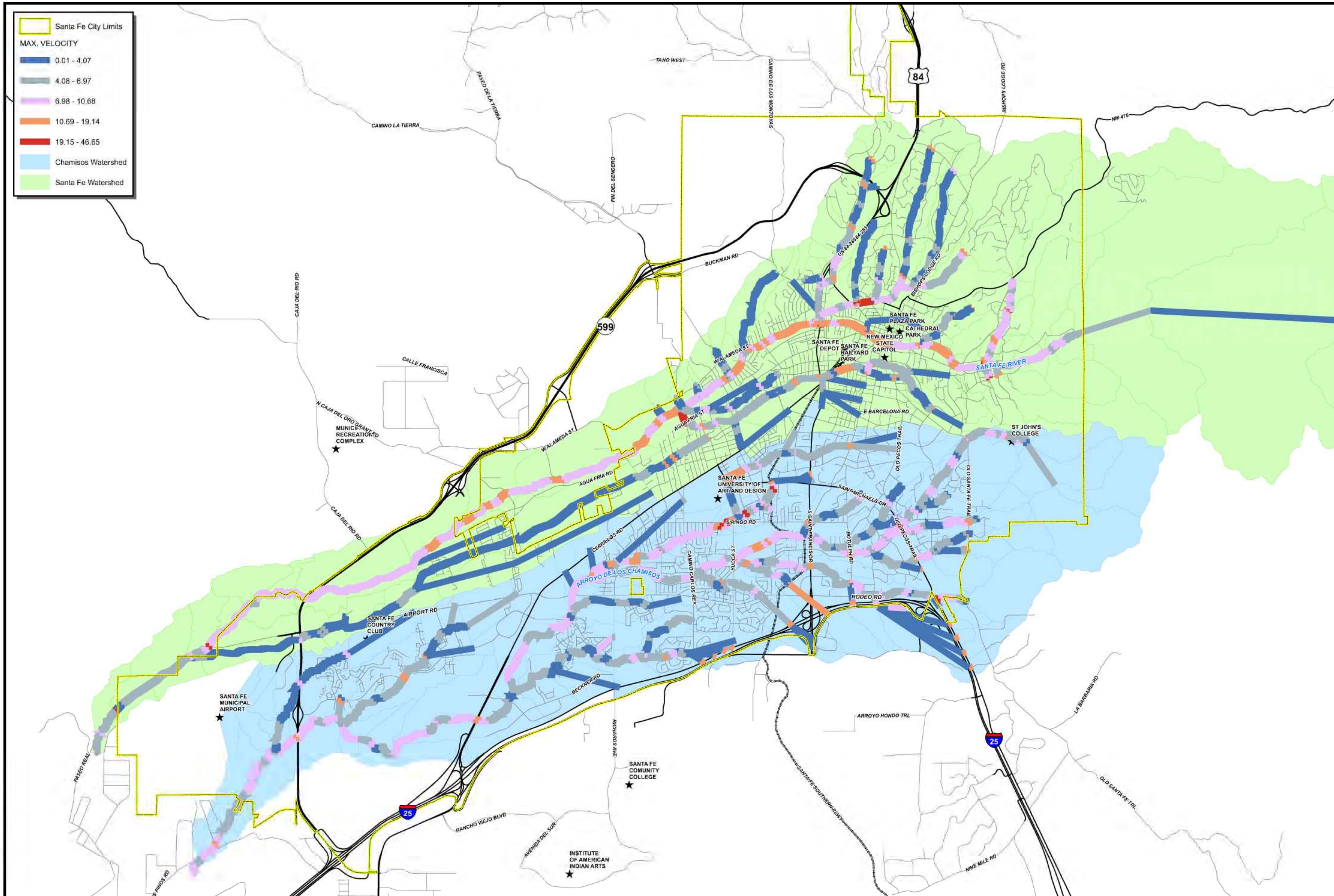
CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
SANTA FE & CHAMISOS WATERSHEDS AND SLOPE ANALYSIS

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

7

Bar Measures 1 inch
0 3,000 Ft.

Date: 8/2/2018 User Name: Troy Dorman Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit07_SlopesMap.mxd



Date: 8/2/2018 User Name: Troy.Dorman Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit08_VelocityMap.mxd

TETRA TECH
TBPE Firm No. F-3924
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900

N
W E
S

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

CITY OF SANTA FE

STORMWATER MANAGEMENT PLAN

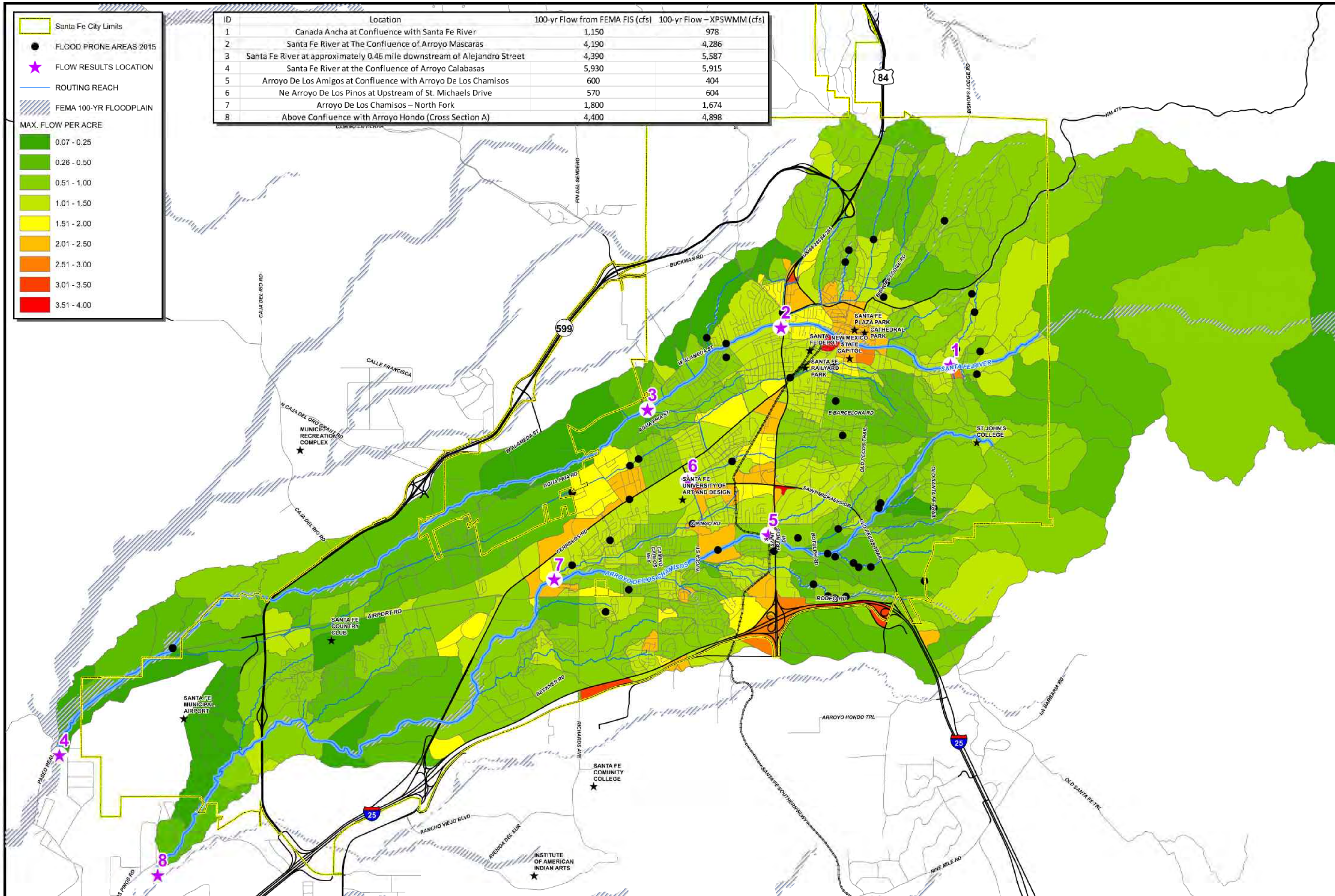
SANTA FE & CHAMISOS VELOCITY RESULTS WITH SLOPE ANALYSIS

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

8

Bar Measures 1 inch
0 3,000 Ft.

ID	Location	100-yr Flow from FEMA FIS (cfs)	100-yr Flow – XPSWMM (cfs)
1	Canada Ancha at Confluence with Santa Fe River	1,150	978
2	Santa Fe River at The Confluence of Arroyo Mascaras	4,190	4,286
3	Santa Fe River at approximately 0.46 mile downstream of Alejandro Street	4,390	5,587
4	Santa Fe River at the Confluence of Arroyo Calabasas	5,930	5,915
5	Arroyo De Los Amigos at Confluence with Arroyo De Los Chamisos	600	404
6	Ne Arroyo De Los Pinos at Upstream of St. Michaels Drive	570	604
7	Arroyo De Los Chamisos – North Fork	1,800	1,674
8	Above Confluence with Arroyo Hondo (Cross Section A)	4,400	4,898



TETRA TECH

www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900

TBPE Firm No. F-3924

N S E W

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

CITY OF SANTA FE

STORMWATER MANAGEMENT PLAN

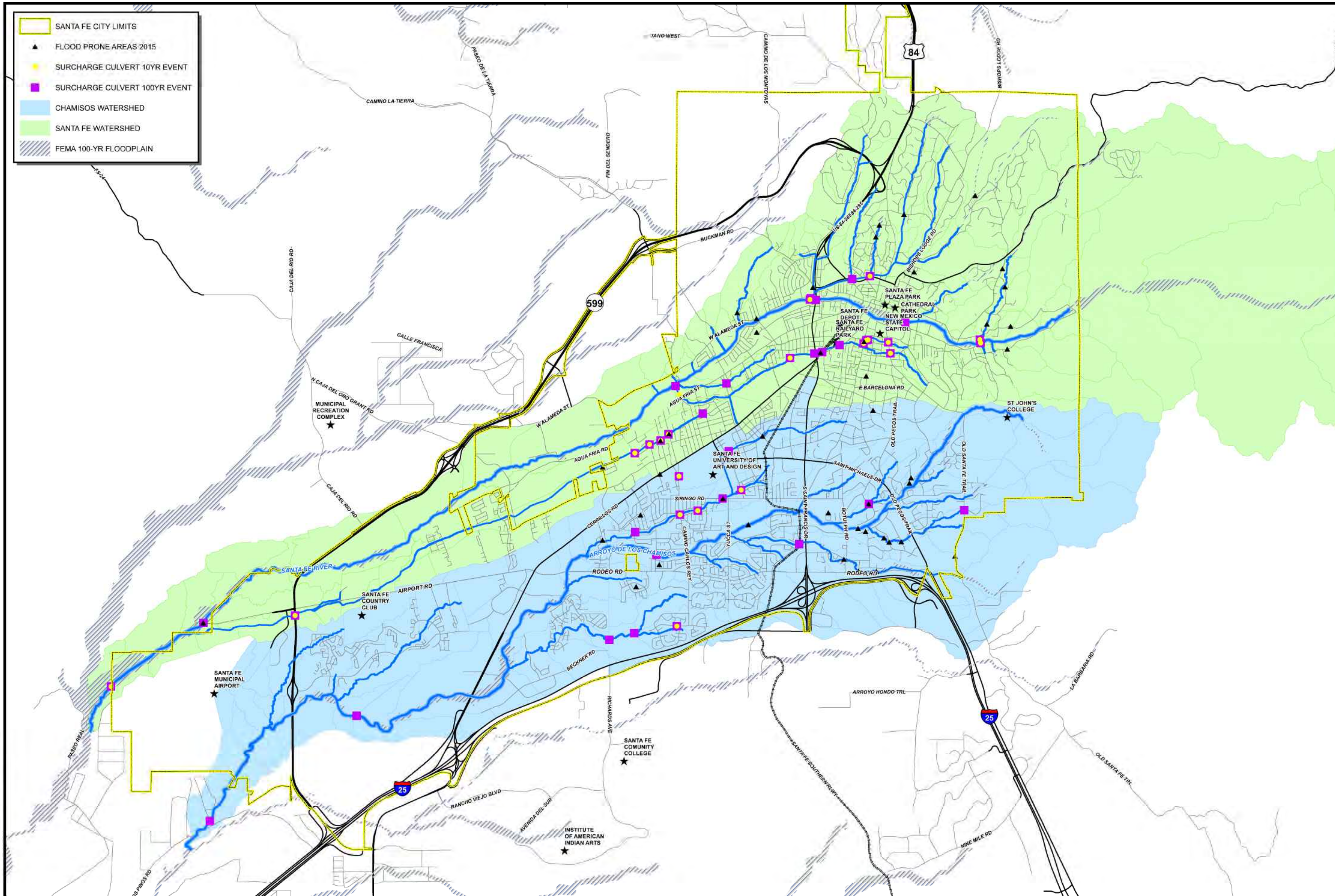
SANTA FE & CHAMISOS PEAK FLOW PER ACRE

Project No.: 100-IWM-T37272
Designed By: VZ
Cartography By: RM
Checked By: TD

9

Bar Measures 1 inch
0 3,000 Ft.

Date: 4/5/2018 User Name: Ruben Martinez Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit09_PeakFlowMap.mxd



Date: 8/2/2018 User Name: Troy Dorman Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit10_SurchargedCulvertsMapGraphics.mxd

TETRA TECH
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900
TBPE Firm No. F-3924

N
W E
S

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

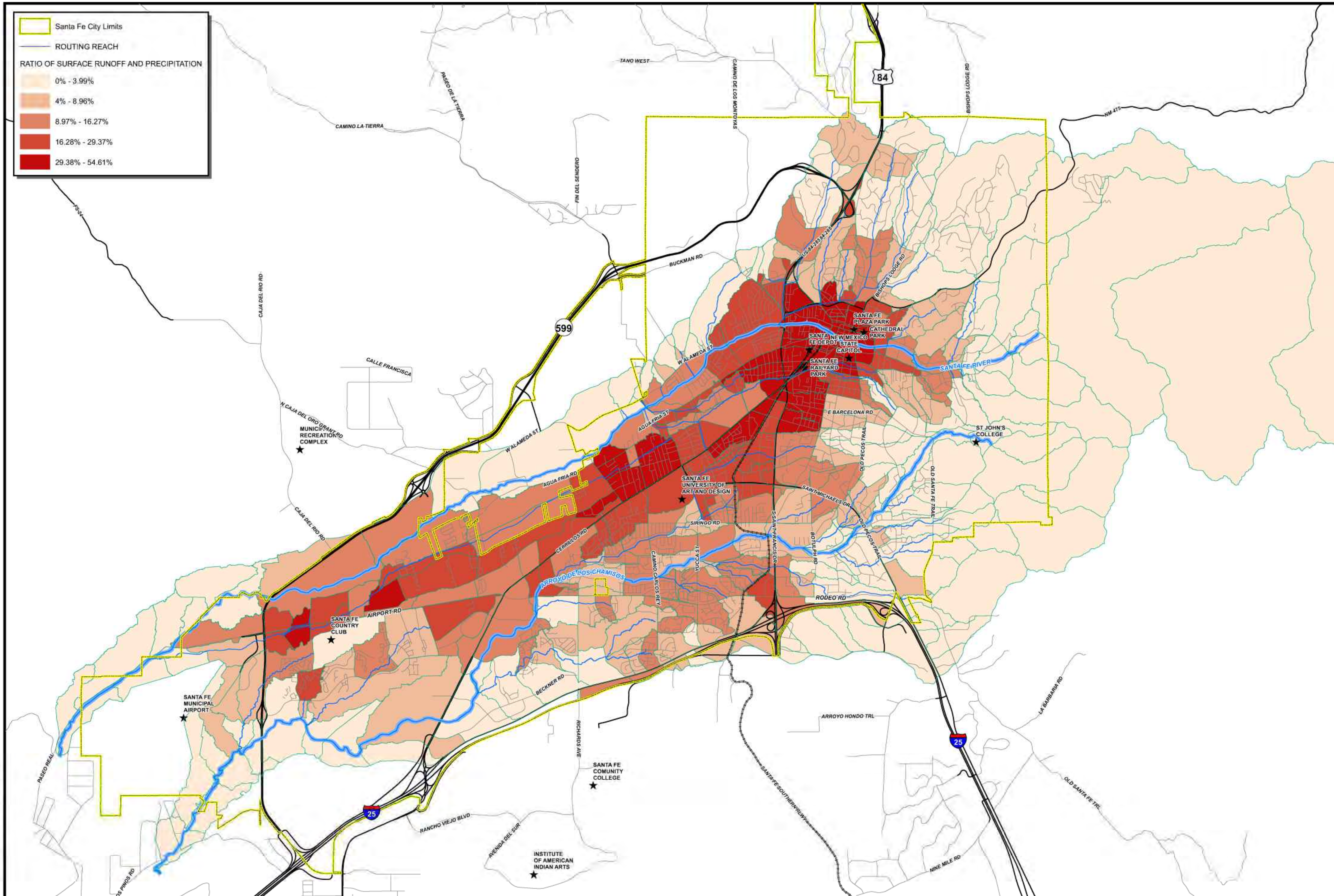
MARK	DATE	DESCRIPTION	BY

CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
SANTA FE & CHAMISOS SURCHARGE CULVERTS

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

10

Bar Measures 1 inch
0 3,000 Ft.



TETRA TECH

www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900

TBPE Firm No. F-3924

N W E S

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

CITY OF SANTA FE

STORMWATER MANAGEMENT PLAN

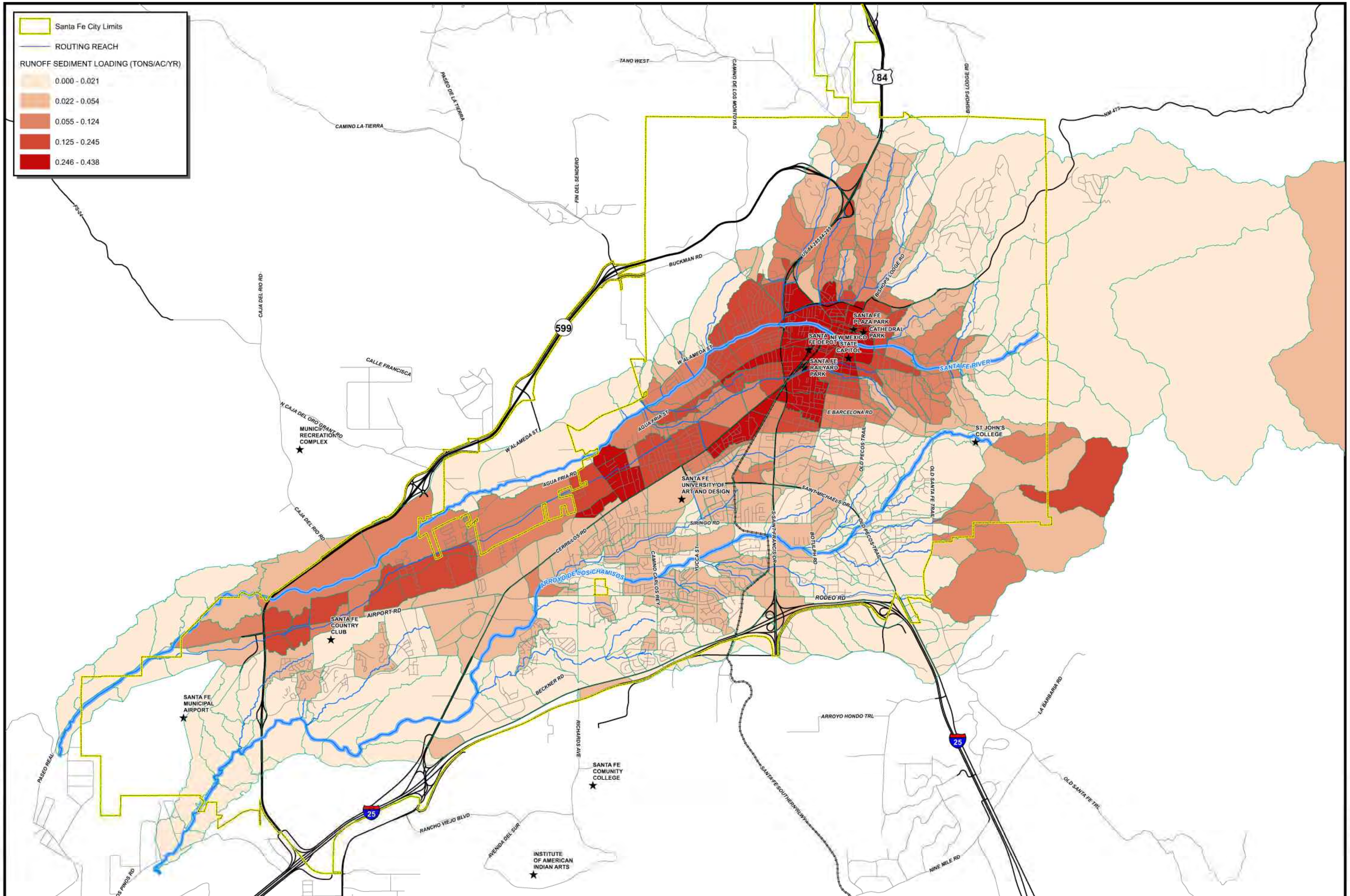
SANTA FE & CHAMISOS RATIO OF SURFACE RUNOFF AND PRECIPITATION

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

13

Bar Measures 1 inch
0 3,000 Ft.

Date: 4/5/2018 User Name: Ruben Martinez Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit13_LSPCModelingMap.mxd



TETRA TECH

www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph: (210) 299.7900
TBPE Firm No. F-3924

N W E S

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

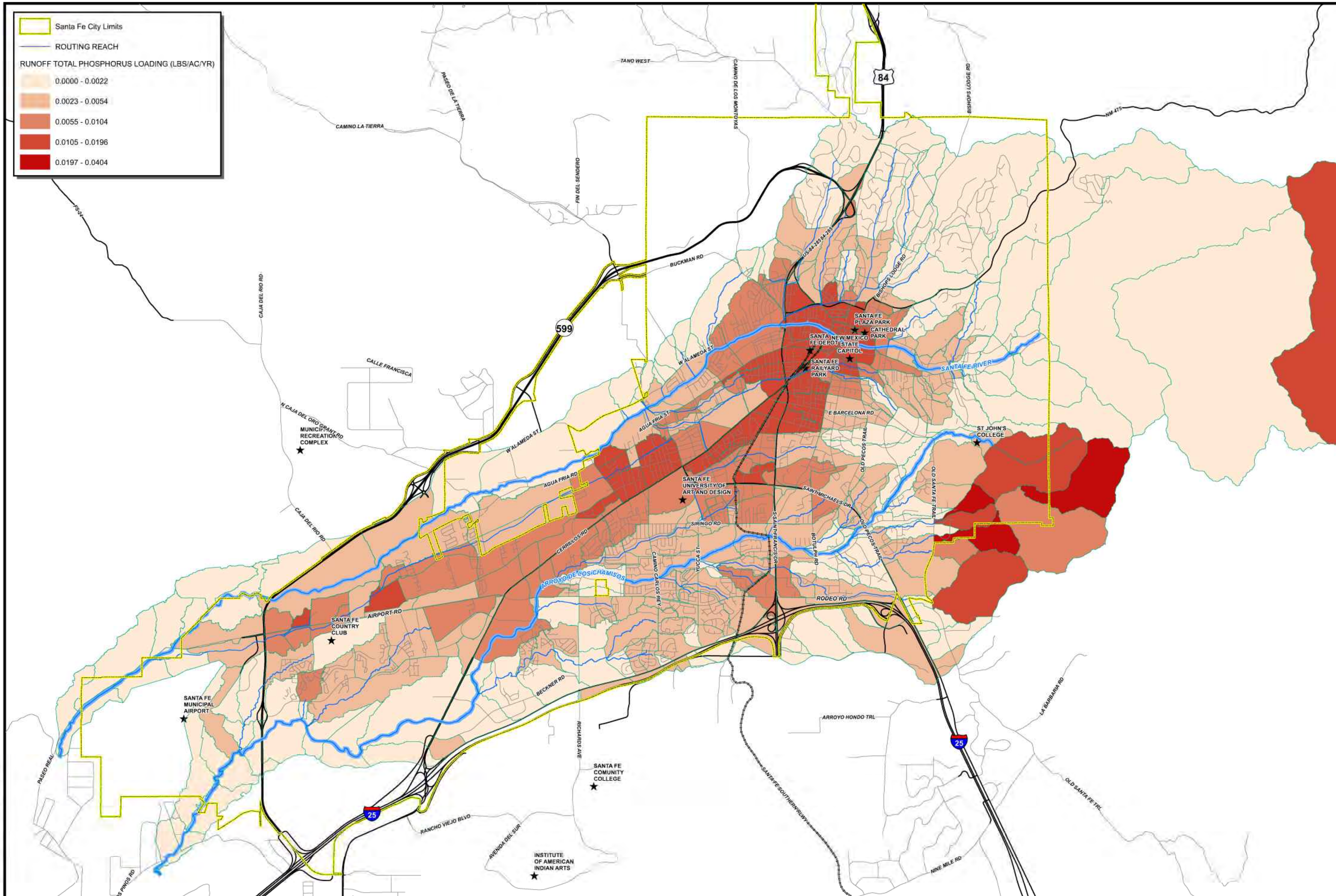
CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
SANTA FE & CHAMISOS
RUNOFF SEDIMENT
LOADING (TON S/AC/YR)

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

14

Date: 4/5/2018 User Name: Ruben Martinez Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit14_RunoffSedimentMap.mxd

Bar Measures 1 inch
0 3,000 Ft.



Date: 4/5/2018 User Name: Ruben Martinez Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit15_RunoffPhosphorusMap.mxd

TETRA TECH
www.tetratech.com
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900
TBPE Firm No. F-3924

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

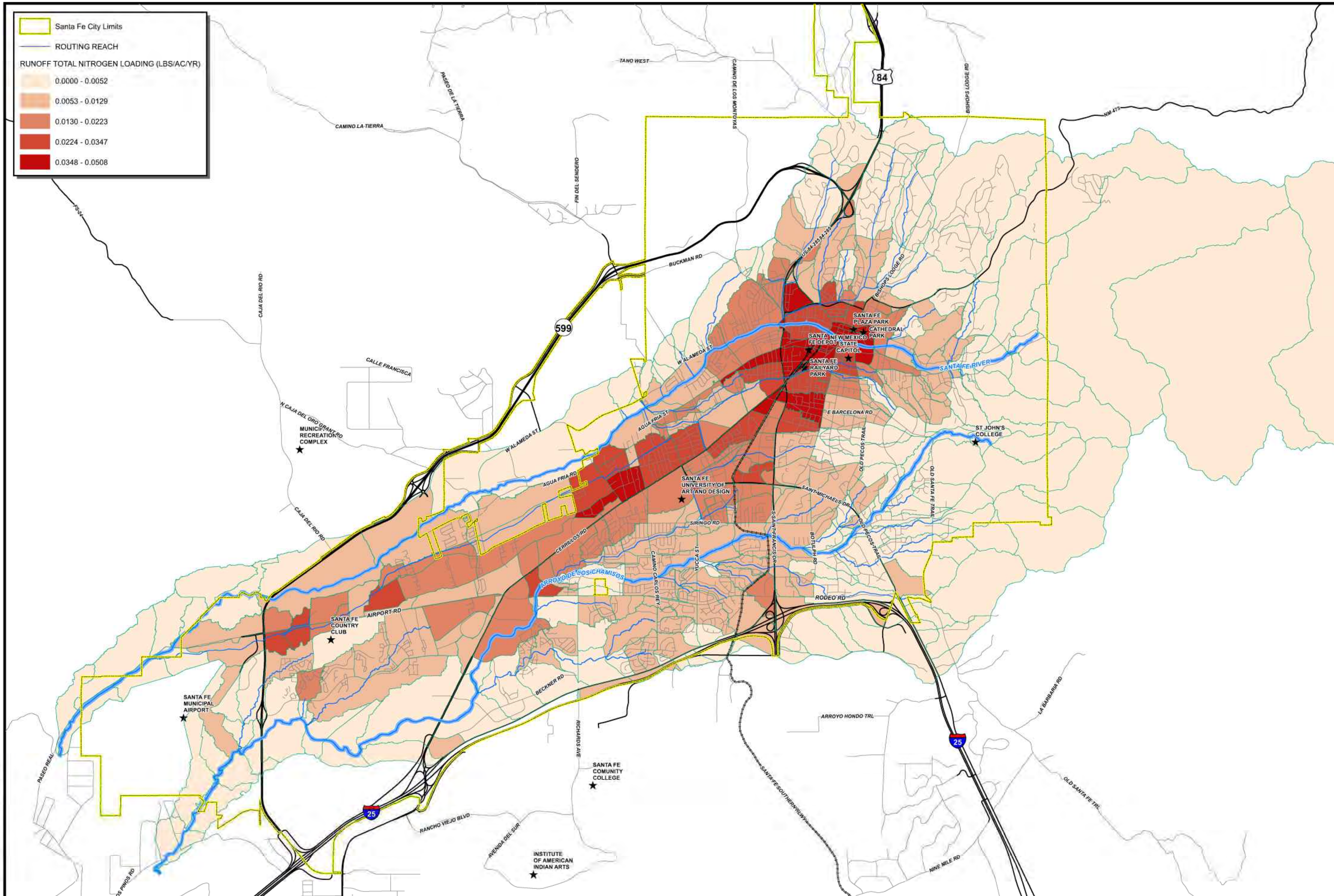
MARK	DATE	DESCRIPTION	BY

CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
SANTA FE & CHAMISOS
RUNOFF TOTAL PHOSPHORUS
LOADING (TON S/AC/YR)

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

15

Bar Measures 1 inch
0 3,000 Ft.



TETRA TECH

www.tetratech.com
TBPE Firm No. F-3924
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph: (210) 299.7900

N
W E
S

La Villa Real de la Santa Fé de San Francisco de Asís

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

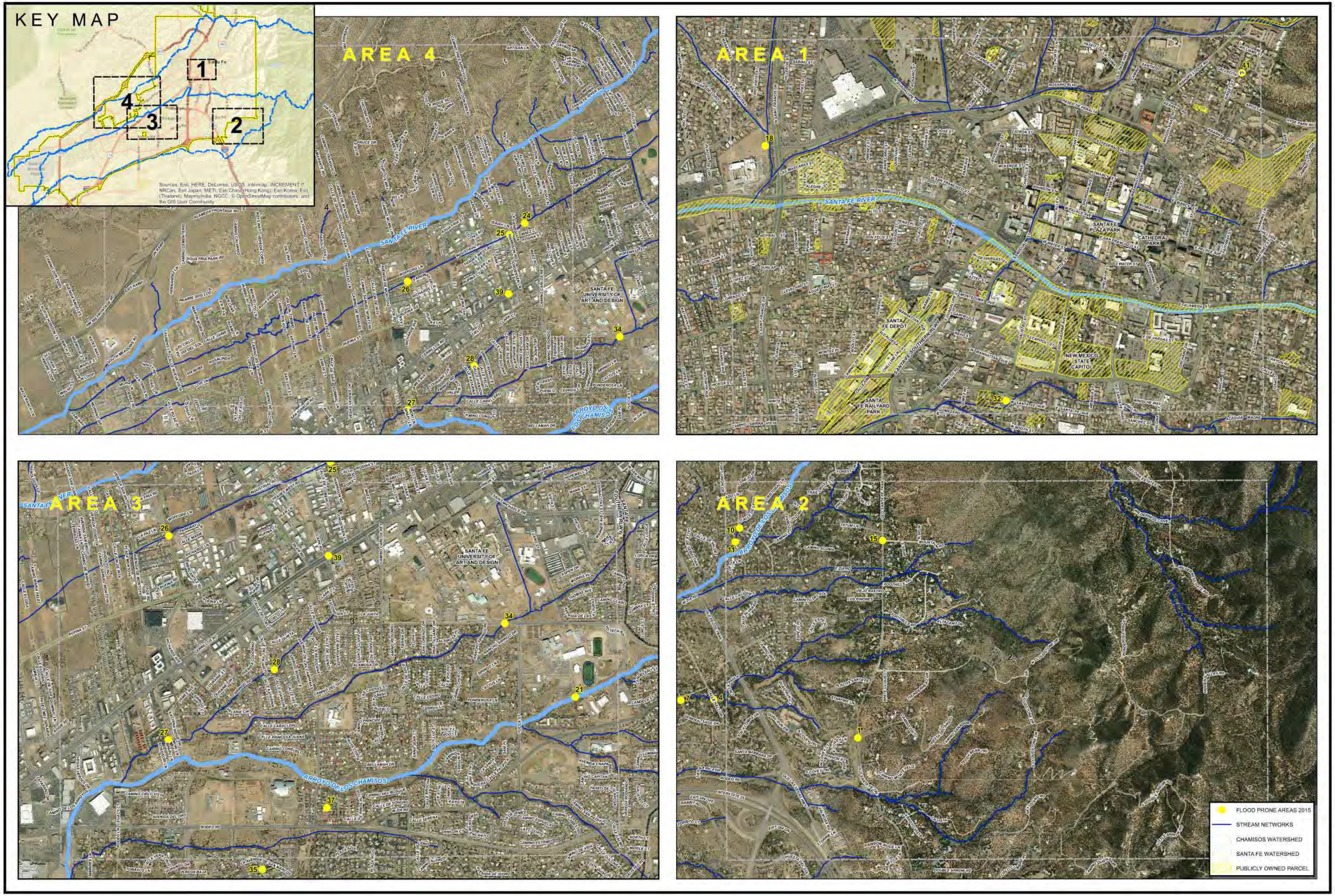
CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
SANTA FE & CHAMISOS RUNOFF TOTAL NITROGEN LOADING (TON S/AC/YR)

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

16

Date: 4/5/2018 User Name: Ruben Martinez Document Path: O:\SantaFeNM\GIS\Exhibits\Exhibit16_RunoffNitrogenMap.mxd

Bar Measures 1 inch
0 3,000 Ft.



TETRA TECH
www.tetratech.com
TBPE Firm No. F-3924
700 N. Saint Mary's Street, Ste. 300
San Antonio, TX 78205
Ph. (210) 299.7900

N
W E
S

City of Santa Fe
200 Lincoln Avenue
Santa Fe, New Mexico
87504-0909

MARK	DATE	DESCRIPTION	BY

CITY OF SANTA FE
STORMWATER MANAGEMENT PLAN
PRIORITY AREAS FOR GREEN INFRASTRUCTURE IMPLEMENTATION

Project No.:	100-IWM-T37272
Designed By:	VZ
Cartography By:	RM
Checked By:	TD

17

0 1 in.
Bar Measures 1 inch

Date: 4/6/2018 User Name: Ruben.Martinez Document Path: O:\SantaFeMGIS\Exhibits\Exhibit XX_TargetAreasMap.mxd

C. WATER QUALITY MEMO

TETRA TECH

MEMO

To:	Melissa McDonald
Cc:	Leroy Pacheco
From:	Troy Dorman, PE Amy King, Senior Environmental Scientist
Date:	December 15, 2017; Revised January 12, 2018
Subject:	Final Subtask 2.4.3 Data Compilation and Preliminary Data Review

Watershed models of the Santa Fe River and Arroyo de Los Chamisos watersheds are being developed to support updates of their drainage management plans, including updated pollutant source characterization. Existing water quality monitoring data are being compiled to support this effort. This memorandum identifies the studies and data evaluated, inventories available data for the pertinent parameters, and discusses how these data will be incorporated into the watershed model. A list of data gaps is also provided. Addressing these gaps will improve the ability of the model to estimate loadings by source category.

1.0 AVAILABLE DATA AND STUDIES

Tetra Tech has discussed project goals and associated data needs with the City. Data files were subsequently provided via email. The majority of data were collected by New Mexico Environment Department (NMED). These data include the following sampling efforts:

- **Santa Fe River monitoring**: Routine monitoring conducted along the Santa Fe River and La Cienega Creek for 2010 through 2017. Analyses were performed for a wide variety of parameters, including nutrients, metals, ions, sediment, bacteria, and organics.
- **Santa Fe River bacteria sampling**: *E. coli* results collected at nine stations along the Santa Fe River in 2005 and 2008.
- **PCB Analyses**: Analyses for PCBs include total of seven samples collected at six stations in 2005. Stations included four stations on the Santa Fe River and two additional stations on drains/arroyos (mostly storm samples).
- **Santa Fe River outfall stormwater monitoring**: Sampling conducted in August 2016 below the Sandoval bridge. Results provided for base neutral acid parameters and bacteria.
- **Well and river water monitoring**: Samples collected at two locations upstream of Nichols Reservoir (well and river samples for comparison) in August 2014 and analyzed for nutrients and ions. Samples were collected to test a piezometer installed by the City, who found an odor of sulphur when it was purged.
- **Genetic marker study**: Results from a 2017 study evaluating presence of human, beaver, bird, dog, and ruminant bacteria. A total of 16 samples were collected at five different locations in the watershed.

The data identified above were compiled into a single consistent format (over 4,500 unique samples, not including quality control results). Data associated with the proposed modeling parameters (nutrients, total suspended solids [TSS], and bacteria) were flagged for further review (approximately 1,000 records).

Tetra Tech, Inc.
700 N. Saint Mary's St., Suite 300, San Antonio, TX 78205
Tel 201-620-7905 Fax 210-226-8497 tetratech.com

2.0 DATA INVENTORY FOR MODELING PARAMETERS

Water quality data for nutrients, sediment, and bacteria were collected at 19 stations in six different assessment units (Table 2-1). Seventeen of these stations represent conditions along the Santa Fe River from McClure reservoir to Cochiti Pueblo, two stations are on Cienega Creek, one station is in the wastewater treatment plant (WWTP) outfall channel, and two stations are associated with stormwater outfalls.

Data by station were compiled into a consistent format. These data include the studies described in Section 1.0 above. The date range and number of samples associated with the available data are summarized by pollutant and station in Table 2-2. All data in this table represent surface water samples unless noted. Most data are available for 2010 through 2017, while *E. coli* samples extend back to 2005. Some stations have a single sample for water quality concentrations while others have up to 16, depending on the parameter (although the average number of samples by station/parameter is less than 10). Overall, these data largely represent conditions within the Santa Fe River. Data from only five stations can be used to represent inputs to the river.

In addition to these stations, five locations in the watershed were sampled in September 2017 and genetic marker tests were performed for the presence of human, beaver, dog, bird, and/or ruminant bacteria. These locations included Cerro Gordo, Patty Smith Park, Paseo, Guadalupe, and Agua Fria. The presence of human and dog bacteria was analyzed at all five locations, while beavers were tested only at Cerro Gordo, ruminants were tested at Agua Fria, and bird bacteria were analyzed at all stations except Agua Fria.

Table 2-1. Water Quality Monitoring Stations by Assessment Unit

Assessment Unit	Station Identification Number	Station Name	Latitude	Longitude
Santa Fe River (Nichols Reservoir to headwaters)	30SantaF061.1	Santa Fe River above McClure Reservoir at gage - 30SantaF061.1	35.688611	-105.82222
	30SantaF059.1	Santa Fe River above Nichols Reservoir at gage 08316000 - 30SantaF059.1	35.686800	-105.843
Santa Fe River (Guadalupe St to Nichols Reservoir)	30SantaF052.4	Santa Fe River below Cerro Gordo Rd. - 30SantaF052.4	35.68148	-105.90910
	30SantaF050.5	Santa Fe River ~75m up stream of Sandoval St - 30SantaF050.5	35.6858	-105.9419
	NMR040000-SR01	City of Santa Fe stormwater outlet #1 into Santa Fe River downstream of Sandoval St. (southside)	35.68641	-105.94307
	NMR040000-SF02	City of Santa Fe stormwater outlet #2 into Santa Fe River downstream of Sandoval St. (northside)	35.68644	-105.94294
	30SantaFF050.3	Santa Fe River 5 meters u/s of Guadalupe St - 30SantaF050.3	35.68703	-105.94397
Santa Fe River (Santa Fe WWTP to Guadalupe St.)	30SantaF048.8	Santa Fe River below Cerro Gordo Rd. - 30SantaF048.8	unknown	unknown
	30SantaF047.9	Santa Fe River below St Francis Dr. - 30SantaF047.9	35.6884	-105.955
	30SantaF044.5	Santa Fe River below Frenchies Field - 30SantaF044.5	35.67283	-105.98618
	30SantaF042.6	Santa Fe River at Siler RD - 30SantaF042.6	35.664365	-105.997811
	30SantaF041.2	Santa Fe River at CRD 68A (San Isidro Crossing) - 30SantaF041.2	35.6597	-106.012
	30SantaF035.9	Santa Fe River above Hwy 599 - 30SantaF035.9	35.64016	-106.06408
	30SantaF032.9	Santa Fe River immediately upstream of WWTP effluent channel - 30SantaF032.9	35.630333	-106.09115
Santa Fe River (Cienega Creek to Santa Fe WWTP)	NM0022292-M	Santa Fe WWTP effluent channel outfall - NM0022292	35.629444	-106.091389
	SFR at effluent outfall	Santa Fe River at effluent channel outfall - NM0022292	unknown	unknown
	30SantaF030.5	Lower Santa Fe River Preserve - 30SantaF030.5	35.61842	-106.11178
	30SantaF028.4	Santa Fe River above CRD 56 downstream of river preserve - 30SantaF028.4	35.60279	-106.12134
Santa Fe River (Cochiti Pueblo bnd to Cienega Creek)	30SantaF013.6	Santa Fe River above La Bajada diversion - 30SantaF013.6	35.546769	-106.22363
	30SantaF012.9	Santa Fe River above Cochiti at USGS gage 08317200 - 30SantaF012.9	35.54726	-106.22922
Cienega Creek (Perennial part of Santa Fe River to headwaters)	30LaCien000.1	Cienega Creek NE 90 ft above mouth on SF River - 30LaCien000.1	35.55862	-106.14719
	30LaCien002.1	Cienega Creek 0.3 miles below bridge in La Cienega - 30LaCien002.1	35.560659	-106.129986

Table 2-2. Data Inventory by Parameter and Station

Station Identification Number	Start Date	End Date	Number of Samples	Notes
Chlorophyll *a* (9/24/2014 – 9/21/17; n = 6)				
30SantaF061.1	9/24/2014	9/24/2014	1	
30SantaF028.4	10/24/2014	9/17/2015	2	
30SantaF013.6	10/23/2014	9/21/2017	3	
Dissolved oxygen concentration (4/15/2010 – 9/21/2017; n = 115)				
30SantaF061.1	4/29/2010	7/20/2016	10	
30SantaF059.1	8/20/2014	8/20/2014	1	
30SantaF052.4	6/4/2012	11/14/2014	8	
30SantaF050.5	5/14/2013	5/6/2015	13	One sample collected after storms (2013)
30SantaF050.3	6/2/2016	8/5/2016	4	
30SantaF047.9	6/4/2012	6/4/2012	1	
30SantaF044.5	6/4/2012	5/6/2015	6	One sample collected after storms (2013)
30SantaF041.2	9/17/2013	8/5/2016	6	One sample collected after storms (2013)
30SantaF035.9	9/17/2013	5/28/2014	5	One sample collected after storms (2013)
30SantaF032.9	4/29/2010	10/8/2013	3	
NM0022292-M	4/29/2010	10/15/2014	10	Municipal waste
30SantaF30.5	4/29/2010	5/18/2010	2	
30SantaF028.4	4/15/2010	9/17/2015	16	
30SantaF013.6	3/20/2014	9/21/2017	12	
30SantaF012.9	4/29/2010	6/25/2014	8	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	9	
Dissolved oxygen saturation (4/15/2010 – 9/21/2017; n = 115)				
30SantaF061.1	4/29/2010	7/20/2016	10	
30SantaF059.1	8/20/2014	8/20/2014	1	
30SantaF052.4	6/4/2012	11/14/2014	8	
30SantaF050.5	5/14/2013	5/6/2015	13	One sample collected after storms (2013)
30SantaF050.3	6/2/2016	8/5/2016	4	
30SantaF047.9	6/4/2012	6/4/2012	1	
30SantaF044.5	6/4/2012	5/6/2015	6	One sample collected after storms (2013)
30SantaF041.2	9/17/2013	8/5/2016	6	One sample collected after storms (2013)
30SantaF035.9	9/17/2013	5/28/2014	5	One sample collected after storms (2013)
30SantaF032.9	4/29/2010	10/8/2013	3	
NM0022292-M	4/29/2010	10/15/2014	8	Municipal waste
30SantaF30.5	4/29/2010	5/18/2010	2	

Station Identification Number	Start Date	End Date	Number of Samples	Notes
30SantaF028.4	4/15/2010	9/17/2015	16	
30SantaF013.6	3/20/2014	9/21/2017	12	
30SantaF012.9	4/29/2010	6/25/2014	8	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	9	
Kjeldahl nitrogen (4/15/2010 – 9/21/2017; n = 89)				
30SantaF061.1	11/10/2011	11/14/2014	7	
30SantaF059.1	8/20/2014	8/20/2014	2	One sample represents well water
30SantaF052.4	10/8/2013	11/14/2014	5	
30SantaF050.5	10/8/2013	10/15/2014	9	
30SantaF044.5	10/8/2013	6/25/2014	2	
30SantaF041.2	10/8/2013	10/8/2013	1	
30SantaF035.9	10/8/2013	5/28/2014	4	
30SantaF032.9	4/29/2010	10/8/2013	3	
NM0022292-M	4/29/2010	10/15/2014	12	Municipal waste
30SantaF30.5	4/29/2010	5/18/2010	2	
30SantaF028.4	4/15/2010	10/15/2014	15	
30SantaF013.6	3/20/2014	9/21/2017	12	
30SantaF012.9	4/29/2010	4/22/2014	7	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	7	
Nitrogen, ammonia as N (4/15/2010 – 9/21/2017; n = 87)				
30SantaF061.1	11/10/2011	11/14/2014	7	
30SantaF059.1	8/20/2014	8/20/2014	2	One sample represents well water
30SantaF052.4	10/8/2013	11/14/2014	5	
30SantaF050.5	10/8/2013	10/15/2014	9	
30SantaF044.5	10/8/2013	6/25/2014	2	
30SantaF041.2	10/8/2013	10/8/2013	1	
30SantaF035.9	10/8/2013	5/28/2014	4	
30SantaF032.9	4/29/2010	10/8/2013	3	
NM0022292-M	4/29/2010	10/15/2014	12	Municipal waste
30SantaF030.5	4/29/2010	5/18/2010	2	
30SantaF028.4	4/15/2010	10/15/2014	15	
30SantaF013.6	3/20/2014	9/21/2017	10	
30SantaF012.9	4/29/2010	4/22/2014	7	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	7	
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N (4/15/2010 – 9/21/2017; n = 87)				
30SantaF061.1	4/10/2011	11/14/2014	7	

Station Identification Number	Start Date	End Date	Number of Samples	Notes
30SantaF059.1	8/20/2014	8/20/2014	2	One sample represents well water
30SantaF052.4	10/8/2013	11/14/2014	5	
30SantaF050.5	10/8/2013	10/15/2014	9	
30SantaF044.5	10/8/2013	6/25/2014	2	
30SantaF041.2	10/8/2013	10/8/2013	1	
30SantaF035.9	10/8/2013	5/28/2014	4	
30SantaF032.9	4/29/2010	10/8/2013	3	
NM0022292-M	4/29/2010	10/15/2014	12	Municipal waste
30SantaF030.5	4/29/2010	5/18/2010	2	
30SantaF028.4	4/15/2010	10/15/2014	15	
30SantaF013.6	3/20/2014	9/21/2017	10	
30SantaF012.9	4/29/2010	4/22/2014	7	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	7	
Phosphorus as P (4/15/2010 – 9/21/2017; n = 89)				
30SantaF061.1	11/10/2011	11/14/2014	7	
30SantaF059.1	8/20/2014	8/20/2014	2	One sample represents well water
30SantaF052.4	10/8/2013	11/14/2014	5	
30SantaF050.5	10/8/2013	10/15/2014	9	
30SantaF044.5	10/8/2013	6/25/2014	2	
30SantaF041.2	10/8/2013	10/8/2013	1	
30SantaF035.9	10/8/2013	5/28/2014	4	
30SantaF032.9	4/29/2010	10/8/2013	3	
NM0022292-M	4/29/2010	10/15/2014	12	Municipal waste
30SantaF030.5	4/29/2010	5/18/2010	2	
30SantaF028.4	4/15/2010	10/15/2014	15	
30SantaF013.6	3/20/2014	9/21/2017	12	
30SantaF012.9	4/29/2010	4/22/2014	7	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	7	
Temperature, water (4/10/2010 – 9/21/2017; n = 117)				
30SantaF061.1	11/10/11	7/20/2016	10	
30SantaF059.1	8/20/2014	8/20/2014	1	
30SantaF052.4	6/4/2012	11/14/2014	8	
30SantaF050.5	5/14/2013	5/6/2015	13	One sample collected after storms (2013)
30SantaF050.3	6/2/2016	8/5/2016	4	
30SantaF047.9	6/4/2012	6/4/2012	1	
30SantaF044.5	6/4/2012	5/6/2015	6	One sample collected after storms (2013)

Station Identification Number	Start Date	End Date	Number of Samples	Notes
30SantaF041.2	9/17/2013	8/5/2016	6	One sample collected after storms (2013)
30SantaF035.9	9/17/2013	5/28/2014	5	One sample collected after storms (2013)
30SantaF032.9	4/29/2010	10/8/2013	3	
NM0022292-M	4/29/2010	10/15/2014	11	Municipal waste
30SantaF030.5	4/29/2010	5/18/2010	2	
30SantaF028.4	4/15/2010	9/17/2015	16	
30SantaF013.6	3/20/2014	9/21/2017	12	
30SantaF012.9	4/29/2010	6/25/2014	8	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	10	
***E. Coli* (3/23/2005 – 9/21/2017; n = 118)**				
30SantaF061.1	4/22/2014	11/14/2014	6	
30SantaF052.4	6/5/2008	11/14/2014	10	
30SantaF050.5	5/7/2013	10/15/2014	12	One sample collected after storms (2013)
30SantaT050.3	6/2/2016	8/5/2016	4	
NMR040000-SF02	8/5/2016	8/5/2016	1	Stormwater outfall
NMR040000-SR01	8/5/2016	8/5/2016	1	Stormwater outfall
30SantaF048.8	4/20/2005	4/20/2005	1	
30SantaF047.9	10/3/2008	6/4/2012	2	
30SantaF044.5	6/5/2008	6/25/2014	6	One sample collected after storms (2013)
30SantaF041.2	9/17/2013	8/5/2016	6	One sample collected after storms (2013)
30SantaF035.9	3/23/2005	5/28/2014	11	One sample collected after storms (2013)
30SantaF032.9	10/8/2013	10/8/2013	1	
NM0022292-M	10/8/2013	10/15/2014	9	Municipal waste
SFR at effluent outfall	3/23/2005	10/5/2005	9	
30SantaF030.5	7/12/2005	7/12/2005	1	
30SantaF028.4	10/8/2013	10/15/2014	9	
30SantaF013.6	3/20/2014	9/21/2017	10	
30SantaF012.9	3/23/2005	6/25/2014	11	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	7	
Total Coliform (6/4/2012 – 9/21/2017; n = 88)				
30SantaF061.1	4/22/2014	11/14/2014	6	
30SantaF052.4	6/4/2012	11/14/2014	8	
30SantaF050.5	5/7/2013	10/15/2014	12	One sample collected after storms (2013)
NMR040000-SF02	8/5/2016	8/5/2016	1	Stormwater outfall
NMR040000-SR01	8/5/2016	8/5/2016	1	Stormwater outfall

Station Identification Number	Start Date	End Date	Number of Samples	Notes
30SantaF050.3	6/2/2016	8/5/2016	4	
30SantaF047.9	6/4/2012	6/4/2012	1	
30SantaF044.5	6/4/2012	6/25/2014	5	One sample collected after storms (2013)
30SantaF041.2	9/17/2013	8/5/2016	6	One sample collected after storms (2013)
30SantaF035.9	9/17/2013	5/28/2014	5	One sample collected after storms (2013)
30SantaF032.9	10/8/2013	10/8/2013	1	
NM0022292-M	10/8/2013	10/15/2014	9	Municipal waste
30SantaF028.4	10/8/2013	10/15/2014	9	
30SantaF013.6	3/20/2014	9/21/2017	10	
30SantaF012.9	3/20/2014	6/25/2014	2	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	7	
Total suspended solids (8/16/2010 – 9/21/2017; n = 59)				
30SantaF061.1	11/10/2011	11/14/2014	7	
30SantaF059.1	8/20/2014	8/20/2014	2	One sample represents well water
30SantaF052.4	4/22/2014	11/14/2014	4	
30SantaF050.5	4/22/2014	10/1/2014	6	
30SantaF044.5	6/25/2014	6/25/2014	1	
30SantaF035.9	3/27/2014	5/28/2014	3	
NM0022292-M	3/27/2014	10/1/2014	7	Municipal waste
30SantaF028.4	8/16/2010	10/1/2014	9	
30SantaF013.6	3/20/2014	9/21/2017	9	
30SantaF012.9	8/16/2010	5/28/2014	5	
30LaCien000.1	4/22/2014	10/1/2014	6	
Turbidity (4/10/2010 – 9/21/2017; n = 113)				
30SantaF061.1	11/10/11	7/20/2016	11	
30SantaF059.1	8/20/2014	8/20/2014	1	
30SantaF052.4	6/4/2012	11/14/2014	8	
30SantaF050.5	5/14/2013	5/6/2015	12	One sample collected after storms (2013)
30SantaF050.3	6/2/2016	8/5/2016	4	
30SantaF047.9	6/4/2012	6/4/2012	1	
30SantaF044.5	6/4/2012	5/6/2015	6	One sample collected after storms (2013)
30SantaF041.2	9/17/2013	8/5/2016	6	One sample collected after storms (2013)
30SantaF035.9	9/17/2013	5/28/2014	5	One sample collected after storms (2013)
30SantaF032.9	4/29/2010	10/8/2013	3	
NM0022292-M	4/29/2010	10/15/2014	10	Municipal waste
30SantaF030.5	4/29/2010	5/18/2010	2	

Station Identification Number	Start Date	End Date	Number of Samples	Notes
30SantaF028.4	4/15/2010	9/17/2015	15	
30SantaF013.6	3/20/2014	9/21/2017	11	
30SantaF012.9	4/29/2010	6/25/2014	8	
30LaCien002.1	3/27/2014	3/27/2014	1	
30LaCien000.1	4/22/2014	10/15/2014	8	
Instantaneous Flow (64/10/2010 – 9/21/2017; n = 173)*				
30SantaF061.1	11/10/11	7/20/2016	17	
30SantaF059.1	8/20/2014	8/20/2014	1	
30SantaF052.4	6/4/2012	11/14/2014	13	
30SantaF050.5	5/7/2013	5/6/2015	22	One sample collected after storms (2013)
30SantaF050.3	6/2/2016	8/5/2016	4	
30SantaF047.9	6/4/2012	7/18/2012	3	
30SantaF044.5	6/4/2012	5/6/2015	11	One sample collected after storms (2013)
30SantaF042.6	5/13/2013	5/13/2013	1	
30SantaF041.2	9/17/2013	8/5/2016	6	One sample collected after storms (2013)
30SantaF035.9	9/17/2013	5/28/2014	8	One sample collected after storms (2013)
30SantaF032.9	4/29/2010	10/8/2013	5	
NM0022292-M	4/29/2010	10/15/2014	9	Municipal waste
30SantaF030.5	4/29/2010	5/18/2010	2	
30SantaF028.4	4/15/2010	9/17/2015	31	
30SantaF013.6	3/20/2014	9/21/2017	23	
30LaCien002.1	3/27/2014	3/27/2014	2	
30LaCien000.1	4/22/2014	10/15/2014	10	

*Some results are qualitative (i.e., low, moderate, high) rather than quantitative.

3.0 APPLICATION FOR POLLUTANT SOURCE CHARACTERIZATION

During model configuration, land categories that share hydrologic or pollutant loading characteristics will be grouped. It is assumed that the loading processes associated with *E. coli* and nutrient parameters that are not associated with sediment will be represented in the model using build-up/wash-off functions in which the pollutants are assumed to accumulate on the land surface during dry periods and are subsequently washed off during storm events. Sediment will be estimated using the sediment modules that simulate the production and removal of sediment from all land segments. Once the model represents the sediment transported to the stream channel by overland flow, transport, deposition, and scour of sediment in the stream channels can also be simulated. Additional water quality simulations will then be performed for any parameters that are correlated with sediment using wash-off potency factors.

The vast majority of stations with available data represent conditions within the Santa Fe River itself. Data for these stations will be useful for calibrating in-stream water quality concentrations. One exception is the station located at the Santa Fe WWTP effluent outfall channel (NM0022292). The datasets indicated that these samples represent municipal wastewater; therefore, data from this station will be used to characterize the immediate in-stream conditions associated with the WWTP contributions. In addition, the Cienega Creek stations can be used to characterize water quality conditions associated with that drainage area. All available data will also be useful to identify relationships between any parameters (i.e., are any of the nutrient species correlated with TSS?).

The genetic marker study is also useful to identify the relative contribution of various sources of bacteria in the watershed. Where data are available, loads associated with the five sources analyzed can be appropriately proportioned by source at the different locations. For locations without data on all of the five sources, the data will be used to the extent possible and assumptions can be made for the sources without measurements.

In the absence of land cover- or source-specific water quality data, water quality calibration will likely be conducted moving from upstream to downstream in the watershed as the upstream areas have more homogenous land cover. Calibrating water quality parameters at a station with a fairly homogenous drainage area helps to define the parameters for that land cover early in the modeling process. Model calibration will then continue at each station sequentially downstream, taking into consideration the additional land cover included in the upstream drainage area (depending on the proximity of the new land use[s] to the stream and the associated area). Literature values quantifying the relative difference in pollutant loading between land cover types will be used as a guide to ensure that model parameterization is realistic.

After the available data are used in model calibration for the Santa Fe River, the parameters will be transferred to the model for the Arroyo de Los Chamisos as there are no additional data for this waterbody to inform water quality calibration.

4.0 DATA GAPS

Additional data sources may be available that would enhance the spatial representation of the watershed model. These data gaps include:

- Arroyo de Los Chamisos is currently not represented by any of the data compiled to date. Any data for this waterbody would be useful to characterize local conditions.
- Additional water quality data representing storm drain outfalls and/or drainages with fairly homogenous land uses would be valuable to model calibration for specific pollutant sources.
- Sampling locations for the genetic marker study would be useful to identify drainage areas associated with the sources of bacteria.

D. ASSET MANAGEMENT MEMO

TETRA TECH

MEMO

To:	Melissa McDonald
Cc:	Leroy Pacheco, PE
From:	Troy Dorman, PE
Date:	July 9, 2018
Subject:	Asset Management Inventory and Program Recommendations - Final

1.0 INTRODUCTION

Starting a discussion about asset management requires defining what it is. According to the EPA:

Asset management is maintaining a desired level of service for what you want your assets to provide at the lowest life cycle cost. Lowest life cycle cost refers to the best appropriate cost for rehabilitating, repairing or replacing an asset. Asset management is implemented through an asset management program and typically includes a written asset management plan.

Our focus during development of this memo was to adapt the “textbook” idea of asset management into a practical set of recommendations for Santa Fe. The information gained during Tetra Tech’s review of the existing stormwater program guided the creation of Asset Management Goals specifically for the City of Santa Fe. These goals will improve asset tracking, operation and maintenance while advancing watershed-based stormwater management outcome desired by the City. The goals are

- Document and guide maintenance of the storm drain system
- Provide basis for study, design, modeling and fixing drainage issues
- Guide creation of a stormwater monitoring program
- Develop programs and processes to maintain existing and incorporate new asset management data

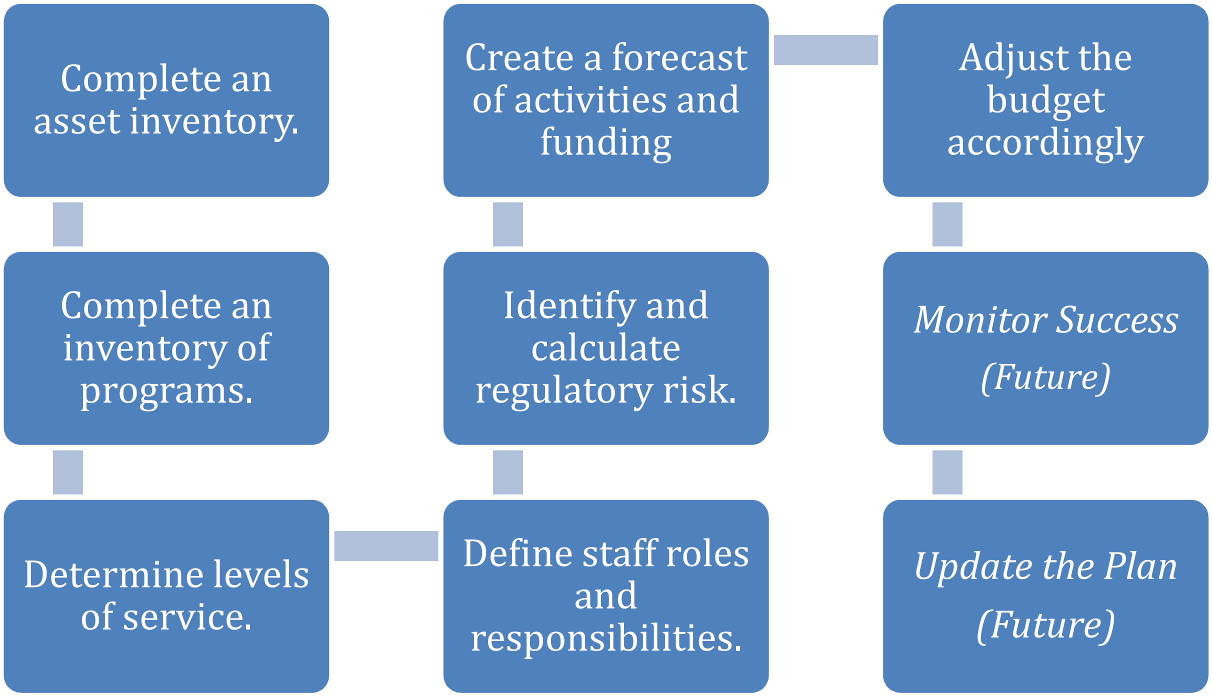
As the City looks at actions to implement stormwater asset management, keeping a few questions in mind can help provide focus. Answering the questions when considering new expenditures and processes can guide decision makers to the optimal approach.

You should ask:

How do our current efforts improve the public’s perception of the Santa Fe stormwater team’s service?
What have we learned since last year that can improve our asset management system and processes?
How does the current system inhibit the City of Santa Fe meeting MS4 permit requirements?
How does the current system help the City of Santa Fe meet MS4 permit requirements?

2.0 ASSET MANAGEMENT FRAMEWORK

Once goals are set, it is necessary to develop a plan to implement them and achieve the desired outcomes. There a many national and instate guidance documents for how to achieve asset management using financial, GIS, and planning tools. Based on our understanding of the City of Santa Fe, the team adapted steps that ESRI developed from more than 20 years of GIS based asset management.



These steps provide a road map for Santa Fe to create a successful asset management program that improves customer service, reduces cost, and maps out the funding necessary to maintain and expand the stormwater management system. The following sections discuss these steps and provide specific recommendations for Santa Fe. The last two future steps are considered self-explanatory and are not discussed in this memo.

2.1 EXISTING STORMWATER DATA

To complete an asset inventory, Santa Fe needed a data inventory and review. Staff provided Tetra Tech with a wide variety of data sources including GIS information, text files, aerial photography and LiDAR data. Tetra Tech evaluated the available data for purposes of stormwater management planning and asset management and to identify gaps in data.

The GIS data received from the City of Santa Fe include the following stormwater system shapefiles:

- Drop Inlet
- Outfall
- Storm Water Areas
- Storm Water Channels
- Storm Water Curb Openings
- Storm Water Inlets
- Storm Water Outlets
- Storm Water Pond Embankments
- Storm Water Ponds

None of the files cover the whole area of the watershed and the attribute tables are incomplete. Figure 1 shows the location of data that was provided by City staff. It is apparent that much of the city is not represented in the data. Field checks and review of aerial photography indicated that there is a large part of the stormwater system that is not represented in the existing data. Also, there are several files with the same type of information and they need to be accumulated and collected in one comprehensive database file. Missing (or incomplete) data for the proposed stormwater database includes: stormwater inlet and outlets, pipes, culverts, channels, manholes, and easement and cleanout locations.

Key Recommendation #1 - The top priority is collection of complete stormwater system data including a condition assessment of all surface and subsurface assets.

2.2 INVENTORY OF SANTA FE ASSET MANAGEMENT PROGRAMS

The City of Santa Fe uses multiple "asset management" programs across the different departments. There are separate asset management needs and software programs for facilities, financials, human resources, utilities and billing. City staff and Tetra Tech met on March 8, 2018 to compare the asset management solutions in order to determine the best path forward for a Stormwater asset management approach. Full notes for the meeting are included at the end of this memo. The highlights from the meeting are:

- The city is in the process of implementing several enterprise-wide systems from Tyler Technologies, including Munis (for Financial and HR systems), EnerGov (for land management, licensing and permitting) and Tyler Enterprise Asset Management (EAM). Both EnerGov and EAM are fully integrated with ESRI GIS allowing display of ESRI shapefiles. According to Santa Fe's IT department, Tyler EAM does not have the ability to edit geodatabases directly within the software.
- The Public Utilities department currently uses Cityworks for water transmission and distribution assets. All sewer lines are in a GIS database which is used internally by city staff and asset repairs and maintenance are tracked in a MS Access database. Additional software is used in the water/wastewater treatment plants to track asset work orders, data, and repairs. Utility billing is through a separate software program but there are plans to move to a system that works with Cityworks. Cityworks is a GIS based asset management tool that is developed on top of the GIS software created by ESRI.

Tetra Tech considered the existing programs and planned conversions of software to make recommendations for the stormwater department. A GIS based tool is the most beneficial for collecting, developing and maintaining the stormwater system asset management data. However, no one system within Santa Fe currently provides the functionality of a GIS interface for data with backend functions for billing, tracking changes, and creating system reports.

Key Recommendation #2 -Tetra Tech recommends using the ESRI stormwater data structure to standardize data collection in the next 9 to 12 months.

Key Recommendation #3 - Determine cost for City Works support to add Stormwater Asset Management to the Public Utilities department contract.

2.3 DETERMINE LEVELS OF SERVICE

The City of Santa Fe currently requires all stormwater infrastructure to be design for the 100-yr storm event. However, future stormwater permit requirements will most likely include a water quality design storm with retention, infiltration and beneficial uses that increase the time that water is discharging to the storm drain system. In addition, the city has experienced erosion and deposition issues within the natural/earthen channel network of arroyos. As part of the overall stormwater program master plan, Santa Fe is determining the aspirational goals for reducing erosion, increasing stream health, maximizing beneficial recharge, and improving water quality.

In addition, Santa Fe will need to define maintenance and street sweeping schedules that both meet resident's expectations and implement stormwater permit requirements to assist with achieving water quality goals. Current water quality level of service goals are undefined.

Key Recommendation #4 – After completing Key Recommendation #2, assess level of service goals based on resident reports, maintenance records, and priority water quality or pilot areas.

2.4 DEFINE STAFF ROLES AND RESPONSIBILITIES.

Staff roles and responsibilities are included in the Stormwater Management Strategic Plan developed in concurrence with this memo.

2.5 IDENTIFY AND CALCULATE RISK.

Regulatory risk will be determined through the process of developing the Stormwater Management Program in response to the upcoming EPA Phase II MS4 permit. As the SWMP is developed, specific requirements will be worked out with NMED and the EPA. These requirements will define the risk associated with non-compliance.

There is also political risk associated with an underperforming stormwater management system. The public relies on effective drainage solutions to live in an urban area and often is less interested in water quality benefits. A comprehensive asset management program will allow the Stormwater Department to respond to customer complaints in a timely fashion while also justifying the cost of service through data driven reports.

Key Recommendation #5 – Develop a monitoring program based on critical water quality areas indicated by the stormwater management modeling. Collection of the local water quality data will assist Santa Fe with defining areas of concern and tailor approaches in the SWMP to address issues defined by local information.

2.6 CREATE A FORECAST OF ACTIVITIES AND FUNDING

The forecast of activities and associated costs need to be determined after the asset inventory is completed. For Santa Fe, this will include an understanding of the existing costs associated with maintenance of closed systems and repair of erosion issues. However, with the new MS4 regulations resulting in more stormwater BMPs on private property, this forecast will need to include costs associated with review of privately owned BMP plans, inspection and enforcement staffing needs.

Key Recommendation #6 – Begin building a Capital Improvement Plan based on existing projects and known drainage issues. Geolocate additional problem areas as citizens report drainage issues and hire local engineering firms to develop preliminary engineering reports to assist with budgeting.

Key Recommendation #7 – Develop a budget for collecting storm drain information for 10 priority areas in the next 3 months.

Key Recommendation #8 – Document maintenance activities and evaluate whether changes are necessary to meet proposed level of service.

2.7 ADJUST THE BUDGET ACCORDINGLY

As the city grows and stormwater management requirements become clearer, projections on a five-year cycle should be made to plan for programmatic costs, new construction, repair, and maintenance costs. At this time, the initial budgeting has been estimated as part of the funding discussion in the Stormwater Management Strategic Plan which has assessed the overall funding sources and expenditures under existing programs.

These seven steps provide a path forward for creating an asset management program.

3.0 DATA REVIEW AND CONVERSION PROCESS

Tetra Tech has developed the initial GIS based framework for asset data collection as part of the GIS Data collection and Review tasks associated with the Drainage Management Plan updates for the Santa Fe River and Arroyo De Los Chamisos. The GIS framework is based on the ESRI StormUtility database that is available for free and defines features classes and basic information fields that should be collected for a GIS based stormwater asset management system. Table 1 shows the connection between the available types of data that were provided by Santa Fe and the feature classes in the ESRI database. More details on the specific field mapping that was used to populate the database are included in the attachements to this memo. While the Stormwater team finalizes the asset management data system, the ESRI database provides a structure to focus stormwater system data collection and storage for a broad range of uses. The database is standardized but flexible enough to feed into Cityworks or a Cloud based solution such as those provided by ESRI.

4.0 SUMMARY OF RECOMMENDATIONS

We recommend that the City of Santa Fe Stormwater team develop an Asset Management Plan (AMP) that will be approved by City Council and provide the guidance and budgeting to implement stormwater asset management in support of the Stormwater Management Strategic Plan. The individual recommendations have been explained in the previous discussion. The efforts should be started immediately with recommendations 1 through 5 running concurrently. Recommendations 6 through 8 will be necessary to develop the AMP document but depend on tasks 1 through 5.

- Key Recommendation #1 - The top priority is collection of complete stormwater system data including a condition assessment of all surface and subsurface assets.
- Key Recommendation #2 -Tetra Tech recommends using the ESRI stormwater data structure to standardize data collection in the next 9 to 12 months.
- Key Recommendation #3 - Determine cost for City Works support to add Stormwater Asset Management to the Public Utilities department contract.
- Key Recommendation #4 – After completing Key Recommendation #2, assess level of service goals based on resident reports, maintenance records, and priority water quality or pilot areas.
- Key Recommendation #5 – Develop a monitoring program based on critical water quality areas indicated by the stormwater management modeling. Collection of the local water quality data will assist Santa Fe with defining areas of concern and tailor approaches in the SWMP to address issues defined by local information.
- Key Recommendation #6 – Begin building a Capital Improvement Plan based on existing projects and known drainage issues. Geolocate additional problem areas as citizens report drainage issues and hire local engineering firms to develop preliminary engineering reports to assist with budgeting.
- Key Recommendation #7 – Develop a budget for collecting storm drain information for 10 priority areas in the next 3 months.
- Key Recommendation #8 – Document maintenance activities and evaluate whether changes are necessary to meet proposed level of service.

E. EXTERNAL STAKEHOLDER SUMMARY & EXHIBITS

City of Santa Fe Stormwater Management

External Stakeholder Taskforce Meeting
Public Works Roundhouse Room – Railyard
AUGUST 24, 2018

Summary of Meeting

Facilitator: Rosemary Romero
Consultant: Troy Dorman, Tetra Tech
Staff: Melissa McDonald, Leroy Pacheco

Purpose of Session:

- Review updated modeling conducted by Tetra Tech
- Review elements of Stormwater Management Strategic Plan
- Overview of EPA
- Discussion and applicability of the model

Welcome, Introductions and Purpose: Participants introduced themselves noting their affiliation.

Overview of current efforts: Melissa McDonald, River and Watershed Coordinator for the City of Santa Fe gave a brief overview of the two efforts currently underway. She explained that the City of Santa Fe was chosen by EPA to help develop materials needed for implementation of stormwater management through handbooks and other materials. Tetra Tech was contracted to develop the modeling and strategic plan to prepare the City for meeting the upcoming MS-4 permitting that the City is required to do. The two efforts will dovetail with each other.

Overview of Strategic Plan: Christy Williams from Tetra Tech gave an overview of the Outline and themes for progressive stormwater management.

Outcomes from flood management and water quality modeling: Troy Dorman, project lead for the modeling aspect of the contract lead the discussion about how the modeling worked and potential design criteria changes.

- Potential land use management changes

- Data collection needs and new processes for private development?

Discussion:

Consider how land use looks at uses through “zones” that are overlay districts.

Impacts mostly come from development as noted by the recent storms and perhaps consideration could be to incorporate fees.

The modeling will be important as an analysis tool specific to sediment and terrain management and provided to developers. For example, the Arroyo de las Mascaras would be a relevant area to utilize the modeling.

Dual uses of stormwater are aesthetics and management. For example, a current issue that the City is dealing with are the maintenance and upkeep of medians. Plant selection could be helpful for weed management.

Design criteria should be varying depending on the circumstances. For new development changes to land use are doable – the issue will be for older areas of the city.

There is a potential for “pushback” from engineering for green infrastructure, mostly because of cost and design

Additional project areas could be those significantly affected by the July 23 flooding such as the Commons on West Alameda

Next Steps

The report to the governing body should be graphic and simple

It would be helpful to analyze Impact Fees and include needed budgetary information prior to discussion of the annual budget cycle

The IT department should work on how to integrate incoming information from developers and engineers. This may require a different kind of website to make it useful.

Follow-up Comments from Michael Gomez sent via email:

I have reviewed the Santa Fe River and Arroyo De Los Chamisos Modeling Report. The report is well done and is needed. I do have the following comments for consideration.

Executive Summary

- The Stormwater System priority 1 recommendations are appropriate. Especially constructing monitoring stations to obtain water quality, sediment load, hydrographs of real storms, as well as runoff quantities.

- The Detailed Impervious cover database priority 2 recommendations include identification of unpermitted, unreported buildings and development. In my experience, this does not happen in Santa Fe. Santa Fe is a small town and the residents are aware of known developments. A task to identify unpermitted, unreported buildings would obtain little information and would be waste of resources.
- The Refine Stormwater criteria contains some incorrect statements. SFCC 14-8.2 "Terrain and Stormwater Management" states "*the stormwater runoff peak flow rate discharged from a site shall not exceed pre-development conditions for any frequency storm event up to the one percent chance, twenty-four-hour storm event at each discharge point*;" and "*stormwater detention basins and overflow structures shall be sized and designed to adequately accommodate flows from one percent chance, twenty-four-hour storm events; provided, however, that such basins shall also be equipped with outflow structures that limit flow-through from lesser magnitude storms to runoff rates equal to or less than pre-development runoff rates*." SFEC does analyze various frequency storms for all projects. In addition, if sediment transport is to be included as a "design criteria" then the City needs to provide erosion rates, methodology and other data that is currently not available.

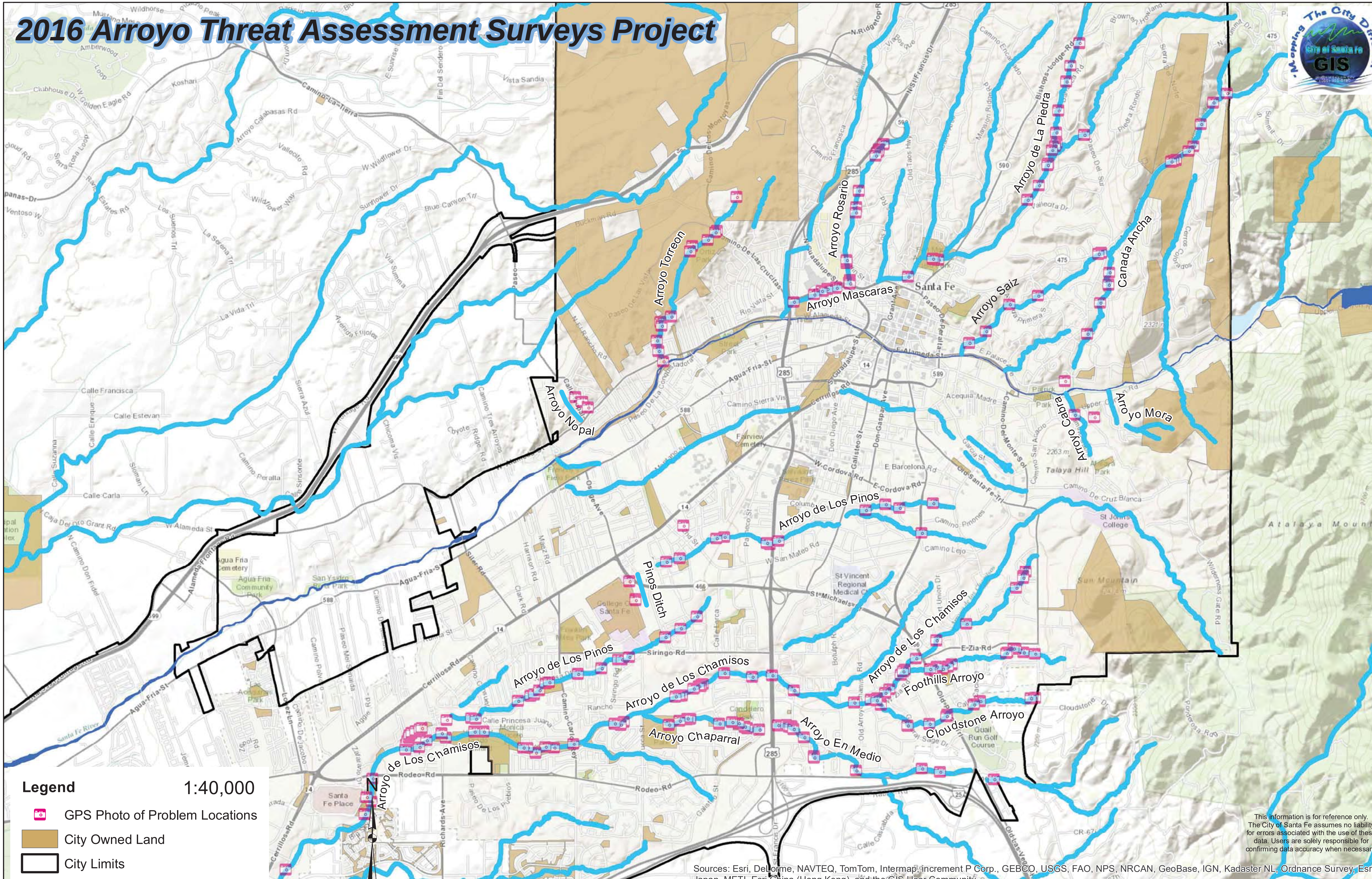
Report

- Section 3.2 Rainfall-Runoff Generation. The use of Snyder's unit hydrograph has been discouraged by the State Engineer on other projects. The SEO contend that Sniders unit hydrograph does not work well in the Southwest. They have in the past recommended that S graphs as presented in "Flood Hydrology Manual," (Chatsworth 1989) be used. When rainfall and runoff data is available and then site specific unit hydrographs could be developed.

- The graphics are difficult to read. Can better images be downloaded so that they do not become pixelated?

The City Staff and the consultant have done an excellent job. This is a good first step for stormwater management in the City of Santa Fe. Public participation in any code changes is essential. I look forward to the actual model.

2016 Arroyo Threat Assessment Surveys Project



Legend

1:40,000

GPS Photo of Problem Locations

City Owned Land

City Limits

This information is for reference only. The City of Santa Fe assumes no liability for errors associated with the use of these data. Users are solely responsible for confirming data accuracy when necessary.

Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

2018 Stormwater Strategic Plan Project List

Arroyo Name	Segment Location, Upstream	Segment Location, Downstream	Infrastructure Damage/Risk	Channel Character,	Cost Estimate
1. C. Arroyo de los Chamisos	Conejo Road	Saint Francis Drive	**1.2**	**1.6**	$ 1,100,000.00
1. D. Arroyo de los Chamisos	S.Saint Francis Drive	Yucca Street	**1.4**	**0.8**	$ 450,000.00
1. E. Arroyo de los Chamisos	Yucca Street	Carlos Camino Rey	**2.4**	**1.7**	$ 300,000.00
1. F. Arroyo de los Chamisos	Camino Carlos Rey	Ave de las Campanas	**1.7**	**1**	$ 1,750,000.00
1. G. Arroyo de los Chamisos	Ave de las Campanas	Rodeo Road	**1.7**	**1.3**	
1. H. Arroyo de los Chamisos	Rodeo Road	Governor Miles Road	**1.4**	**1.9**	$ 150,000.00
1. I. Arroyo de los Chamisos	Governor Miles Road	Cactus Flower Lane	**NA**	**NA**	$ 500,000.00
2. A. Arroyo Rosario	Below HWY 285-S	373 Calle Loma Norte	**1**	**1.7**	$ 300,000.00
2. B. Arroyo Rosario	373 Calle Loma Norte	388 Calle Loma Norte	**2.4**	**2.4**	-
2. C. Arroyo Rosario	388 Calle Loma Norte	Los Arboles	**NA**	**0.9**	$ 300,000.00
2. D. Arroyo Rosario	Los Arboles	Rio Grande Street	**2.2**	**1.4**	$ 300,000.00
2. E. Arroyo Rosario	Rio Grande Street	Paseo de Peralta **MASCARAS**	**2**	**2**	-
2. F. Arroyo Lovatos	Los Lovatos Road	Rosario Blvd **MASCARAS**	**NA**	**NA**	-
3. Arroyo Saiz	Begin at Hyde Park + Gonzalez Rd	**SANTA FE RIVER**	**1.7**	**1**	-
4. Arroyo Mora (Upper Canyon Road)	South of Calle Militar	**SANTA FE RIVER**	**NA**	**1.9**	$ 100,000.00
5. Arroyo Cabra (Cristo Rey Area)	Apodaca Hill	**SANTA FE RIVER**	**NA**	**1.9**	$ 100,000.00
6. Arroyo en Medio	Old Santa Fe Trail	St Francis Drive **CHAPARRAL**	**1.4**	**1.3**	$ 500,000.00
7. A. Arroyo Ancha	Near Ten Thousand Waves Spa	Cañada Sur	**0.9**	**NA**	$ 1,000,000.00
7. B. Arroyo Ancha	Cañada Sur	**SANTA FE RIVER**	**1.2**	**0.3**	$ 1,000,000.00
8. Arroyo de los Pinos *Upper A*	Camino Corrales/Lejo	Galisteo Street	**NA**	**0.9**	$ 1,000,000.00
8. Arroyo de los Pinos *Upper B*	Camino Corrales/Lejano	Don Gaspar Street	**2**	**1.1**	$ 500,000.00
8. Arroyo de los Pinos *Ditch*	St. Michael's Drive	Siringo Road	**1.4**	**1.8**	$ 500,000.00
8. B. Arroyo de los Pinos	St. Francis Drive	6th Street	**2.3**	**2.5**	-
8. C. Arroyo de los Pinos	St. Michael's Drive	Camino Carlos Rey	**1.9**	**1.9**	$ 500,000.00
8. D. Arroyo de los Pinos	Camino Carlos Rey	Richards Avenue	**2.7**	**2.2**	$ 500,000.00
8. E. Arroyo de los Pinos	Richards Avenue	**ARROYO DE LOS CHAMISOS**	**1.9**	**1.6**	$ 1,350,000.00
9. A. Arroyo Mascaras	Bishop's Lodge Road	**ARROYO BARRANCA**	**0.9**	**1.9**	$ 500,000.00
9. C. Arroyo Mascaras	Old Taos Highway	Paseo de Peralta Culvert	**0.9**	**0.7**	$ 500,000.00
9. D. Arroyo Mascaras	Paseo de Peralta Culvert	**SANTA FE RIVER**	**NA**	**1.2**	-
10. A Arroyo de la Piedra East Fork	Calle Conejo	Camino Real	**NA**	**0.9**	$ 250,000.00
10. B Arroyo de la Piedra West Fork	Brownell-Howland	Hyde Park Road **MASCARAS**	**1.1**	**1.1**	$ 250,000.00
10. B Arroyo de la Piedra	Hyde Park	Old Taos Highway **MASCARAS**	**NA**	**NA**	$ 500,000.00
11. Arroyo Foothill	Old Santa Fe Trail	**ARROYO DE LOS CHAMISOS**	**1.2**	**1.2**	$ 250,000.00
12. A. Arroyo Cloudstone	Old Santa Fe Trail	Old Pecos Trail	**0.8**	**0.5**	$ 250,000.00
12. B. Arroyo Cloudstone	Old Pecos Trail	**ARROYO DE LOS CHAMISOS**	**1.4**	**1**	$ 250,000.00
13. Arroyo Nopal	East of Calle Nopal	W. Alameda	**1.9**	**2.4**	
14. A. Arroyo Torreon	East of Buckman Rd	Camino de las Crucitas	**1.2**	**1.1**	$ 1,000,000.00
14. B. Arroyo Torreon	Camino de las Crucitas	**SANTA FE RIVER**	**0.9**	**0.7**	$ 5,000,000.00
15. B. Arroyo Chaparral	Galisteo Road	Esplendor Street	**1.7**	**2**	-
15. C. Arroyo Chaparral	Esplendor Street	**ARROYO DE LOS CHAMISOS**	**0.9**	**1**	$ 1,000,000.00
16. Acequia Madre Stormwater Separation	Arroyo Tenorio	Maez Road	**NA**	**NA**	$ 2,000,000.00
17 A. SF River - Reach 1	Cerro Gordo	Santa Fe River	**NA**	**NA**	$ 1,000,000.00
17 B. SF River - Reach 15	Sandoval	Guadalupe	**NA**	**NA**	$ 500,000.00
17 C SF River - Reach 19	Boys & Girls Club	St Francis Drive	**NA**	**NA**	
17 D. SF River - Reach 26	Ricardo	La Joya	**NA**	**NA**	$ 500,000.00
17 E. SF River - Reach 27	Don Jose	Camino Carlos Rael	**NA**	**NA**	$ 50,000.00
17 F. SF River - Reach 30	Paseo Rael	Waste Water Treatment Plant	**NA**	**NA**	$ 500,000.00
18. Culvert Capacity Improvement Study		City-Wide	**NA**	**NA**	$ 500,000.00
19. Asset Management Data Collection		City-Wide	**NA**	**NA**	$ 500,000.00
					$ 27,500,000.00

*Project List Derived from SF Watershed Arroyo Assessment, Acequia Madre mapping, Tt Model, 2015 and 2018 Storm effects (EOC/CRM)

** Cost estimates are based solely on city owned property/easements and don't include private development project costs

*** Project funding sources may vary: CIP Bonds, Utiltiy Fee, Living River, Grants, etc.

F. STORMWATER FINANCIAL MEMO

MEMO

To:	Melissa McDonald
Cc:	Leroy Pacheco, Christy Williams, Troy Dorman
From:	Rick Schaefer, PE
Date:	July 31, 2018
Subject:	Stormwater Utility Service Charge Rate Structure Assessment

In 2017, the Tetra Tech team (team) was hired by the City of Santa Fe to evaluate the City's stormwater management program for compliance with the new stormwater permit as well as opportunities for operational and administrative improvements. Based on this evaluation, Tetra Tech is developing a Stormwater Management Strategic Plan that outlines recommended actions to ensure compliance and increase the efficiency and effectiveness of the stormwater management program, Tetra Tech also is updating the City's drainage management plans, providing a fiscal analysis of stormwater fees and budget, and evaluating the City's asset management system. The strategic plan will include and align with the outcomes of these efforts as appropriate.

This memorandum presents the findings of the fiscal analysis of stormwater fees and budget.

The Tetra Tech team has reviewed operating budgets, annual reports, capital improvement plans, and other documentation of the stormwater program and related City divisions engaged in the design, construction, maintenance and operation of stormwater facilities and services. Interviews have been conducted with stormwater program staff and with the Public Works and Finance departments.

STORMWATER FUNDING

Current Funding

Storm Water Drainage expenditures have varied over recent years (Figure 1). Expenditures budgeted for FY17/18 of $2,082,930 exceed the estimated annual revenues of $1,570,000 generated by the Stormwater Utility Service Charge. The Storm Water Fund 21401 has a projected FYE balance of $973,474. At the current pace of revenues and expenditures, the balance surplus will be fully depleted during FY19/20.

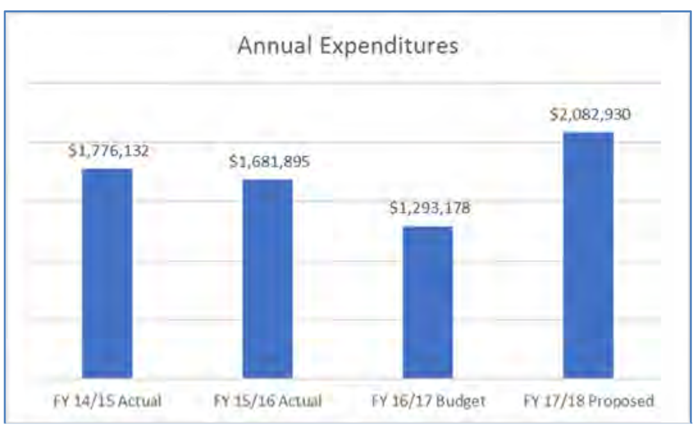


Figure 1 Annual Storm Water Expenditures

Tetra Tech
700 N. Saint Mary's Suite 300, San Antonio, Texas 78205
Tel 210.299.7900 tetratech.com

Revenue sources funding stormwater activities have shifted over recent years. Funding for some staff has been alternately provided through Fund 21401 and the General Fund. Fund 21401 at times has paid for drainage components of street capital projects, the acquisition of a vactor truck, tipping fees, and staff salaries. Because of the variability in both funding sources and in expenditures, and variations in the availability of documentation by year, clear trends were not discernable over the past 4 fiscal years.

Fund 21401 revenues are primarily expended for maintenance. Maintenance of the storm drainage system is performed by the Streets and Drainage Maintenance Division of Public Works, and by the Parks Department. This work involves cleaning storm drainage pipes, culverts and catch basins; routine repairs and minor capital improvements; vegetation management in arroyos and roadway medians; erosion repairs and sediment management; and storm recovery (clearing debris). Annual maintenance expenditures for storm drainage, based on the FY16/17 base budget report, total $1.56M as allocated below:

- Fund 22401 Expenditures Storm Water Drainage $383K
- Fund 22402 Expenditures Storm Water Parks $249K
- Fund 22403 Expenditures Storm Water Streets $924K

Maintenance is currently considered understaffed, and additional maintenance positions have been requested.

Capital projects are partially funded from outside grant sources, but such funding is opportunistic and not reliably available for City projects. The City has the option of advancing capital improvements by leveraging a portion of stormwater fees using capital bonds in a manner similar to that commonly applied to other City capital projects. The City could leverage $500,000 of the annual stormwater fee revenues to service bond debt and, at current market interest rates, produce the capital project capacities shown in Table 1 below.

Table 1. Debt Financing Options

Term	Assumed Annual Interest Rate	Capital Project Capacity [1]
10 years	3.0 %	$4.98 million
15 years	3.5%	$7.47 million
20 years	4.0%	$9.95 million

[1] *Assumes annual debt service of $500,000*

Future Funding Requirements

The scope of stormwater related activities will expand to meet pending regulatory obligations and to address other operating and capital needs. These activities will require additional revenues beyond the currently allocated funding resources. Near-term priority actions that will require additional staffing and capital expense are identified below:

<u>Capital Program</u>

- Including post-construction stormwater management infrastructure in new City facilities. This would affect capital budgets of departments constructing the facilities.

<u>Operations & Maintenance</u>

- Conducting post-construction stormwater facility inspection, maintenance and operation consistently for City facilities.
- Consistently require and inspect erosion and sedimentation control practices on private development projects.

- Consistently require and inspect post-construction stormwater facility operation and maintenance on private facilities.
- Complete and maintain mapped inventory of public and private stormwater infrastructure assets.
- Develop and implement formal training on design, installation and maintenance of post-construction stormwater controls.

Planning & Engineering

- Complete a comprehensive inventory of stormwater infrastructure needed for watershed modeling, siting water quality BMPs, determining monitoring locations, building an asset management program, and documenting maintenance concerns and compliance with MS4 program requirements.
- Complete a detailed impervious cover dataset based on the existing LiDAR data and new high resolution aerial imagery acquired for support of several stormwater program elements including watershed and system modeling, developing a runoff based stormwater utility fee, and stormwater planning.
- Prepare and adopt refined stormwater system criteria addressing water quality, stream stability, sediment transport, and stormwater volume management.
- Update water quality monitoring program to comply with the proposed MS4 permit to both necessary water quality data acquisition and analysis, and to acquire runoff rate and volume measurements to verify watershed scale modeling and local design parameters.

Beyond the priorities identified above, other needs and associated costs will become better defined through further system planning, and as conditions change and system knowledge grows.

Conceptual Financial Model

A spreadsheet model was developed for use in evaluating stormwater program funding strategies and is appended to this memorandum with an explanatory narrative. The model has been developed with three scenarios: (1) a “pay-as-you-go” approach wherein rates are set to generate needed revenues; (2) the use of a 15-year bond to fund capital expenditures; and (3) a 20-year bond. An electronic copy of the spreadsheet model is provided separately to City staff.

Assumptions used in the model (e.g. annual capital investment, interest rates, cost escalation rates, customer growth rate) are explicitly identified and can be modified to examine alternative conditions or scenarios.

Fee revenues are premised upon the current rate structure and a presumed uniform annual growth rate. The monthly fee per residential water service can be modified over time to provide needed revenue and operating reserves.

The model was prepared with limited expenditure detail, considering the historical variability cited above, and because the scope of stormwater activities will change significantly. The spreadsheet model can be readily modified to add detail where it could better inform decision making.

To support the expansion of capital investment, the model’s functionality provides for debt financing. The two scenarios presented in the appendix proposes issuing bonds in FY18/19 over terms of 15 years and 20 years, respectively, at current market rates. The bond amounts in both scenarios were selected to result in annual debt service payments of approximately $500,000. Interest earned on unspent bond revenues is included with revenues.

STORMWATER UTILITY SERVICE CHARGE FEE RATE STRUCTURE

As noted in the preceding discussion, the present rate of revenue generated by the Stormwater Utility Service Charge Fee (“utility fee”) is not sufficient to sustain the current scope of the stormwater program, and the scope of stormwater activities will necessarily expand to achieve regulatory compliance and meet other identified needs. To meet these financial needs, the City could elect to supplement the utility fee revenues from other sources, as it has supported specific efforts with General Fund revenues on past occasions. From a policy perspective, however, we strongly recommend that an ongoing utility service be sustained through a dedicated and reliable funding mechanism.

The Tetra Tech team reviewed the stormwater utility service charge rate structure currently in place in Santa Fe along with alternative approaches to generating charges. This following presents outcomes of the review in three parts:

1. Current stormwater charge rate structure
2. Scope of the stormwater utility service charge
3. Rate structure alternatives

Current Stormwater Charge Rate Structure

Stormwater utility service charges are collected through the City’s water utility billing system, as set forth in SFCC Section 13-1. The charges are based on a flat monthly rate, with monthly charges assigned to customers based on the water meter size serving the property. The current rate structure, amended under Ordinance 2010-17, is presented in Table 1. Customers with household gross income not exceeding 120 percent of the most recent federal poverty guidelines may be exempted from the charge.

Table 2. Current Rate Structure Charges

Meter Size	Stormwater Utility Service Charge
Residential – All meters	$3.00
Commercial	
5/8-inch	$3.00
3/4-inch	$4.50
1 inch	$7.50
1-1/2 inch	$15.00
2-inch	$24.00
3-inch	$46.80
4-inch	$75.00
6-inch	$150.00
8-inch	$240.00

The present fee structure is efficient and inexpensive to administer. However, there is little to no nexus between water meter size and a property’s contribution of runoff volume, rate or quality which define a parcel’s “demand” for stormwater service. This produces a low level of equity across customer classes and between individual customers. As an example, a parcel occupied by a large parking lot, which does not have a water service, would not receive a charge for the stormwater it generates, whereas a residence with a relatively small footprint is charged a fee.

The present stormwater charge is inflexibly structured, and there is no basis for extending incentives or credits to customers for taking measures to reduce the rate or volume of storm runoff or to improve runoff water quality.

Scope of the Stormwater Service Charge

Revenues collected through the stormwater utility service charge are accounted for separately from other City funds, and designated uses of these revenues under SFCC 13-1.7 encompass the full scope of stormwater program activities:

- Acquisition, design, construction, maintenance and operation of the stormwater system, including capital improvements designated in the capital improvement program;
- Administration and enforcement of regulations and procedures relating to the stormwater system;
- Comprehensive drainage infrastructure planning and monitoring;
- Review of development plans and inspection for regulatory conformance;
- Enforcement of regulations protecting water quality and quantity; and,
- Other activities related to the improvement, maintenance and operation of the stormwater system.

As noted earlier, the City has occasionally supported selected stormwater projects and activities through other sources beyond the stormwater utility service charge, including the General Fund and outside grants.

Certain activities of the stormwater program are continuous ongoing functions which, in order to be sustained, should be reliably funded to meet City requirements, external regulatory obligations, and to assure properly functioning infrastructure. Examples of such activities include:

- MS4 compliance
- System maintenance and operation
- Administration and reporting
- Planning and programming
- Enforcement.

Because of their immediate relationship to the stormwater system and the intent of SFCC 13-1, these activities are most appropriately funded through the service charge.

Other significant stormwater program expenditures which can be funded both through service charges as well as other fees and revenue sources include development and permit reviews and capital works.

When establishing a rate structure and setting rates, it is recommended that accompanying policies be adopted that prioritize which expenditures are to be paid for primarily through the stormwater utility service charges. Such policies provide the stability required to carry on programmatic activities. Such policies also provide a basis for allocating the charges to various customers and customer classes, and for defining the basis for credits or incentives in a resulting rate structure. It is recommended that service charges provide the underlying funding of programmatic activities, plus whatever share of capital projects can be supported by stormwater rates.

Other services are provided that are customer-specific, such as permitting review and facility inspections, and demand for these services fluctuate over time. It is increasingly common for utilities to recover the costs for such activities through specific service fees, and this approach should be considered when establishing the governing policies.

Rate Structure Alternatives

There are many issues and policies to evaluate when designing a rate structure and rate incentives, but generally the objectives of a rate structure address the following:

> The rate structure establishes a rational nexus between the services provided and fee charged. The rate structure should provide an equitable allocation of costs among customers and customer classes.
>
> The rate structure is legally defensible and is authorized by statute.

The administrative feasibility of establishing individual charges, and setting up and maintain accounts. The data exists or can be developed to characterize conditions on a parcel and assign charge appropriate to the parcel.

The basis for the charge is easy to understand and to communicate, and the rate structure is transparent.

The rate structure promotes revenue stability over time, and is not subject to volatility generated by external factors.

Rate structures can take several forms, as demonstrated by the variety found across jurisdictions. The trend is toward structures that provide enhanced equity between customers and also incentivize customers to take onsite measures that support water management goals.

Example rate structures are described below. We have omitted from the discussion the concept of an ad valorem tax, as it would constitute simply a dedicated extension of the general property tax treatment of parcels.

Flat Rate

Flat rate structures allocate cost uniformly to each land parcel, irrespective of parcel size, level of development or other features. This approach would capture in the ratepayer base undeveloped parcels and other properties which are not served by water, but otherwise offers a less-equitable approach than the current rate structure, whereby meter size infers a coarse indication of the level of development on the property.

Gross Parcel Area

This structure allocates program costs in proportion to the gross area of a land parcel. The data exists to support such a charge in assessor databases, and the administrative costs would be relatively low. Parcels which are not served by the water utility would need to be added to the billing database. There is an equity tradeoff when comparing this gross parcel area approach to the current meter size basis, in that gross parcel area does not reflect the nature of development and impervious area on the parcel; whereas, the presence of a meter and the meter size infer the scale of development on the property, albeit in a coarse manner.

Factored Gross Area

Some communities apply an approach that is based on gross parcel area to which a land use factor (or runoff factor) is applied to approximate the intensity of development on the parcel and, hence, the runoff it generates. This approach was originally developed to approximate an impervious area method (described further below) when aerial imagery and mapping capabilities were much less robust than today's technologies. This approach can improve on equity between customer classes (such as among parcels having similar zoning classifications) but does not offer substantial enhancement over the current meter size basis.

Impervious Surface Area

Using a parcel's impervious area footprint (encompassing rooflines, pavements, and vehicle-traveled gravel surfaces) is the method applied for the most equitable types of rate structures, as it provides a more robust nexus between a land parcel and the volume and rate of runoff. With the availability of high-resolution LiDAR and photo imagery, and geographic information systems for managing parcel data, appropriate charges can be accurately determined for individual parcels. The nature of impervious area (such as parking versus rooftop) and other features (presence of BMPs) can also be captured to incorporate water quality-based rate factors and rate credits.

Often single family residential properties are grouped into a uniform residential rate or into rate tiers that reflect large distinctions in impervious footprint between residential zoning classifications. Because single family residential comprises most parcels in Santa Fe, this approach can significantly streamline the administrative effort in establishing accounts without compromising equity between highly similar properties.

Hybrid Rate Structures

There are options that can be developed to modify or combine the foregoing rate structure methods in order to address jurisdiction-specific conditions, policies or preferences. Examples of such hybrid rate structures include:

Flat Rate + Impervious Area. A two-component fee method combining the flat rate and the impervious area rate approaches would allocate by a flat fee costs for city-wide programmatic elements (planning, reporting, monitoring). Costs for capital improvements and other active measures directed at remediating stormwater impacts would be allocated to accounts on an impervious area basis.

Trip Generation**.** Where roadway-generated runoff quantity and water quality are prominent issues, trip generation methods have been incorporated to allocate responsibility for projects and activities driven by public roadway impacts.

Rate Credits

A variety of rate adjustments and credits have been adopted by jurisdictions a means to implement policies, to recognize differing conditions on properties within similar rate classes, or to incentivize beneficial on-site actions. When adopting credits and rate reductions, the City should establish a cap on the allowable compounded credits so as not to undermine the core support to the stormwater program. Some examples are cited below.

Low income/senior fixed income. Typically aligned with similar credits for other city charges.

Credits for on-site BMPs. This is used to recognized that more recently developed properties may have robust stormwater controls in place, whereas older properties do not control runoff as effectively.

NPDES-permitted properties. This credit recognizes that some industrial, commercial and agricultural properties are permitted and regulated under the NPDES program and are assumed compliant with their permit obligations to control runoff.

Alternately, the City could elect to provide incentives that do not impact rates. Such credits are offered as one-time rebates to underwrite the costs of installing rainbarrels, cisterns, rain gardens, and similar beneficial actions.

ADDITIONAL STORMWATER FUNDING STRATEGIES

With respect to the goals set out in Resolution 2016-25, some aspects of the analysis were considered by staff rather than made part of the consultant’s scope. These strategies include the possibilities of a) creating a local flood-control authority financed by an annual property-tax assessment, b) holding periodic mill-levy elections for specific stormwater management projects, and c) obtaining new or amending existing impact fees for ongoing stormwater management work. The three strategies would require support at the highest levels of city management and possibly the approval of the state legislature and/or the electorate. A deeper analysis of these additional strategies would be the purview of the City Attorney (a) and (b), and the Land Use Department (c).

a. **Local Flood Control Authority:** By means of legislation passed by both houses of the state legislature and signed by the governor, municipalities in New Mexico can create a flood-control authority with the power to raise revenue through mill levies. Such an authority would allow property-tax assessments to be assigned to stormwater management with a levy not to exceed 1 mills (or $1 for every $1,000 of taxable property value). These authorities are independent of the governing bodies of the municipality, and their purpose is to fund an ongoing sediment and flood-control program. The major benefit of such an authority would be that its budget would be predictable on an annual basis. This would allow for meaningful long-term planning to be achieved and, therefore, the efficient use of financial resources to be the norm.

Two nearby flood-control authorities that have been in existence for decades include the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) and the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA). These authorities would serve as prototypes for the city to replicate with respect to organizational structure. Their proximity, ages, and history of effectiveness would also help alleviate concerns among property-tax payers.

Such a system, that taxes the properties that affect the watershed, is inherently more equitable than the current revenue-generating system for stormwater management, which relies on gross receipts taxes and stormwater fees. A significant public education-program would be required in order to generate the public support necessary to generate such a change.

b. **Project specific mill-levy:** According to state law[1, 2] municipalities can fund flood-control projects with specific mill levies for large, individual projects. This type of funding source does not provide the kind of ongoing funding that a flood-control authority would have, but it has the benefit of not creating an entity that would be separate from the city. With this option levies can be assessed up to 5 mills, but these monies are terminated after the completion of the associated stormwater project.

c. **Developer Impact Fees:** The city currently assesses and collects developer impact fees for four capital improvement categories: Roads, Parks, Fire/EMS, and Police. Per the City's current impact fee plan[3], the impact fee for roads is based on a traffic generation methodology, and that for parks is typically assessed on residential development. The city's next 5-year update of the plan will be required in 2020. A deeper examination of impact fee categories should be extended to consider drainage impacts beyond the roadway, and perhaps a "River and Arroyos" category should be assessed in future development in order to direct funds towards drainage specific mitigation impacts.

---

[1] Municipal Flood Control:
New Mexico Statutes-Municipalities Section § 3-41-1 - 3-41-5

[2] Arroyo and Flood Control Authority:
New Mexico Statues Section 72-19-1 through 72-19-103, 1990

[3] "Impact Fee Capital Improvements Plan 2020 for Road, Parks, Fire/EMS and Police" (adopted by City Council 8/27/14)

APPENDIX - CONCEPTUAL FINANCIAL MODEL

This appendix presents a spreadsheet model developed for use in evaluating stormwater program funding strategies for the City of Santa Fe. The model was initially constructed with three scenarios: (1) a "pay-as-you-go" approach wherein rates are set to generate needed revenues; (2) the use of a 15-year bond to fund capital expenditures; and (3) a 20-year bond. All three scenarios assume the same level of annual capital investment at $1 million (in FY18/19 dollars). Copies of each scenario are provided in this appendix. An electronic copy of the spreadsheet model is provided separately to City staff.

Assumptions used in the model (e.g. annual capital investment, interest rates, cost escalation rates, customer growth rate) are explicitly identified (Rows 36-39) and can be modified to examine alternative assumptions or scenarios. Interfund transfers have been used in the recent past; no future transfers are assumed in these scenarios, but the model allows for such transfers (see Row 23).

Fee revenues are premised upon the current rate structure and a presumed uniform annual growth rate. The monthly fee per residential water service can be modified over time (see Row 8) to provide needed revenue and operating reserves. In the scenarios, fees were set over time to approximate a FYE balance equal to 12 months' expenditures within a few years. Where debt financing is employed, interest on the prior year's unspent bond balance is accrued in Row 11; the rate of interest can be modified by year.

The model was prepared with limited expenditure detail, considering the historical variability of expenditures over recent years and because the scope of stormwater activities will change significantly going forward. The spreadsheet model can be readily modified (see "Other Expenditures", Row 20) to add detail where it could better inform decision making.

To support the expansion of capital investment, the model's functionality provides for debt financing. The two bond scenarios developed in the model propose issuing bonds in FY18/19 over terms of 15 years and 20 years, respectively, at current market rates. The bond amounts in both scenarios were selected to result in annual debt service payments of approximately $500,000. Interest earned on unspent bond revenues is included with revenues.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	**Financial Projections**	**Santa Fe Stormwater Program**			**Scenario: Pay-as-you-go**															
2		*actual*	*budget*	*projected*																
3		**FY16/17**	**FY17/18**	**FY18/19**	**FY19/20**	**FY20/21**	**FY21/22**	**FY22/23**	**FY23/24**	**FY24/25**	**FY25/26**	**FY26/27**	**FY27/28**	**FY28/29**	**FY29/30**	**FY30/31**	**FY31/32**	**FY32/33**	**FY33/34**	**FY34/35**
4	***FY Beginning Balance***	***$ (190,673)***	***$ 736,404***	***$ 989,474***	***$ 1,361,474***	***$ 1,686,574***	***$ 1,963,247***	***$ 2,187,874***	***$ 2,358,742***	***$ 2,473,036***	***$ 2,527,843***	***$ 2,521,142***	***$ 2,737,799***	***$ 2,889,571***	***$ 2,974,093***	***$ 2,986,878***	***$ 2,925,312***	***$ 3,240,649***	***$ 3,479,005***	***$ 3,637,355***
5																				
6	**Revenues**																			
7	No. of Equivalent Accounts	43,611	44,047	44,487	44,932	45,381	45,835	46,293	46,756	47,224	47,696	48,173	48,655	49,142	49,633	50,129	50,630	51,136	51,647	52,163
8	Monthly Rate	$ 3.00	$ 3.00	$ 4.50	$ 4.50	$ 4.50	$ 4.50	$ 4.50	$ 4.50	$ 4.50	$ 4.50	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.75	$ 5.75	$ 5.75	$ 5.75
9	Annual Fee Revenue	$ 1,570,000	$ 1,586,000	$ 2,402,000	$ 2,426,000	$ 2,451,000	$ 2,475,000	$ 2,500,000	$ 2,525,000	$ 2,550,000	$ 2,576,000	$ 2,890,000	$ 2,919,000	$ 2,949,000	$ 2,978,000	$ 3,008,000	$ 3,493,000	$ 3,528,000	$ 3,564,000	$ 3,599,000
10	Bond Revenue			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11	Interest Revenue				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	Other Revenue																			
13	***Total Revenue***	***$ 1,570,000***	***$ 1,586,000***	***$ 2,402,000***	***$ 2,426,000***	***$ 2,451,000***	***$ 2,475,000***	***$ 2,500,000***	***$ 2,525,000***	***$ 2,550,000***	***$ 2,576,000***	***$ 2,890,000***	***$ 2,919,000***	***$ 2,949,000***	***$ 2,978,000***	***$ 3,008,000***	***$ 3,493,000***	***$ 3,528,000***	***$ 3,564,000***	***$ 3,599,000***
14																				
15	**Expenditures**																			
16	Direct Capital Investment		$ 1,082,930	$ 1,000,000	$ 1,040,000	$ 1,081,600	$ 1,124,864	$ 1,169,859	$ 1,216,653	$ 1,265,319	$ 1,315,932	$ 1,368,569	$ 1,423,312	$ 1,480,244	$ 1,539,454	$ 1,601,032	$ 1,665,074	$ 1,731,676	$ 1,800,944	$ 1,872,981
17	Bonded Capital Investment			$ -	$ -	$ -	$ -	$ -	$ -	$ -										
18	Debt Service		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
19	Operations	$ 1,293,178	$ 1,000,000	$ 1,030,000	$ 1,060,900	$ 1,092,727	$ 1,125,509	$ 1,159,274	$ 1,194,052	$ 1,229,874	$ 1,266,770	$ 1,304,773	$ 1,343,916	$ 1,384,234	$ 1,425,761	$ 1,468,534	$ 1,512,590	$ 1,557,967	$ 1,604,706	$ 1,652,848
20	Other Expenditure																			
21	***Total Expenditures***	***$ 1,293,178***	***$ 2,082,930***	***$ 2,030,000***	***$ 2,100,900***	***$ 2,174,327***	***$ 2,250,373***	***$ 2,329,133***	***$ 2,410,705***	***$ 2,495,193***	***$ 2,582,702***	***$ 2,673,342***	***$ 2,767,228***	***$ 2,864,478***	***$ 2,965,215***	***$ 3,069,566***	***$ 3,177,663***	***$ 3,289,644***	***$ 3,405,650***	***$ 3,525,829***
22																				
23	**Transfers**	***$ 650,255***	***$ 750,000***																	
24																				
25	***FY End Balance***	***$ 736,404***	***$ 989,474***	***$ 1,361,474***	***$ 1,686,574***	***$ 1,963,247***	***$ 2,187,874***	***$ 2,358,742***	***$ 2,473,036***	***$ 2,527,843***	***$ 2,521,142***	***$ 2,737,799***	***$ 2,889,571***	***$ 2,974,093***	***$ 2,986,878***	***$ 2,925,312***	***$ 3,240,649***	***$ 3,479,005***	***$ 3,637,355***	***$ 3,710,526***
26	Net Change	*$ 927,077*	*$ 253,070*	*$ 372,000*	*$ 325,100*	*$ 276,673*	*$ 224,627*	*$ 170,867*	*$ 114,295*	*$ 54,807*	*$ (6,702)*	*$ 216,658*	*$ 151,772*	*$ 84,522*	*$ 12,785*	*$ (61,566)*	*$ 315,337*	*$ 238,356*	*$ 158,350*	*$ 73,171*
27																				
28	**Debt Financing**																			
29	Bond Sale			$ -																
30	Interest Rate, %			4.00%																
31	Term, years			20																
32	Annual Debt Service			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
33	Balance			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
34	Interest rate on balance			1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
35	**Assumptions**																			
36	Account Growth Rate	1.0%	/year																	
37	Capital Cost Escalation	4.0%	/year																	
38	Operations Cost Escalation	3.0%	/year																	
39	Annual capital investment	$ 1,000,000	in FY18/19 dollar equivalents																	
40	*year -->*			*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*

	A	B	C	D	E	F	G	H	I	J
1	**Financial Projections**	**Santa Fe Stormwater Program**			**Scenario: 15-year Bond**					
2		*actual*	*budget*	*projected*						
3		**FY16/17**	**FY17/18**	**FY18/19**	**FY19/20**	**FY20/21**	**FY21/22**	**FY22/23**	**FY23/24**	**FY24/25**
4	***FY Beginning Balance***	$ (190,673)	$ 736,404	$ 989,474	$ 1,061,796	$ 1,705,768	$ 2,328,513	$ 2,929,660	$ 3,507,793	$ 3,183,474
5										
6	**Revenues**									
7	No. of Equivalent Accounts	43,611	44,047	44,487	44,932	45,381	45,835	46,293	46,756	47,224
8	Monthly Rate	$ 3.00	$ 3.00	$ 3.00	$ 4.00	$ 4.00	$ 4.00	$ 4.00	$ 4.00	$ 4.00
9	Annual Fee Revenue	$ 1,570,000	$ 1,586,000	$ 1,602,000	$ 2,157,000	$ 2,178,000	$ 2,200,000	$ 2,222,000	$ 2,244,000	$ 2,267,000
10	Bond Revenue			$ 1,000,000	$ 1,040,000	$ 1,081,600	$ 1,124,864	$ 1,169,859	$ 338,677	$ -
11	Interest Revenue				$ 47,550	$ 37,150	$ 26,334	$ 15,085	$ 3,387	$ 0
12	Other Revenue									
13	***Total Revenue***	$ 1,570,000	$ 1,586,000	$ 2,602,000	$ 3,244,550	$ 3,296,750	$ 3,351,198	$ 3,406,944	$ 2,586,064	$ 2,267,000
14										
15	**Expenditures**									
16	Direct Capital Investment		$ 1,082,930						$ 877,976	$ 1,265,319
17	Bonded Capital Investment			$ 1,000,000	$ 1,040,000	$ 1,081,600	$ 1,124,864	$ 1,169,859	$ 338,677	
18	Debt Service		$ -	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678
19	Operations	$ 1,293,178	$ 1,000,000	$ 1,030,000	$ 1,060,900	$ 1,092,727	$ 1,125,509	$ 1,159,274	$ 1,194,052	$ 1,229,874
20	Other Expenditure									
21	***Total Expenditures***	$ 1,293,178	$ 2,082,930	$ 2,529,678	$ 2,600,578	$ 2,674,005	$ 2,750,051	$ 2,828,811	$ 2,910,383	$ 2,994,871
22										
23	**Transfers**	$ 650,255	$ 750,000							
24										
25	***FY End Balance***	$ 736,404	$ 989,474	$ 1,061,796	$ 1,705,768	$ 2,328,513	$ 2,929,660	$ 3,507,793	$ 3,183,474	$ 2,455,603
26	Net Change	$ 927,077	$ 253,070	$ 72,322	$ 643,972	$ 622,745	$ 601,147	$ 578,133	$ (324,319)	$ (727,871)
27										
28	**Debt Financing**									
29	Bond Sale			$ 5,755,000						
30	Interest Rate, %			3.50%						
31	Term, years			15						
32	Annual Debt Service			$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678
33	Balance			$ 4,755,000	$ 3,715,000	$ 2,633,400	$ 1,508,536	$ 338,677	$ 0	$ 0
34	Interest rate on balance			1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
35	**Assumptions**									
36	Account Growth Rate	1.0%	/year							
37	Capital Cost Escalation	4.0%	/year							
38	Operations Cost Escalation	3.0%	/year							
39	Annual capital investment	$ 1,000,000	in FY18/19 dollar equivalents							
40	*year -->*			*0*	*1*	*2*	*3*	*4*	*5*	*6*

	A	K	L	M	N	O	P	Q	R	S	T
3		**FY25/26**	**FY26/27**	**FY27/28**	**FY28/29**	**FY29/30**	**FY30/31**	**FY31/32**	**FY32/33**	**FY33/34**	**FY34/35**
4	***FY Beginning Balance***	$ 2,455,603	$ 2,235,223	$ 1,952,203	$ 1,604,297	$ 1,189,141	$ 1,298,248	$ 1,338,004	$ 1,305,663	$ 1,198,341	$ 1,511,691
7	No. of Equivalent Accounts	47,696	48,173	48,655	49,142	49,633	50,129	50,630	51,136	51,647	52,163
8	Monthly Rate	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00
9	Annual Fee Revenue	$ 2,862,000	$ 2,890,000	$ 2,919,000	$ 2,949,000	$ 3,574,000	$ 3,609,000	$ 3,645,000	$ 3,682,000	$ 3,719,000	$ 3,756,000
10	Bond Revenue	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11	Interest Revenue	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
13	***Total Revenue***	$ 2,862,000	$ 2,890,000	$ 2,919,000	$ 2,949,000	$ 3,574,000	$ 3,609,000	$ 3,645,000	$ 3,682,000	$ 3,719,000	$ 3,756,000
16	Direct Capital Investment	$ 1,315,932	$ 1,368,569	$ 1,423,312	$ 1,480,244	$ 1,539,454	$ 1,601,032	$ 1,665,074	$ 1,731,676	$ 1,800,944	$ 1,872,981
18	Debt Service	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678		
19	Operations	$ 1,266,770	$ 1,304,773	$ 1,343,916	$ 1,384,234	$ 1,425,761	$ 1,468,534	$ 1,512,590	$ 1,557,967	$ 1,604,706	$ 1,652,848
21	***Total Expenditures***	$ 3,082,380	$ 3,173,020	$ 3,266,906	$ 3,364,156	$ 3,464,893	$ 3,569,244	$ 3,677,341	$ 3,789,322	$ 3,405,650	$ 3,525,829
25	***FY End Balance***	$ 2,235,223	$ 1,952,203	$ 1,604,297	$ 1,189,141	$ 1,298,248	$ 1,338,004	$ 1,305,663	$ 1,198,341	$ 1,511,691	$ 1,741,862
26	Net Change	$ (220,380)	$ (283,020)	$ (347,906)	$ (415,156)	$ 109,107	$ 39,756	$ (32,341)	$ (107,322)	$ 313,350	$ 230,171
32	Annual Debt Service	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678	$ 499,678
33	Balance	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
34	Interest rate on balance	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
40	*year -->*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	**Financial Projections**	**Santa Fe Stormwater Program**			**Scenario: 20-year Bond**															
2		*actual*	*budget*	*projected*																
3		**FY16/17**	**FY17/18**	**FY18/19**	**FY19/20**	**FY20/21**	**FY21/22**	**FY22/23**	**FY23/24**	**FY24/25**	**FY25/26**	**FY26/27**	**FY27/28**	**FY28/29**	**FY29/30**	**FY30/31**	**FY31/32**	**FY32/33**	**FY33/34**	**FY34/35**
4	***FY Beginning Balance***	***$ (190,673)***	***$ 736,404***	***$ 989,474***	***$ 1,061,486***	***$ 1,715,548***	***$ 2,348,383***	***$ 2,959,620***	***$ 3,547,843***	***$ 4,111,590***	***$ 3,547,054***	***$ 2,753,364***	***$ 2,759,034***	***$ 2,702,818***	***$ 2,581,352***	***$ 2,690,149***	***$ 2,729,595***	***$ 2,696,944***	***$ 2,589,312***	***$ 3,021,674***
5																				
6	**Revenues**																			
7	No. of Equivalent Accounts	43,611	44,047	44,487	44,932	45,381	45,835	46,293	46,756	47,224	47,696	48,173	48,655	49,142	49,633	50,129	50,630	51,136	51,647	52,163
8	Monthly Rate	$ 3.00	$ 3.00	$ 3.00	$ 4.00	$ 4.00	$ 4.00	$ 4.00	$ 4.00	$ 4.00	$ 4.00	$ 5.50	$ 5.50	$ 5.50	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 7.00	$ 7.00
9	Annual Fee Revenue	$ 1,570,000	$ 1,586,000	$ 1,602,000	$ 2,157,000	$ 2,178,000	$ 2,200,000	$ 2,222,000	$ 2,244,000	$ 2,267,000	$ 2,289,000	$ 3,179,000	$ 3,211,000	$ 3,243,000	$ 3,574,000	$ 3,609,000	$ 3,645,000	$ 3,682,000	$ 4,338,000	$ 4,382,000
10	Bond Revenue			$ 1,000,000	$ 1,040,000	$ 1,081,600	$ 1,124,864	$ 1,169,859	$ 1,216,653	$ 162,025	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11	Interest Revenue				$ 57,950	$ 47,550	$ 36,734	$ 25,485	$ 13,787	$ 1,620	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)
12	Other Revenue																			
13	***Total Revenue***	***$ 1,570,000***	***$ 1,586,000***	***$ 2,602,000***	***$ 3,254,950***	***$ 3,307,150***	***$ 3,361,598***	***$ 3,417,344***	***$ 3,474,440***	***$ 2,430,645***	***$ 2,289,000***	***$ 3,179,000***	***$ 3,211,000***	***$ 3,243,000***	***$ 3,574,000***	***$ 3,609,000***	***$ 3,645,000***	***$ 3,682,000***	***$ 4,338,000***	***$ 4,382,000***
14																				
15	**Expenditures**																			
16	Direct Capital Investment		$ 1,082,930	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,103,294	$ 1,315,932	$ 1,368,569	$ 1,423,312	$ 1,480,244	$ 1,539,454	$ 1,601,032	$ 1,665,074	$ 1,731,676	$ 1,800,944	$ 1,872,981
17	Bonded Capital Investment			$ 1,000,000	$ 1,040,000	$ 1,081,600	$ 1,124,864	$ 1,169,859	$ 1,216,653	$ 162,025										
18	Debt Service		$ -	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988
19	Operations	$ 1,293,178	$ 1,000,000	$ 1,030,000	$ 1,060,900	$ 1,092,727	$ 1,125,509	$ 1,159,274	$ 1,194,052	$ 1,229,874	$ 1,266,770	$ 1,304,773	$ 1,343,916	$ 1,384,234	$ 1,425,761	$ 1,468,534	$ 1,512,590	$ 1,557,967	$ 1,604,706	$ 1,652,848
20	Other Expenditure																			
21	***Total Expenditures***	***$ 1,293,178***	***$ 2,082,930***	***$ 2,529,988***	***$ 2,600,888***	***$ 2,674,315***	***$ 2,750,361***	***$ 2,829,121***	***$ 2,910,693***	***$ 2,995,181***	***$ 3,082,690***	***$ 3,173,330***	***$ 3,267,216***	***$ 3,364,466***	***$ 3,465,203***	***$ 3,569,554***	***$ 3,677,651***	***$ 3,789,632***	***$ 3,905,638***	***$ 4,025,817***
22																				
23	**Transfers**	***$ 650,255***	***$ 750,000***																	
24																				
25	***FY End Balance***	***$ 736,404***	***$ 989,474***	***$ 1,061,486***	***$ 1,715,548***	***$ 2,348,383***	***$ 2,959,620***	***$ 3,547,843***	***$ 4,111,590***	***$ 3,547,054***	***$ 2,753,364***	***$ 2,759,034***	***$ 2,702,818***	***$ 2,581,352***	***$ 2,690,149***	***$ 2,729,595***	***$ 2,696,944***	***$ 2,589,312***	***$ 3,021,674***	***$ 3,377,857***
26	Net Change	*$ 927,077*	*$ 253,070*	*$ 72,012*	*$ 654,062*	*$ 632,835*	*$ 611,237*	*$ 588,223*	*$ 563,746*	*$ (564,536)*	*$ (793,690)*	*$ 5,670*	*$ (56,216)*	*$ (121,466)*	*$ 108,797*	*$ 39,446*	*$ (32,651)*	*$ (107,632)*	*$ 432,362*	*$ 356,183*
27																				
28	**Debt Financing**																			
29	Bond Sale			$ 6,795,000																
30	Interest Rate, %			4.00%																
31	Term, years			20																
32	Annual Debt Service			$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988	$ 499,988
33	Balance			$ 5,795,000	$ 4,755,000	$ 3,673,400	$ 2,548,536	$ 1,378,677	$ 162,025	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)	$ (0)
34	Interest rate on balance			1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
35	**Assumptions**																			
36	Account Growth Rate	1.0%	/year																	
37	Capital Cost Escalation	4.0%	/year																	
38	Operations Cost Escalation	3.0%	/year																	
39	Annual capital investment	$ 1,000,000	in FY18/19 dollar equivalents																	
40	*year -->*			*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*

G. CODE OF ORDINANCE PROPOSED REVISIONS

TETRA TECH

To:	Melissa McDonald, City of Santa Fe Leroy Pacheco, City of Santa Fe
From:	Christy Williams, Tetra Tech, Inc.
CC:	Troy Dorman, Tetra Tech, Inc. Rick Schaefer, Tetra Tech, Inc. Rosemary Romero
Date:	August 8, 2018
Subject:	Municipal Code Green Infrastructure Update – Key Revisions and Decision Points

Attached are sections of the Santa Fe Municipal Code deemed pertinent to stormwater management revised using redline strikeout. The revisions have been recommended either because 1) the draft USEPA Small Municipal Separate Storm Sewer System Permit No. NMR040000 requires municipal code updates or 2) code updates were necessary to address findings of Tetra Tech's stormwater management program evaluation.

This memo summarizes the ten primary recommended revisions to the Santa Fe Municipal Code and provides associated rationale. Additional revisions are included in the redline document, but were considered self-explanatory. The redline document also includes comments inserted to provide the reader additional explanation.

In addition, the memo points out a few critical decision points for the City to consider as it moves forward with code updates. These are by no means all of the decisions that will need to be made during the code update process, however, the Tetra Tech team felt it was important to highlight a few key questions to be addressed. Decision points are indicated by <u>underlined text</u> in the memo.

1. **Inclusion of post-construction stormwater management retention performance standard**. Revisions to § 14-8.2(D)(4)(b) are proposed to require all regulated projects to infiltrate a volume of water to ensure that runoff from the project, post-development, is equal to that which would leave the site under natural conditions (for the 90th percentile storm event). This volume is termed "regulatory volume." The draft MS4 permit requires that this standard be applied to all projects of one acre or larger (Part I.D.5.b.). The draft permit does not specify the comparative condition for the project site, therefore, the Tetra Tech team recommends the condition be "natural" rather than "pre-development" to allow for some retrofit for redevelopment projects.
2. **Inclusion of post-construction stormwater management water quality treatment performance standard.** Revisions to § 14-8.2(D)(4)(b) are proposed to require all regulated projects to treat the regulatory volume to achieve a minimum of 85 percent removal of total suspended solids. This requirement is not included in the draft MS4 permit however, water quality of MS4 discharges is of primary importance to the City due to river conditions and TMDLs and the removal of sediment prior to discharge to the City's storm sewer system will also reduce maintenance needs. Meeting the retention standard required by the draft MS4 permit (and described in item no. 1 above) may provide the necessary

Tetra Tech
700 North St. Mary's Street, Suite 300, San Antonio, Texas 78205
Tel 512.643.9430 tetratech.com

treatment to achieve this treatment standard, however, in the event that alternative compliance options are allowed for a project, it is highly recommended that the project still be required to treat on-site runoff to this standard prior to discharge.

3. **Selection of applicability threshold for new post construction performance standards**. The draft MS4 permit requires that the 90th percentile storm event retention standard apply all private projects of one acre or more, however, the City's existing drainage standards apply to much smaller projects (i.e. minor development projects which disturb more than 250 square feet but less than 5,000 square feet comply with discharge standards at §14-82(E) and other non-minor development currently must comply with discharge requirements found in §14-8.2(E)). <u>The City will need to decide what the threshold will be used to trigger the retention standard required by the draft MS4 permit as well as the water quality standard proposed based upon input from City staff.</u> The redline document presumes that the 90th percentile storm standard will not apply to minor developments.
4. **Type of alternative compliance option(s) authorized.** The Municipal Code has been revised to include a placeholder for alternative compliance options for the retention standard mandated by the draft MS4 permit (§14-8.2(B)). As previously stated, alternative compliance is not recommended for the proposed water quality standard or the existing channel protection (peak flow rate) standard. The draft MS4 permit allows for alternative compliance for the retention of the regulatory volume under specific circumstances (Part I.D.5.b.). <u>The City must decide if a) the city will allow alternative compliance options and b) which of options allowed by the draft MS4 permit can be utilized by applicants.</u> The draft MS4 permit allows the use of off-site mitigation, implementation of a groundwater replenishment project, a payment-in-lieu or another option approved by USEPA.
5. **Site constraints necessary for allowing alternative compliance rather than compliance onsite**. If the City chooses to allow for alternative compliance, <u>the criteria for determining that onsite retention is infeasible due to site constraints must be decided and codified.</u> The draft MS4 permit indicates that the following site constraints could make on-site volume management infeasible (Part I.D.5.b.(v)) – *A. too small a lot outside of the building footprint to create the necessary infiltrative capacity even with amended soils; B. soil instability as documented by a thorough geotechnical analysis; C. a site use that is inconsistent with capture and reuse of storm water; D. other physical conditions; or, E. to comply with applicable requirements for on-site flood control structures leaves insufficient area to meet the standard.*
6. **Tighten operation and maintenance planning requirements and add new requirement that owners of private post-construction stormwater control measures regularly inspect the measures and report on their condition to the City.** The draft MS4 permit requires that the City have procedures for site inspection and enforcement to ensure proper long-term operation, maintenance and repair of stormwater control measures (§ 14-8.2(K)). Tetra Tech recommends that the City develop a program which requires private property owners to regularly (e.g. once every three years) inspect all stormwater control measures and report on their condition and any maintenance or repairs conducted.
7. **Addition of administrative penalties for stormwater violations, generally**. The existing Code did not allow for the use of administrative penalties for stormwater violations. Section 13-2.15 has been revised to authorize this type of enforcement action. The draft MS4 permit request that the City have enforcement escalation procedures and the current Code has limited enforcement options therefore very little opportunity to escalate and address repeat offenders.
8. **Addition of specific enforcement actions authorized for active construction.** Further, the existing Code does not authorize the use of "stop work" or the revocation of a project's grading permit. These enforcement actions are typically quite effective during active construction and are integral to a typical enforcement escalation procedure for construction stormwater violations. Section 14-8.2(L) has been added to the Code to include these enforcement actions. This section could also refer to the enforcement actions authorized in Section 13-2.15 however, the power to suspend or revoke the grading permit should be expressly authorized in Section 14-8.2.
9. **Requirement that projects of a certain size must phase disturbance.** The existing Code indicates that phasing may be required on projects at the discretion of the city engineer. The Tetra Tech team recommends that phasing be required for all projects which will disturb five acres or more at a minimum.

This size is considered a “large” construction project and phasing projects of this size will help to control dust and surface erosion. The Code at 14-8.2(D)(2) has been revised to require this.

10. **Specified requirements for temporary and permanent site stabilization during and after construction**. Specific requirements for temporary (during construction) and permanent stabilization have been included in the redline document (§14-8.2(D)(7)). These requirements include more specific requirements for seeding or other stabilization treatments as well as daily stockpile protection.

13-1 STORMWATER UTILITY SERVICE CHARGE.

13-1.1 Short Title.

This section may be cited as the Stormwater Utility Service Charge Ordinance. (Ord. #2003-22, §2)

13-1.2 Legislative Findings.

The governing body of the city has determined that:

A. The federal Clean Water Act, 33 U.S.C. 1251 et seq., requires certain political entities, such as the city of Santa Fe, to implement stormwater management programs within prescribed time frames, and the environmental protection agency, pursuant to the federal Clean Water Act, has published rules for stormwater outfall permits.

B. Section 3-49-5 NMSA 1978 authorizes cities to "open, construct, repair, keep in order and maintain water mains, laterals, reservoirs, standpipes, sewers and drains," and section 3-27-4 authorizes cities to "levy by general ordinance a just and reasonable service charge" for "maintaining, enlarging, extending, constructing, and repairing water facilities."

C. The Santa Fe region will benefit from the city's efforts to maintain and improve the system of stormwater facilities and other efforts to improve and safeguard the water quality of the Santa Fe River and its tributary arroyos, due to their reliance on the Santa Fe River and groundwater for their long-term supply.

D. The stormwater system that provides for the collection, treatment, storage and disposal of stormwater provides benefits and services to the Santa Fe region. Such benefits include, but are not limited to: the provision of adequate systems of collection, conveyance, detention, treatment and release of stormwater; and improvements to the water quality in the stormwater and surface water system and its receiving waters.
(Ord. #2003-22, §3)

13-1.3 Purpose.

The city shall impose a stormwater utility service charge on the monthly utility bills of its utility customers for the purpose of funding the operation, construction and maintenance of stormwater facilities, for stormwater system planning, and for review of stormwater development plans for compliance with stormwater management codes. (Ord. #2003-22, §4)

[This may need to be updated to match new level of service goals if developed.]

13-1.4 Definitions.

For the purpose of this section, the following definitions shall apply:

Construction means the erection, building, acquisition, alteration, reconstruction, improvement or extension of stormwater facilities; preliminary planning to determine the economic and engineering feasibility of stormwater facilities; the engineering, architectural, legal, fiscal and economic investigations and studies, surveys, designs, plans, working drawings, specifications, procedures, and other action necessary in the construction of stormwater facilities; and the inspection and supervision of the construction of stormwater facilities.

Stormwater means ~~stormwater~~ surface runoff, snow melt runoff, surface runoff, street wash waters related to street cleaning or maintenance, infiltration, and drainage.

Stormwater management means the planning, design, construction, regulation, improvement, repair, maintenance, and operation of facilities and programs relating to water, flood plains, flood control, grading, erosion, tree conservation, and sediment control.

Stormwater utility service charge means the charge established under this section and levied on utility customers to fund the costs of stormwater management and of operating, maintaining, and improving the stormwater system in the city.
(Ord. #2003-22, §5)

13-1.5 Stormwater Utility Service Charge Established.

Each city utility customer account, except those set forth in subsection 13-1.6, shall be billed a monthly stormwater utility service charge as shown on the attached Exhibit A. The governing body shall, by ordinance, periodically amend Exhibit A based upon increased costs to the city for stormwater management. The stormwater utility service charge is in addition to any other charge that the city has the right to charge under any other rule or regulation of the city. (Ord. #2003-22, §6; Ord. #2010-17, §1)

Editor's Note: Exhibit A, referred to herein, may be found at the end of this chapter.

13-1.6 Exemptions from Charges.

Customers may be exempt from monthly stormwater utility service charge if they meet the following:

A. Any customer filing an affidavit setting out the following facts:

(1) The customer is the head of the household residing in the residence being assessed;

(2) The household's gross annual income does not exceed one hundred twenty percent (120%) of the most recent federal poverty guidelines issued by the U.S. Department of Health and Human Services; and

(3) The customer shall submit documents as required by city policy in order to verify income.

B. Any person filing an affidavit requesting exemption of the charge consents to any reasonable investigation and substantiation by the city of the facts stated in the affidavit.

C. The filing of a false statement or otherwise fraudulently obtaining the benefits of this subsection is a violation of the Santa Fe Code and is punishable pursuant to Section 1-3 of this Code and shall entitle the city to recover any fraudulently exempted amount and applicable interest penalties.
(Ord. #2003-22, §7)

13-1.7 Use of Revenues.

Stormwater utility service charge revenues shall be accounted for separately from other funds of the city. The charges and any interest earned on the fund shall be spent only for the following:

A. The acquisition, design, construction, maintenance and operation of the stormwater system, including capital improvements designated in the capital improvement program;

B. Administration and enforcement of this section and all regulations and procedures adopted relating to the design, construction, maintenance, operation and alteration of the stormwater system, including, but not limited to, the quantity and/or velocity of the stormwater conveyed thereby;

C. Preparation and revision of comprehensive drainage infrastructure and monitoring plans;

D. Review of development plans for conformity with stormwater regulation and inspection and acceptance of extensions and connections to the stormwater system;

E. Enforcement of regulations to protect and maintain water quality and quantity within the system in compliance with water quality standards established by state, regional and/or federal agencies as now adopted or hereafter amended;

F. Other activities related to the improvement, maintenance and operation of the stormwater system.
(Ord. #2003-22, §7)

13-2 STORMWATER ILLICIT DISCHARGE CONTROL.

13-2.1 Title.

Section 13-2 may be cited as the Stormwater Illicit Discharge Control Ordinance. (Ord. #2005-3, §2)

13-2.2 Legislative Findings.

The governing body of the city has determined that the federal Clean Water Act, 33 U.S.C. 1251 et seq., requires the city of Santa Fe, to implement a stormwater management plan to comply with stormwater discharge permits issued under the national pollutant discharge elimination system (NPDES), which includes the requirement to detect and eliminate illicit discharges of pollutants into and illegal connections to the municipal storm drain (storm sewer) system. (Ord. #2005-3, §3)

13-2.3 Purpose.

The purpose and intent of the Stormwater Illicit Discharge Ordinance is to protect and enhance the water quality of watercourses and groundwater by prohibiting non-stormwater discharges to the city's storm drain system. (Ord. #2005-3, §4)

13-2.4 Definitions.

For the purpose of this section, the following definitions shall apply:

Abate means to bring to a halt, eliminate or, where that is not possible or feasible, to suppress, reduce, or minimize.

City means the city of Santa Fe.

Clean Water Act means the federal Water Pollution Control Act (33 U.S.C. 1251 et seq.), and any subsequent amendments thereto.

Hazardous material means any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Illicit discharge means any direct or indirect non-stormwater discharge to the storm drain system that contains any pollutant(s).

~~*Illicit*~~ *Illegal connection* means either of the following:

A. Any drain or conveyance, whether on the surface or subsurface, which allows an illicit discharge to enter the storm drain system including but not limited to any conveyances which allow any non-stormwater discharge including sewage, process wastewater, and wash water to enter the storm drain system and any connections to the storm drain system from indoor drains and sinks, regardless of whether said drain or connection had been previously allowed, permitted, or approved by a government agency; or

B. Any drain or conveyance connected from a commercial or industrial establishment to the storm drain system which has not been documented in plans, maps, or equivalent records and approved by the city.

NPDES stormwater discharge permits means general, group, and individual stormwater discharge permits which regulate facilities defined in federal NPDES regulations pursuant to the Clean Water Act.

Pollutant means anything which causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; oil, anti-freeze, and other automotive fluids; nonhazardous liquid and solid wastes and yard wastes; branches, trimmings, refuse, rubbish, garbage, litter, or other discarded or abandoned objects, articles, and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; hazardous substances and wastes; sewage, fecal coliform and pathogens, dissolved and particulate metals; animal wastes; wastes and residues that result from constructing or remodeling a building or structure (including but not limited to sediments, slurries, mud, plasters, and concrete rinsates); and noxious or offensive matter of any kind.

Pollution means the human-made or human-induced alteration of the quality of waters by waste to a degree which unreasonably affects, or has the potential to unreasonably affect, either the waters for beneficial uses or the facilities which serve these beneficial uses.

Premises means any lot or combination of contiguous lots held in single ownership and the buildings, structures or other appurtenances thereon.

Storm drain system means publicly-owned facilities and appurtenances operated by the city by which stormwater is collected and/or conveyed, including but not limited to any roads with drainage systems, municipal streets, curbs, gutters, drop inlets, piped storm drains (culverts), pumping facilities, retention and detention basins, natural and human-made or altered drainage channels and arroyos, reservoirs, and other drainage structures which are within the city and are not part of a publicly owned treatment works as defined at 40 CFR 122.2.

Stormwater means any surface flow, runoff, snow melt, and drainage consisting entirely of water from rain and snow storm events.

Waters of the United States means surface watercourses and water bodies as defined at 40 CFR 122.2, including all natural waterways, channels, and depressions in the earth that may carry water, even though such waterways may only carry water during rain and snow storms and may not carry stormwater at and during all times and seasons.
(Ord. #2005-3, §5)

13-2.5 Responsibility for Administration.

The city shall administer, implement, and enforce the provisions of this section. Any powers granted or duties imposed upon the city may be delegated in writing by the city to persons or entities acting in the beneficial interest of or in the employ of the city. (Ord. #2005-3, §6)

13-2.6 Prohibition of Illicit Discharges.

A. No person shall discharge or cause to be discharged any direct or indirect non-stormwater discharge to the storm drain system that contains any pollutants that cause or contribute to a violation of local, state or federal water quality standards.

B. Discharges from the following activities will not be considered a source of pollutants to the storm drain system and to waters of the U.S. when properly managed to ensure that no potential pollutants are present, and therefore they shall not be considered illicit discharges unless determined to cause a violation of the provisions of the Clean Water Act, state law or this section:

(1) Water line flushing;

(2) Uncontaminated pumped groundwater and other discharges from potable water sources;

(3) Landscape irrigation and lawn watering;

(4) Rising groundwater;

(5) Uncontaminated groundwater infiltration to the storm drain system;

(6) Uncontaminated foundation drains;

(7) Uncontaminated water from crawl space pumps;

(8) Air conditioning condensation;

(9) Uncontaminated nonindustrial roof drains;

(10) Springs;

(11) Individual residential car washing;

(12) Flows from riparian habitats and wetlands; or

(13) Dechlorinated swimming pool discharges; street wash waters; and flows from fire fighting.

C. The prohibition shall not apply to any non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered by

the federal environmental protection agency, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations. If requested, a copy of said NPDES permit, waiver, or waste discharge order shall be provided to the city within ten (10) days of request.
(Ord. #2005-3, §7)

13-2.7 Prohibition of ~~Illicit~~ Illegal Connections.

The construction, use, maintenance or continued existence of illicit connections to the storm drain system is prohibited. This prohibition expressly includes, without limitation, illicit connections made in the past, regardless of whether the connection was permissible under law or practices applicable or prevailing at the time of connection. (Ord. #2005-3, §8)

13-2.8 Waste Disposal Prohibitions.

No person shall throw, deposit, leave, maintain, keep, or permit to be thrown, deposited, left, or maintained, in or upon any component of the storm drain system, or water of the U.S., any pollutant. (Ord. #2005-3, §9)

13-2.9 Watercourse Protection.

Every person owning property through which a watercourse passes, or such person's lessee, shall keep and maintain that part of the watercourse within the property reasonably free of trash, debris, excessive vegetation, and other substances that would pollute, contaminate, obstruct, or significantly retard the flow of water through the watercourse. In addition, the owner or lessee shall maintain existing privately owned structures within or adjacent to a watercourse, so that such structures will not become a hazard to the use, function, or physical integrity of the watercourse. The owner or lessee shall not remove healthy bank vegetation beyond that actually necessary for maintenance, nor remove said vegetation in such a manner as to increase the vulnerability of the watercourse to erosion. The property owner shall be responsible for maintaining and stabilizing that portion of the watercourse that is within their property lines in order to protect against erosion and degradation of the watercourse originating or contributed from their property. (Ord. #2005-3, §10)

13-2.10 Requirement to Notify the City of Spills.

Notwithstanding other requirements of law, as soon as any person responsible for a facility or operation, or responsible for emergency response for a facility or operation has information of any known or suspected release of materials which are resulting or may result in illicit discharges or pollutants discharging into stormwater, the storm drain system, or water of the U.S. from said facility, said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release. In the event of such a release of a hazardous material said person shall immediately notify emergency response officials of the occurrence. In the event of a release of nonhazardous materials, said person shall notify the city's public works department in person or by phone or facsimile no later than 5:00 p.m. of the next business day. Notifications in person or by phone shall be confirmed by written notice addressed and mailed to the city's public works department within three business days of the phone notice. If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least three (3) years. (Ord. #2005-3, §11)

13-2.11 Authority to Inspect.

Whenever necessary to make an inspection to enforce any provision of this section, or whenever the city has probable cause to believe that there exists any condition which constitutes a violation of this section, the city may enter such premises at all reasonable times to inspect the same and to inspect and copy records related to stormwater discharge compliance. In the event the owner or occupant refuses entry after a request to enter and inspect has been made, the city is hereby empowered to seek assistance from any court of competent jurisdiction in obtaining such entry. (Ord. #2005-3, §12)

13-2.12 Authority to Sample, Establish Sampling Devices and Test.

During any inspection as provided herein, the city may take any samples and perform any testing deemed necessary to aid in the pursuit of the inquiry or to record site activities. In the event the owner or occupant denies permission to sample, establish sampling devices, and test, the city is hereby empowered to seek assistance from any court of competent jurisdiction in obtaining such samples, sampling devices, or tests. (Ord. #2005-3, §13)

13-2.13 Requirements to Eliminate Illicit Discharges.

The city may require by written notice that a person responsible for an illicit discharge immediately, or by a specified date, discontinue the discharge and, if necessary, take measures to eliminate the source of the discharge to prevent the occurrence of future illicit discharges. (Ord. #2005-3, §14)

13-2.14 Requirement to Eliminate ~~Illicit~~ Illegal Connections.

The city may require by written notice that a person responsible for an ~~illicit~~ illegal connection to the storm drain system comply with the requirements of this section to eliminate the connection by a specified date. (Ord. #2005-3, §15)

13-2.15 Violations; Penalties, and Enforcements.

A. It shall be unlawful for any person to violate any provision or fail to comply with any of the requirements of the Illicit Discharge Control Ordinance. Each day the violation continues shall be considered a separate offense.

B. Whenever the city finds that a person has violated or is violating a requirement of the section the city may:

(1) Issue a written notice of violation;

(2) Assess an administrative penalty;

(~~2~~3) File a citation in municipal court as set forth in Section 1-3 SFCC 1987;

(~~3~~4) Commence a civil action in district court for appropriate relief, including injunctive relief;

(~~4~~5) Determine that the violation is a threat to public health, safety, and welfare and is therefore declared a nuisance, and as such may be abated as set forth ~~in~~ elsewhere in this code.

C. A notice of violation shall state with reasonable specificity the nature of the violation and set forth a deadline for correction of the violation pursuant to the requirements set forth in the notice. The notice shall further advise that, should the violator fail to correct the violation pursuant to the requirements, the city will take any and all measures necessary to abate the violation and and/or restore the property and the expense thereof shall be charged to the violator pursuant to subsection 13-2.17 SFCC 1987.
(Ord. #2005-3, §16)

D. Any person who violates or fails, without sufficient cause, to comply with any permit or authorization or order issued pursuant to the Illicit Discharge Control Ordinance shall be liable for an administrative civil penalty of not more than [$5,000] per violation per day.

13-2.16 Abatement by City.

If after the notice is issued, the violation has not been corrected pursuant to the requirements set forth in said notice, the city of a contractor, designated by the city, shall request permission to enter upon the subject private property and if granted, is authorized to take any and all measures necessary to abate the violation and/or restore the property. In the event the owner or occupant refuses entry after a request to enter and abate has been made, the city is hereby empowered to seek assistance from any court of competent jurisdiction in obtaining such entry. (Ord. #2005-3, §17)

13-2.17 Charging Cost of Abatement/Liens.

Within thirty (30) days after abatement of the violation by the city, the city shall notify the owner of the property of the cost of abatement, including administrative costs. If the amount due is not paid within ten (10) days, the charges shall become a special assessment against the property and shall constitute a lien on the property for the amount of the assessment. The city may assess a fee for the placement of the lien. (Ord. #2005-3, §18)

13-2.18 Exigent Circumstances Abatement.

The city, pursuant to its police powers, is authorized to require immediate abatement of any violation of this section that constitutes an immediate threat to the health, safety or well-being of the public. If any such violation is not abated immediately as directed by the city, the city and/or its agents are authorized to enter onto private property and to take any and all measures required to remediate the violation for the protection of the community. Any expense related to such remediation undertaken by the city shall be fully reimbursed by the property owner and/or responsible party. Any relief obtained under this section shall not prevent the city from seeking other and further relief authorized under this section. (Ord. #2005-3, §19)

13-2.19 Severability.

The requirements and provisions of this section and their parts, subparts and clauses are severable. In the event that any requirement, provision, part, subpart or clause of this section, or the application thereof to any person or circumstance, is held by a court of competent jurisdiction to be invalid or unenforceable, it is the intent of the governing body that the remainder of the section be enforced to the maximum extent possible consistent with the governing body's purpose of detecting and eliminating illicit discharges. (Ord. #2005-3, §20)

...

14-8.2 ~~TERRAIN~~ EROSION CONTROL AND POST CONSTRUCTION STORMWATER MANAGEMENT

(Ord. No. 2011-37 § 10)

(A) Purpose

The purpose of this Section 14-8.2 is to protect, maintain and enhance the health, safety and general welfare of the citizens and natural environment of Santa Fe. The following considerations shall be used during the design and planning process for all proposed *developments* subject to this Section 14-8.2:

(1) ensure sound and orderly *development* of the natural terrain;

(2) protect life and *property* from the dangers of *flooding* and the hazard of improper *cuts* and *fills*;

(3) minimize *erosion* and sedimentation;

(4) minimize destruction of the natural *landscape*;

(5) protect the scenic character of Santa Fe from the visual blight of indiscriminate *cuts* and *fills* and vegetation removal resulting from extensive *grading* and utility scars;

(6) treat stormwater runoff as a valuable natural resource in Santa Fe, a community that is prone to drought, by encouraging water collection and infiltration on site;

(7) control the adverse impacts associated with accelerated stormwater runoff on natural drainage ways and all *structures* due to increased *development* and impervious surfaces;

(8) minimize *erosion* and degradation of arroyo channels and improve the condition of the channels where possible;

(9) respect, protect, maintain and restore natural *drainageways*, wetlands, bosques, *floodplains*, steep *slopes*, riparian vegetation and wildlife habitat areas;

(10) prevent stormwater runoff from entering or damaging acequias or other irrigation facilities;

(11) integrate stormwater management measures into the *landscape* and site planning process as set forth in Section 14-8.4 (Landscape and Site Design);

(12) provide aesthetically pleasing solutions to post construction stormwater management and *erosion* control measures by integrating measures into the overall *landscape* and site design; and

(13) promote improved water quality through compliance with the EPA NPDES MS4 *permit* and Construction General Permit (CGP).

(B) Applicability

(1) Minimum Standards and Submittal Requirements

(a) Minimum standards and submittal requirements for ~~terrain~~ erosion control and post-construction stormwater management are based on the type of project and all projects shall meet the minimum standards in Subsection 14-8.2(D) (Standards for All Grading).

(b) Projects for which a construction *permit* for *grading* is required by Section 14-3.10(E) (Development in Special Flood Hazard Areas) shall also meet the applicable minimum standards and submittal requirements in Subsection 14-8.2(E) for minor *development* or Subsection 14-8.2(F) for all other *development*.

(c) Master plan, preliminary *development* plan and preliminary subdivision *plat applications* shall also meet the minimum standards and submittal requirements in Subsection 14-8.2(G).

(d) Final *development* plan and subdivision *plat applications* shall also meet the requirements in Subsection 14-8.2(H).

(e) All *city* departments that implement construction projects shall comply with the objectives, intent and minimum standards of this Section 14-8.2.

(2) Exemptions

A *development* is exempt from the requirements of this Section 14-8.2 if it meets the following conditions:

(a) less than two hundred fifty (250) square feet of total land area is disturbed;

(b) no *slopes* greater than ten percent are disturbed;

(c) existing drainage patterns on the *property* are not changed in a way that would increase the amount of stormwater runoff leaving the *property* or cause significant change to on-site drainage patterns as determined by the *city engineer*, and

(d) adequate *erosion* control best management practices ~~is provided~~ are utilized.

(3) Alternative ~~Means of~~ Compliance

~~*Applicants* may propose alternatives to standard post-construction stormwater management techniques, so long as these alternatives allow the project to meet the minimum standards and general requirements of this Section 14-8.2. Alternative techniques may be proposed that achieve improved environmental performance, including reduced stormwater runoff, increased infiltration, reduced sedimentation and *erosion*, and for aesthetic purposes.~~

(a) On-site retention of the regulatory volume described in Subsection 14-8.2(D)(b)(ii) can be waived if the following site constraints exist on the development: [insert appropriate site constraints[1]] and alternative compliance measures are implemented. The *applicant* shall demonstrate, to the satisfaction of the [insert appropriate official], that the site constraints cannot be overcome or mitigated through reasonable re-design of the site. Infeasibly must be demonstrated with site-specific hydrologic and design analyses conducted and endorsed by a professional engineer or landscape architect properly licensed in the State of New Mexico.

(b) In the event that the [land use director] determines retention infeasibility has been adequately demonstrated, the *applicant* shall comply with all other post-construction performance standards and [insert alternative compliance option(s)].[2]

[1] Draft MS4 permit allows for the following site constraints to trigger alternative compliance: A. too small a lot outside of the building footprint to create the necessary infiltrative capacity even with amended soils; B. soil instability as documented by a thorough geotechnical analysis; C. a site use that is inconsistent with capture and reuse of storm water; D. other physical conditions; or, E. to comply with applicable requirements for on-site flood control structures leaves insufficient area to meet the standard

[2] Draft MS4 permit allows for the following alternative compliance options: A. Off-site mitigation. The off-site mitigation option only applies to redevelopment sites and cannot be applied to new development. Management of the standard volume, or a portion of the volume, may be implemented at another location within the MS4 area, approved by the permittee. The permittee shall identify priority areas within the MS4 in which mitigation projects can be completed. The permittee shall determine who will be responsible for long-term maintenance on off-site mitigation projects. B. Ground Water Replenishment Project: Implementation of a project that has been determined to provide an opportunity to replenish regional ground water supplies at an offsite location. C. Payment in lieu. Payment in lieu may be made to the permittee, who will apply the funds to a public stormwater project. MS4s shall maintain a publicly accessible database of approved projects for which these payments may be

(c) Proposals for ~~alternative compliance to standard post-construction stormwater management techniques~~ retention volume alternative compliance options are subject to review and approval of the *city engineer* in writing, stating the basis for proposing such ~~a waiver~~ options.[3]

(C) Procedures and General Requirements

(1) The *city engineer* may determine the following:

(a) the completeness of all required erosion control ~~terrain~~ and post-construction stormwater management submittals;

(b) compliance with all minimum standards;

(c) the acceptability of all proposed *erosion* control best management practices and post-construction stormwater management methods; and

(d) the need for additional information or written approval in order to determine compliance with the purposes, intent and minimum standards of this Section 14-8.2.

(2) The preparation of submittals shall be as provided in this Subsection 14-8.2(C)(2) and in accordance with the provisions of Chapter 61 NMSA 1978 (Professional and Occupational Licensing) regulating the practice of architecture, *landscape* architecture, engineering and land surveying. (Ord. No. 2013-16 § 44)

(a) *~~Grading~~ Erosion and sediment control plan* submittals for minor *development* or for *grading* incidental to the construction or modification of a *structure* may be prepared by any person, including the homeowner, who has the legal authority to design the *structure*; however, the *city engineer* may require that submittals be prepared and signed by a *professional engineer*, *architect*, *professional land surveyor* or *landscape architect* licensed in New Mexico if necessary to fulfill the requirements of this Section 14-8.2, Chapter 61 NMSA 1978 or applicable regulations;

(b) Submittals for *development* other than minor *development* or incidental to the construction or modification of a *structure* shall be prepared as follows:

(i) topographic plans shall be prepared and certified by a *professional engineer* or *professional land surveyor;*

(ii) post-construction stormwater management submittals for master plans, subdivisions and *development* plans shall be prepared and certified by a *professional engineer*. Stormwater

---

used. D. Other. In a situation where alternative options A through C above are not feasible and the permittee wants to establish another alternative option for projects, the permittee may submit to the EPA for approval, the alternative option that meets the standard.

[3] The draft MS4 permit does not allow for any waiver of the post-construction performance standard, therefore the City would not be allowed to waive these requirements for any project of one acre or more.

management submittals for all other types of *development* shall be prepared by a *professional engineer* or an *architect* or *landscape architect* registered in New Mexico; and

(iii) site restoration submittals shall be prepared and certified by a *professional engineer, architect* or *landscape architect* licensed in New Mexico.

(3) No *certificate of occupancy* or any type of final construction approval shall be issued by the *city* unless a *parcel* is in full compliance with the requirements of this Section 14-8.2 and all inspections have been conducted as described in this Section 14-8.2.

(4) Activities permitted pursuant to this Section 14-8.2 may also require notification or permitting by other agencies, including written approval from the Acequia Madre de Santa Fe community acequia association or other official watercourse-related entity, the EPA, the United States army corps of engineers, the federal emergency management agency (FEMA) and the New Mexico Department of Environment. It is the responsibility of each *applicant* to determine whether additional notification or permitting is required.

(5) All inspections shall be documented in written form, shall be made available to the *city engineer* or code enforcement officer upon request.

(D) Standards for All Grading

When a construction *permit* for *grading* is required by this Section 14-8.2, *applications* for the *permit* shall show compliance with the following erosion and sediment control minimum standards:

(1) Cut and Fill Slopes

(a) exposed cut *slopes* on a site shall not exceed ten (10) feet in height, except as otherwise permitted by this Section 14-8.2. In no case shall the height of a cut exceed the height of any *building* constructed in the *excavated* area; (Ord. No. 2013-16 § 45)

(b) *fill slopes* on a site shall not exceed fifteen (15) feet in height. Retaining *walls* for *fill slopes* shall be no greater than six (6) feet in height as provided in Section 14-8.5(B)(1), except as otherwise provided in Section 14-5.6(G) (Escarpment Overlay District Landscaping). *Fill slopes* shall be no steeper than 3:1, unless a structural alternative such as a retaining *wall* or some other measure acceptable to the *city engineer* is provided;

(c) *cut* or *fill slopes* for roads shall not exceed fifteen (15) feet in height; and

(d) all *cut slopes* that are not stabilized by a retaining *wall* or some other measure acceptable to the *city engineer*, shall be no steeper than 2:1, unless a structural alternative is provided or unless it can be demonstrated by a geotechnical study that existing soils will naturally accommodate a steeper *slope* and acceptable revegetation or other *erosion* control can be achieved.

(2) Grading

(a) *Grading* for *buildings* is limited to fifteen (15) feet beyond the outer edge of the *building* foundation, patio, *wall*, driveway, road, parking area or other constructed facility except as necessary:

(i) for the construction of stormwater ~~runoff management~~ control measures in compliance with this Section 14-8.2; or

(ii) to accommodate required horizontal to vertical measurements for *cut* and *fill slopes*.

(b) Natural *slopes* thirty percent or greater shall remain undisturbed, except for arroyo crossings and for no more than three isolated occurrences of *sloped* areas where each individual disturbance shall not exceed one thousand (1,000) square feet, as approved by the *city engineer*. The *city engineer* may waive this provision, in writing, stating the reasons and basis for such approval, if evidence is provided by the *applicant* showing that strict enforcement of this provision would prohibit access to the *lot* or placement of utilities. This provision applies solely to the construction of roads, driveways and utility placement and is not intended to allow *development* on natural *slopes* exceeding thirty percent. The other provisions of the escarpment overlay district ordinance and the terrain and stormwater management regulations shall remain in effect.

(c) Phasing for *grading* and clearing shall ~~may~~ be required for all sites greater than [five acres], with the size of each phase to be established at plan reviews and approved by the *city engineer* ~~on all sites where construction will not begin immediately after clearing and *grading*.~~

(d) A construction *permit* for *grading* for driveway construction shall not be issued unless the *city engineer* has first determined that the driveway provides access to a buildable area as defined in Subsection 14-8.2(D)(3) and that the *permit* complies with the requirements of Section 14-5.6 (Escarpment Overlay District); and

(e) All *grading* completed on the site shall conform to the approved *grading* plan.

(3) Topography

(Ord. No. 2014-31 § 28)

(a) Each *residential lot* shall have a *buildable site* designated as suitable for a *building with a footprint* of not less than forty percent of the minimum required net *lot* area or two thousand (2,000) square feet, whichever is less, which can be developed in accordance with the terrain and stormwater management standards and with other applicable *development* standards, including required *setbacks* and access requirements. The planning commission or summary committee may approve residential lots with a smaller *buildable site* to accommodate lot size averaging or within multi-family developments.

(b) At least one-half of the area designated as suitable for building and at least one-half of any *building* footprint shall have a natural *slope* of less than twenty percent; the remainder of the area or *building* footprint may have a natural *slope* of twenty percent or greater, but less than thirty percent.

(c) The first floor finished floor elevation at any point of any portion of a *building* built on a natural *slope* of twenty percent or greater shall not exceed five (5) vertical feet above the natural *slope* at that point.

(d) A *structure* shall not be built on a natural *slope* of thirty percent or greater.

(4) Post Construction Stormwater Management

(a) General Standards:

(i) stormwater ~~management~~ control measures shall be selected to best accommodate the specific geologic, hydrologic and topographic features of the land to be developed;

(ii) stormwater ~~management~~ control measures shall be designed as both a comprehensive and integral part of the *development*;

(iii) stormwater ~~management~~ control measures shall be designed to directly address additional flows from the proposed *development*. Compliance with these standards shall not be achieved solely by alterations to flows upstream of a proposed *development*; and

(iv) stormwater management plans may be designed to incorporate measures that are shared by two or more *developments*; provided that the measures comply with the minimum standards of this Section 14-8.2, including provision of an enforceable legal agreement for construction and maintenance.

(b) ~~Discharge~~ Post Construction Stormwater Management Performance Standards[4]:

(i) except as otherwise required by this Section 14-8.2, the stormwater runoff peak flow rate discharged from a site post-development shall not exceed pre-*development* conditions for any frequency storm event up to the one percent chance, twenty-four-hour storm event at each discharge point;

(ii) The runoff volume of stormwater runoff leaving the site post-construction associated with the 90th percentile annual storm event, known as the regulatory volume, shall not exceed the

[4] The draft MS4 permit allows for the management of the 80th percentile storm event for redevelopment, however, since Santa Fe has not previously differentiated between new and redevelopment that distinction not included.

runoff volume[5] leaving the site under natural conditions[6]. If retention is determined to be infeasible due to site constraints, the land use director can approve alternative compliance options for up to one-hundred percent of the retention volume. See Subsection 14-8.2 (B) for alternative compliance requirements.

(iii) The regulatory volume must be treated to achieve a minimum of 85 percent removal of total suspended solids, as compared with uncontrolled runoff.

(i~~i~~v) runoff control measures may include the use of *detention* or *retention* basins and *active water harvesting* and *passive water harvesting* techniques, *swales*, berms, check dams, vegetative ground cover, *permeable pavements*, tree wells, dry wells, cisterns and other techniques appropriate for retaining and infiltrating water on site;

(iii) stormwater shall not be discharged into any watercourse or drainage channel without adequate reduction of flow velocity, which shall be accomplished by *erosion* control techniques that may include the routing or energy dissipation of stormwater runoff to a vegetated *swale*, vegetated basin or stone-protected area. The techniques used shall be sufficient to diminish runoff velocity and spread runoff flow adequately to avoid *erosion* upon entering the watercourse;

(~~i~~v) stormwater runoff shall not be routed into irrigation ditches, canals, acequias or watercourses related to an acequia system unless specific plans have been approved in writing by the *person* legally responsible for the operation and maintenance of the facility and the *city engineer*. The developer is responsible for obtaining all such approvals before submittal of an *application*; and

(vi) an active, historic acequia, whether on site or off site, shall not be disturbed in any way by *building development* or construction activity unless specific plans have been approved in writing by the *person* or entity legally responsible for the operation and maintenance of the acequia. The developer is responsible for obtaining all such approvals before submittal of an *application*.

(c) Detention Basin Standards:

(i) stormwater *detention* basins and overflow *structures* shall be sized and designed to adequately accommodate flows from *one percent chance*, twenty-four-hour storm events; provided, however, that such basins shall also be equipped with outflow *structures* that limit

[5] With no design manual in Santa Fe at this time, recommend including a reference for determining this volume in the Municipal Code as specified in the draft MS4 permit. Permit states: Estimation of the 90th or 80th percentile storm event discharge volume is included in EPA Technical Report entitled “Estimating Predevelopment Hydrology in the Urbanized Areas in New Mexico. Permittees can also estimate: Option A: a site specific 90th or 80th percentile storm event discharge volume using methodology specified in the referenced EPA Technical Report. Option B: a site specific pre-development hydrology and associated storm event discharge volume using methodology specified in the referenced EPA technical Report.

[6] The draft MS4 permit does not indicate the comparative condition as pre-development. Specifying ‘natural condition’ as comparative condition will allow for some retrofit in redeveloping areas.

flow-through from lesser magnitude storms to runoff rates equal to or less than pre-*development* runoff rates;

(ii) ~~infiltration,~~ *detention* ~~and *retention*~~ basins shall provide a means of controlling and removing sediment. Methods may include sedimentation settling ponds, sediment traps, filters on drop inlets or other methods. All basins shall be designed to empty within no more than twenty-four hours;

(iii) *landscape treatment* of *detention* and *retention* basins may be required in accordance with Section 14-8.4 (Landscape and Site Design); and

(iv) discharge standards for minor *development* are provided in Subsection 14-8.2(E)(2).

(d) ~~Detention in~~ Cisterns

(i) *Cisterns* may be used if they are connected to an irrigation system or other water use.

(ii) A maximum of fifty percent of required stormwater *detention* volume and one hundred percent of retention volume may be ~~stored~~retained in *cisterns*.~~, except that o~~One hundred percent of required stormwater detention volume may be ~~stored~~ retained in cisterns for minor *development*.

(iii) *Cisterns* shall be installed and operated in compliance with applicable provisions of other regulations, including Section 14-8.4 (Landscape and Site Design) and Chapter 7 SFCC 1987 (Building and Housing).

(e) Arroyo, Stream and Watercourse Standards:

(i) for arroyos, streams or watercourses that carry one hundred (100) cubic feet per second or more of stormwater flow in a *one percent chance event*, all *structures*, paved roads, driveways and parking *lots* shall be set back a minimum of twenty-five (25) feet from the top shoulder of an arroyo plus the depth of the arroyo channel. This *setback* provision does not apply to stormwater management *structures* or public access trails. The *city engineer* may waive this provision, in writing, stating the reasons and basis for such approval, if evidence is provided by a *professional engineer* demonstrating arroyo bank stability;

(ii) for arroyos, streams or watercourses that carry less than one hundred (100) cubic feet per second in a *one percent chance event*, the *city engineer* may require a *setback* based on soils and hydrologic information supplied by the *applicant*.

(iii) except for *erosion* control ~~measures~~ practices, stormwater ~~management~~ control measures, public access trails or the placement of underground utilities required for *development*, no *grading* shall occur within the *setback* area;

(iv) where practical, *erosion* control and *channel* stability in arroyos, streams or watercourses shall be achieved using techniques that reduce stormwater velocity and pollution, preserve active *floodplains*, provide adequate room for *flood* waters to spread safely and use native vegetation. Arroyo and watercourse banks shall not be armored with concrete, gabion baskets, sheet piling, rip-rap or similar hardened material unless no reasonable alternative exists to protect public *infrastructure* or pre-existing *structures*; and

(v) fences, *walls* and similar *structures* may not be constructed in or across an arroyo, stream or watercourse.

(5) Site Restoration and Permanent Stabilization:

(a) soil stabilization and *erosion* control ~~measures~~ practices for all land disturbed by construction shall be completed within twenty-one days after completion of construction or other activities on site that interfere with soil stabilization measures. If the time of year is not conducive to planting, it may be delayed until the next appropriate planting season if all other appropriate temporary *erosion* control ~~measures~~ practices are maintained until permanent *erosion* control measures are implemented; ~~(b)~~ one or more of the following permanent stabilization and *erosion* control ~~measures~~ practices shall be used:

(i) revegetation with appropriate drought-tolerant plant materials, including grasses or other ground cover;

(ii) restoration with bioengineering techniques such as *live staking, brush layering, brush mattress* and *live crib walls*; and

(iii) stabilization with stones, terracing or similar techniques; and

(c) all trees and shrubs shall be *mulched* and irrigated until established. Grass seed should either be hydroseeded or covered with biodegradable material or synthetic soil *erosion* control blankets or matting and irrigated until established. Irrigation shall be pursuant to the irrigation requirements in Section 14-8.4 (Landscape and Site Design).

(6) Increase in Minimum Standards

The *city engineer* may require implementation of more than the minimum stormwater standards if arroyos on site or immediately downstream of a site show evidence of increased *flooding*, channel *erosion* or sedimentation as a direct result of conditions on the site. Increased requirements shall be limited to the following on-site measures:

(a) *erosion* and sediment control measures extended to a broader area of the site than the *development* area;

(b) revegetation or stabilization of highly eroded areas;

(c) arroyo restoration or other *erosion* control ~~measures~~ practices within highly eroded channels; or

(d) a combination of the measures specified in Subsections 14-8.2(D)(6)(a) through (c).

(7) Best Management Practices. (Ord. No. 2016-40 § 2)

The following best management practices shall be used before and during the construction process:

(a) disturbed areas shall be protected from *erosion* during construction by diverting stormwater around the disturbed area, dissipating the energy of stormwater adequate to prevent *erosion*, retaining sediment on the disturbed area or other means adequate to retain soil on site~~, or a notice of intent (NOI) is filed~~;

(b) except as necessary to install temporary *erosion* and sediment control devices, land shall not be *graded* or cleared of vegetation until all such temporary devices have been properly installed and inspected. Temporary *erosion* and sediment control devices may include silt fencing, *swales*, straw bales, berms, geotextiles, sediment basins or traps and fencing. Temporary ~~E~~rosion control ~~devices~~ practices shall be kept in place and functional until the disturbed area is permanently stabilized~~; or notice of termination (NOT) is filed;~~

(c) temporary soil stabilization shall be completed within [fourteen] days of clearing or inactivity in construction. If seeding or another vegetative erosion control method is used, it shall become established within [fourteen days] or the site must be reseeded or a nonvegetative option employed.

(d) all *significant trees*, and other trees and vegetation, areas with substantial grass coverage and *drainageways* that are to remain undisturbed shall be fenced off prior to the use of any heavy machinery on-site and shall remain fenced during the entire construction process. Fencing material may include snow fencing, plastic mesh or other similar fencing material. To protect the root zone of all *significant trees*, and other trees and vegetation, fencing shall be placed five (5) feet to the outside of their dripline;

(~~d~~e) to prevent soil from leaving a site, soil stockpiles shall be protected from wind and water *erosion* throughout the time the stockpile remains by using appropriate *erosion* control techniques. Staging and soil stockpile areas shall be clearly designated on the site. All topsoil shall be kept on site, within the disturbance zone of a construction site and then reintroduced into planting areas to the extent possible. Stockpiled soil shall not be allowed to enter arroyos or other *drainageways*~~;~~. Soil stockpiles must be stabilized or covered at the end of each workday;

(~~e~~f) techniques to prevent the blowing of dust or sediment from the site, such as watering down exposed areas, are required for projects that disturb greater than five thousand (5,000) square feet; and alternate forms shall be readily available and used if watering is not sufficient;

(~~f~~g) protection for storm drain inlets, *drainageways* and any stormwater conveyance shall be provided to prevent the entry of sediment and pollutants from the site while still allowing the entry of stormwater.

(E) Standards for Minor Development; Submittal Requirements

(1) Minor Development

A minor *development* includes the construction of any *structure*, including single *family* residences, additions, sheds, *garages*, fences, driveways or pavement, that meets all of the following criteria:

(a) it takes place on a single *lot* or a subdivision of fewer than three *lots*;

(b) it results in cumulative total disturbance of less than five thousand (5,000) square feet of land on a *lot*;

(c) it disturbs no *slope* equal to or greater than twenty percent; and

(d) no more than three thousand five hundred (3,500) square feet of new impervious surface is created per *lot*.

(2) Minimum Standards; Discharge Standards

Minor *development* must comply with the standards in Subsection 14-8.2(D), except that the minimum volume of water to be contained or infiltrated on site shall be determined by multiplying the total area of new impervious surface, in square feet, by 0.16 feet to arrive at a value expressed in cubic feet, i.e. one hundred sixty (160) cubic feet of water containment is required per one thousand (1,000) square feet of impervious surface.[7]

(3) Submittals

Construction *permit applications* for *grading* for *minor development* must provide sufficient information to demonstrate compliance with the standards in Subsection 14-8.2(D) and Subsection 14-8.2(E)(1) and (2), including the following, unless the requirement is waived by the *land use director*:

(a) a brief narrative description of the proposed project;

(b) a topographic map of the *property* to scale, including United States Geological Survey quadrangle maps or maps generated by the *city*, adequate to show elevation contours, natural *drainageways* and existing and proposed improvements;

(c) a brief written description or representative photographs of the type of existing vegetation, such as piñon and juniper trees, annual weeds, grass cover, bare ground and so on, and approximate coverage of existing vegetation at the site, and a plan for vegetation removal at the site;

[7] Need to confirm that this is less stringent than EPA required standard. If not less stringent, then would not be appropriate as a minor development allowance.

(d) a ~~description~~ site map showing boundaries of all proposed *grading* or ground disturbance;

(e) calculations and a plan drawing showing:

(i) the ~~size, volume, dimensions~~ design specifications and calculations establishing compliance with the performance standards set forth in [Subsection 14-8.2(D)], construction details, and location of all proposed ~~runoff containment *structures*~~ stormwater control measures or methods and how water will be directed to the ~~*structures*~~ measures or methods; and

(ii) percolation test results or other means of demonstrating that containment *structures* will empty within twenty-four hours;

(f) a roof run-off drainage plan; and

(g) a planting plan for revegetation showing proposed plant materials and a description of the proposed irrigation method or other methods used to establish vegetation and prevent *erosion* until vegetation becomes established.

(F) Submittal Requirements For All Other Development

(Ord. No. 2014-31 § 29)

All other *development* that requires a construction *permit* for *grading*, and that is not classified as minor *development* under the provisions of Subsection 14-8.2(E), shall meet the following minimum submittal requirements:

(1) Submittals for construction *permit applications* for *grading* must provide sufficient information to show compliance with Subsection 14-8.2(D) and (E). Unless waived by the *land use director*, submittals must include:

(a) a topographic survey and *grading* plan with elevation contours shown at not more than two (2) foot intervals on *slopes* less than thirty percent and five (5) foot intervals on *slopes* of thirty percent or greater that shows:

(i) all *sloped* areas of zero to twenty percent, twenty-one to thirty percent and greater than thirty percent shall be clearly marked and differentiated by shade, tone or color at a scale sufficient to allow verification of the calculations;

(ii) ground elevations that conform to either the United States Geological Survey sea level datum, as modified, or to the *city*'s monument system;

(iii) the designated *buildable sites* or *buildable areas*;

(iv) all areas to be *graded* on the site and the final contours to be achieved by the *grading*;

(v) all finished floor or *grade* elevations;

(vi) spot elevations, as needed;

(vii) areas of soils with severe limitations for the intended use;

(viii) the location of temporary *erosion control structures* and methods used, including staging and stockpile areas;

(ix) all *significant trees* and areas with substantial grass coverage to be removed;

(x) ~~a construction schedule when the project will be developed in phases;~~ sequence of construction of the development site, including stripping and clearing; rough grading; construction of utilities, infrastructure, and buildings; and final grading and landscaping. Sequencing shall identify the expected date on which clearing will begin, the estimated duration of exposure of cleared areas, areas of clearing, installation of temporary erosion and sediment control measures, and establishment of permanent vegetation.

(xi) the location of fencing around the areas to be protected;

(xii) the ratio of horizontal to vertical measurement for *cut* and *fill slopes*;

(xiii) the total volume, in cubic yards, of earth to be moved;

(xiv) all existing disturbed areas;

(xv) *special flood hazard areas* designated by FEMA on the *Flood Insurance Rate Map (FIRM)*; and

(xvi) date, method of survey and certification from a New Mexico *professional engineer* or *professional land surveyor* that the plan is in compliance with national map accuracy standards;

(G) Standards for Master Plans, Preliminary Development Plans and Preliminary Subdivision Plats; Submittal Requirements

(1) Minimum Standards:

(a) projects shall meet the minimum standards of Subsection 14-8.2(D);

(b) all land below the *base flood elevation* for a *one percent chance event* shall be dedicated as a drainage easement and as public or *private open space* or *public right of way*; and

(c) for all *development* where one-half or more of the land within the project site exceeds twenty percent *slope*, the quantity and peak flow rate of post-*development* stormwater runoff on all developed or disturbed land shall not exceed seventy-five percent of the quantity and peak flow rate of the pre-*development* runoff.

(2) Submittals

Submittals for master plans, preliminary *development* plans and subdivision *plats* shall include:

(a) a conceptual plan and report that shows the general approach proposed for terrain and stormwater management, and how the proposed *development* meets all of the minimum standards described in Subsection 14-8.2(D);

(b) a topographic survey and *grading* plan as outlined in Subsection 14-8.2(F)(5); and

(c) a brief description of the watershed directly upstream and downstream of the *parcel*, including the size, terrain, type and extent of vegetation cover and degree of *development* for all areas draining to the project site.

(H) Final Development Plans and Subdivision Plats

(1) Minimum standards

Final *development* plans and subdivision *plats* shall meet the minimum standards described in Subsection 14-8.2(D) and (G).

(2) Submittals

Submittals for final *development* plans and subdivision *plats* shall include:

(a) all submittals required pursuant to Subsection 14-8.2(F);

(b) a long-term operation and maintenance plan and certification statement. This plan shall include a ~~schedule for the life of the stormwater management measures, including the time frame for completion and the responsible party who shall perform the maintenance~~ The operation and maintenance plan shall be binding on the record owner of the property or properties subject to this ordinance and their owners, heirs and assigns. The operation and maintenance plan shall be developed by a professional engineer or landscape architect properly licensed to practice in the State of New Mexico and shall include maintenance requirements and protocols for each stormwater control measure, including an associated schedule of inspection and maintenance activities, and procedures and checklists for each stormwater control measure and a signed certification statement accepting responsibility for the operation, maintenance and inspection of the stormwater control measures.; and

(c) an as-built certification signature block to be executed by a *professional engineer* ~~after the~~ within 90 days of project completion to ensure that the constructed stormwater management systems comply with the approved stormwater plans.

(I) Inspections ~~and Violations~~ During Construction Process

(1) For all *nonresidential* projects and all *residential* projects that do not qualify as minor *development*, an *applicant* shall notify the *land use director* to set up an inspection at the following times:

(a) when the construction *erosion* and sediment control devices and measures are in place;

(b) when final stormwater management measures are completed;

(c) when the final site restoration measures are completed; provided, however, that if final site restoration measures are being delayed due to the season, the *applicant* shall notify the *land use director* when temporary *erosion* control ~~measures~~ practices, for use until site restoration is complete, in place and ready for inspection; and

(~~d~~2) further construction or issuance of any *permits* shall not occur until written approval has been granted by the inspector after each inspection that the best management practices and stormwater ~~management~~ control ~~methods~~ measures have been completed in accordance with approved plans;

(~~2~~3) the *land use director* may enter upon any *property* subject to this Subsection 14-8.2 at reasonable times to conduct inspections of *grading*, *erosion* and stormwater management measures to determine compliance with *city* policies and procedures and to carry out duties in the enforcement of this Subsection 14-8.2; and

(~~3~~4) the *land use director* may waive or consolidate any inspections required under this Section 14-8.2.

(J) Dedications, Easements and Rights of Way

(1) All land below the *base flood elevation* for a one percent, twenty-four-hour storm event shall be dedicated as a *drainage easement* and as public or *private open space* or *public right of way*.

(2) Dedications to the *city* may be required by the *city engineer* for the components of the stormwater drainage system, including access for maintenance. The types of all easements and *open space* dedications shall be determined by the *city engineer*. If a dedication is required, it shall be designated on the plan or *plat* and in effect prior to construction *permit* approval.

(3) An *applicant* may make requests for acceptance of dedications of a stormwater drainage system to the *city*; however, the *city* is not obligated to accept a dedication offer. Only the *governing body* may accept dedications to the *city*. If a dedication is offered to and accepted by the *city*, it shall be designated on the plan or *plat* and shall be in effect prior to construction *permit* approval.

(K) Long-Term Maintenance Responsibilities and Inspections

(1) Responsibilities

All stormwater management measures and facilities shall be maintained by the fee simple *owner* of the *property* or a *property owner*s association, unless a dedication of the stormwater management system was required and accepted by the *city*, in which case, the *city* is responsible for maintenance. The stormwater management system shall be maintained in good condition and promptly repaired. Maintenance shall include the repair and restoration of all grade surfaces, *walls*, *swales*, drains, dams, ponds, basins, site restoration measures, associated vegetation and any other stormwater measure constructed on site. The maintenance shall be in accordance with approved stormwater management plans.

(2) Self-Inspections

Periodic inspections shall be conducted by the *applicant* or the *applicant*'s successors of the stormwater control measure(s) as set forth in the applicable Operations and Maintenance Plan. Inspection and reporting procedures shall be conducted according to the Operation and Maintenance Plan. An inspection report shall be provided to the land use director according to the schedule in the Operation and Maintenance Plan, commencing no more than twelve months after the date of issuance of a certificate of occupancy for the development project, and occurring [annually] or stipulated period thereafter. A professional engineer or landscape architect properly licensed to practice in the State of New Mexico shall certify the periodic inspection reports.

(~~2~~3) City Compliance Inspections

The *city* or its authorized agent may enter upon a *property* that is subject to this Section 14-8.2 at reasonable times to access the stormwater management system to ensure that the system is maintained in proper working condition that meets the approved stormwater management plans and the objectives and minimum standards of this section.

(~~3~~4) Maintenance ~~Violations~~ Abatement by City

If, after notice by the *city* to correct a violation requiring maintenance work, satisfactory corrections are not made by the *owner* or responsible party within a reasonable period of time, the *city* may perform all necessary work to place the facility in proper working condition. The *owner* or responsible party of the facility shall be assessed the associated costs of the work.

(L) Violations; Penalties, and Enforcements.

A. It shall be unlawful for any person to violate any provision or fail to comply with any of the requirements of the Erosion Control and Post Construction Stormwater Management Ordinance. Each day the violation continues shall be considered a separate offense.

B. In addition to the enforcement actions authorized in Santa Fe Municipal Code Sections 13-2.216 through 13-2.219, whenever the city finds that a person has violated or is violating a requirement of the section the city may:

(1) Issue a written notice of violation;

(2) Assess an administrative penalty of up to [$1000] per day per offense;

(~~2~~3) Suspend or revoke the grading permit.

(4~~3~~) File a citation in municipal court as set forth in Section 1-3 SFCC 1987;

(5~~4~~) Commence a civil action in district court for appropriate relief, including injunctive relief;

(6~~5~~) Determine that the violation is a threat to public health, safety, and welfare and is therefore declared a nuisance, and as such may be abated as set forth ~~in~~ elsewhere in this code.

C. A notice of violation shall state with reasonable specificity the nature of the violation and set forth a deadline for correction of the violation pursuant to the requirements set forth in the notice. The notice shall further advise that, should the violator fail to correct the violation pursuant to the requirements, the city will take any and all measures necessary to abate the violation and and/or restore the property and the expense thereof shall be charged to the violator pursuant to subsection 13-2.17 SFCC 1987.
(Ord. #2005-3, §16)

14-8.3 FLOOD REGULATIONS

(Ord. No. 2011-37 § 10; Ord. No. 2012-19 § 3)

(A) Adoption of Special Flood Hazard Areas

(1) The *city* adopts the *special flood hazard areas* identified by FEMA in the current scientific and engineering report entitled, "The Flood Insurance Study (FIS) for Santa Fe County, New Mexico and Incorporated Areas," with accompanying *FIRM*, effective June 17, 2008 and December 4, 2012. (Ord. No. 2013-16 § 46)

(2) The *city* may adopt and establish other *flood hazard zones* or elevations as identified in:

(a) subsequent *drainage* studies prepared for and accepted by the *city;*

(b) subsequent letters of map amendment and letters of map revision, as prepared for and accepted by FEMA; and

(c) other known *flood hazard zones* identified by the *floodplain administrator* and adopted by the *governing body.*

(B) Applicability; Permit Required

(1) The requirements of this Section 14-8.3 are in addition to and not in lieu of other provisions of Chapter 14.

(2) New *development*, including *substantial improvements* to existing *structures* shall comply with the standards of this Section 14-8.3. However, this Section 14-8.3 does not apply to an *application* meeting either of the following criteria:

(a) the project is limited to work that does not change the footprint, size or enclosed area of an existing *structure,* such as re-roofing, re-stuccoing or interior remodeling; or

(b) the project will not result in an increased *flood* risk to *persons* or *structures* or their contents as determined by the *floodplain administrator,* who may require certification by a *professional engineer*.

(3) Regardless of applicability of this Section 14-8.3, all *development* in a *special flood hazard area*, including *excavation* and *fill* operations, requires approval of the *floodplain administrator* and a *permit*.

(C) General Provisions for Development in Special Flood Hazard Areas

(1) All newly created *lots* shall contain a *buildable area* that is entirely outside of any *special flood hazard area.*

(2) If an existing *lot* contains land both within and outside of the *special flood hazard area*, any *new construction*, including roads and driveways, shall only be outside of the *special flood hazard area,* except as allowed by Subsections 14-8.3(E), (F) and (G).

(3) If an existing *lot* contains no land outside the *special flood hazard area,* any *new* construction shall only occur in the *flood fringe* and only pursuant to Subsections 14-8.3(E), (F) and (G).

(4) On an *application* for subdivision *plat* or *development* plan approval, where the *tract* or portions of the *tract* are located within a *special flood hazard area*, the *applicant* shall submit detailed hydrologic data indicating the water surface elevations for a *one percent chance event,* to be shown for sections of the *drainage channel* at intervals of no greater than one hundred feet. The *special flood hazard area* shall be further defined as *floodway* and *flood fringe*, if applicable. The *floodplain administrator* may waive the requirement for the submission of detailed hydrologic data based on a site investigation. The *special flood hazard area, FIRM* panel number and date shall be accurately depicted by an *architect, professional land surveyor* or *professional engineer* on the *development* plan, subdivision plat, and construction permit where applicable.

(5) For purposes of this Section 14-8.3, the *special flood hazard area* is that shown on the appropriate *FIRM*. *Flood fringe*, *floodway* and *base flood elevation* shall be shown as required by the *floodplain administrator.*

(6) New and replacement water supply and sanitary sewage systems located in *special flood hazard areas* shall be designed to minimize or eliminate infiltration.

(7) Onsite liquid waste disposal systems located in *special flood hazard areas* shall be designed to avoid impairment or contamination.

(8) For *subdivisions* or other *developments* greater than fifty lots or five acres that are located entirely or partially within a *special flood hazard area, base flood elevations* are required to be shown on the development plan or subdivision plat for all lots that are entirely or partially within the *special flood hazard area.*

(9) In A and AE zones, *recreational vehicles* shall be:

(a) elevated and anchored; or

(b) on the site for fewer than one hundred eighty consecutive days; or

(c) fully licensed and highway ready.

(D) Engineering Criteria

The analysis, determination and designation of *base flood elevation, special flood hazard areas, floodway* or *flood fringe* shall adhere to professional hydrologic and hydraulic engineering techniques supplemented with data obtained by field examination and surveys as necessary. Engineering practice manuals of the American Society of Civil Engineers and similar competent manuals of professional hydrologic and hydraulic engineering techniques may be used in accordance with FEMA requirements.

(E) Land Use and Development in Floodway

No uses shall be permitted within the *floodway*, except those set out in this Subsection 14-8.3(E); provided that such uses comply with the provisions of Article 14-6 (Permitted Uses and Use Regulations) and any other applicable federal or *state* law; and further provided that such uses do not constrict flow or create a rise in the *base flood elevation* during the *one percent chance event*:

(1) Cultivating and harvesting of crops according to recognized soil conservation practices;

(2) Pasture, grazing land;

(3) Wildlife sanctuary, woodland preserve;

(4) Outlet installations for sewage treatment plants and sealed public water supply wells;

(5) *Passive recreational uses* such as parks or trails;

(6) Open area residential uses, such as lawns, gardens and play areas;

(7) Stormwater management and arroyo or watercourse stabilization facilities, such as check dams and gabions, provided that any such facilities that constrict flow or create a rise in the *base flood elevation* during the *one percent chance event* comply with all applicable FEMA requirements and all provisions of this Section 14-8.3 that are more stringent than the FEMA requirements;

(8) *Legal nonconforming uses* occupying *structures* in existence on June 17, 2008; provided that such uses may not be intensified and that the *structures* that such uses occupy comply with all applicable FEMA requirements and all provisions of this Section 14-8.3 that are more stringent than the FEMA requirements;

(9) Active recreational uses that do not include permanent *structures* and so long as any *temporary structures* or equipment are removed when not in active use; and

(10) Railroads, *streets*, driveways, bridges, private and public utility lines that cross the *floodway* with minimal disturbance as determined by the *floodplain administrator,* and structural works for the control and handling of *flood* flows, such as dams, embankments, flood *walls*, velocity control *structures* or storm drainage control and handling works (with the exception of required stormwater detention facilities) provided that any such facilities that constrict flow or create a rise in the *base flood elevation* during the *one percent chance event* comply with all applicable FEMA requirements and all provisions of this Section 14-8.3 that are more stringent than the FEMA requirements.

(F) Land Use and Development in Flood Fringe

(1) No uses shall be permitted within the *flood fringe* except those set out in this Subsection 14-8.3(F); provided that such uses comply with the provisions of Chapter 14, Article 6 (Permitted Uses and Use Regulations) and any other applicable federal or *state* law.

(2) All uses permitted in the *floodway* pursuant to Subsection 14-8.3(E) are also allowed in the *flood fringe.*

(3) Storage, processing or disposal of materials that in time of *flooding* are buoyant, flammable, explosive, toxic or could be injurious to human, animal or plant life, are prohibited within the *flood fringe.*

(4) No fence, *wall* or similar *structure* shall be erected in or across any arroyo, stream or watercourse unless it is designed to break away and not to cause a flow obstruction.

(5) At-grade parking facilities are allowed so long as such facilities cannot be reasonably accommodated outside the *flood fringe*, as determined by the *floodplain administrator*.

(6) *Structures* or uses within the *flood fringe* portion of the *special flood hazard area* meeting the following requirements are allowed upon review by the *floodplain administrator* and issuance of a *permit*, to the extent that they are not prohibited by any other ordinance, plan or policy:

(a) residential or nonresidential *structures*, to be constructed or *substantially improved* in the *flood fringe*, shall have the elevation of the *lowest floor* at least one foot above the *base flood elevation*. The *floodplain administrator* may authorize dry *flood proofing* for protection of nonresidential *structures* where the elevation of existing *streets* or utilities make compliance with this provision infeasible, or in other special circumstances. The design and construction methods of dry *flood proofing* shall comply with 44 CFR Section 60.3 of the National Flood Insurance Program regulations as certified by a *professional engineer* or *architect*;

(b) *structures* shall be designed and constructed to withstand *flood* conditions at the proposed construction site;

(c) *new construction* and *substantial improvements* with fully enclosed areas below the *lowest floor* that are subject to *flooding* shall be designed to automatically equalize hydrostatic *flood* forces on exterior walls by allowing for the entry and exit of *flood* waters. Designs for meeting this requirement shall either be certified by a *professional engineer* or an *architect* or meet or exceed the following minimum criteria:

(i) a minimum of two openings on different walls having a total net area of not less than one square inch for every square foot of enclosed area subject to *flooding* shall be provided;

(ii) the bottom of all openings shall be no higher than one foot above finished grade; and

(iii) openings may be equipped with screens, louvers, valves or other coverings or devices provided that they allow the automatic entry and exit *of flood* waters;

(d) all *new construction* or *substantial improvements* shall be constructed with electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities that are designed or located so as to prevent water from entering or accumulating within the components during conditions of *flooding*;

(e) sanitary and storm sewer drains shall be equipped with valves capable of being closed, manually or automatically, to prevent backup of sewage and stormwaters into the *building* or *structure*;

(f) the *base flood elevation* shall be certified and superimposed on the site plan, and accurately depicted on the elevation drawings for all sides of a *building* by a *professional surveyor*, *professional engineer* or *architect*. The elevation drawings shall also indicate the lowest floor elevation and location of all windows, doors or other openings. The *floodplain administrator* may request additional data for the construction *permit* if deemed necessary;

(g) before issuance of a construction *permit* for the construction of a *structure* in the *flood fringe*, a *professional engineer* shall certify that the *structure* has been designed to conform with the provisions of this Subsection 14-8.3(F), and that the bottom of all openings in the enclosure are no more than one foot above the *base flood elevation*. The same *professional engineer* shall also certify, upon completion of the *structure*, that construction complies with the submitted plans;

(h) a *manufactured home* or *mobile home* shall be elevated on compacted *fill* or pilings. The lowest floor of the *manufactured home* or *mobile home* shall be at least one foot above the *base flood elevation*;

(i) *manufactured homes* or *mobile homes* shall be anchored to resist flotation, collapse or lateral movement by providing:

(i) over-the-top ties at each of the four corners, with two additional ties per side at intermediate locations, and for *manufactured homes* or *mobile homes* less than fifty feet long, one over the-top tie at each of the four corners is required;

(ii) frame ties at each corner with five additional ties per side at intermediate points and for *manufactured* or *mobile homes* less than fifty feet long, four ties are required per side;

(iii) all components of the anchor system shall be capable of carrying a force of four thousand eight hundred pounds; and

(iv) additions to the *manufactured home* or *mobile home* shall be similarly anchored;

(j) for existing *manufactured home* or *mobile home parks* located in the *special flood hazard area*, a vehicular circulation plan indicating alternative vehicular access and escape routes during the *one percent chance event* shall be submitted as part of any improvement, construction or *development* project; and

(k) no new *manufactured homes*, *mobile homes* or foundations for either type of *structure* shall be permitted in the *special flood hazard area*.

(G) Repair or Replacement of Legal Nonconforming Structures in the Special Flood Hazard Area

A *structure* that on June 17, 2008 was *legally nonconforming* because of its location within a *special flood hazard area*, and that is substantially damaged by flood, fire or other casualty may be replaced or repaired within the *special flood hazard area* subject to the following:

(1) If there is a site on the *property* outside the *special flood hazard area* that will accommodate a *structure* of the same *gross floor area* as the *legal nonconforming structure*, the *structure* shall not be repaired or replaced within the *special flood hazard area*.

(2) If the *legal nonconforming structure* was located within the *flood fringe* and there is no other site on the *property* that will accommodate *a structure* of the same *gross floor area*, the *structure* may be repaired or replaced in the *flood fringe.* The repaired or replacement *structure* must not exceed the *gross floor area* or the footprint of the *legal nonconforming structure* and the footprint must be sized to minimize *flood* hazard.

(3) If the *legal nonconforming structure* was located in the *floodway* but there is a site on the *property* outside the *floodway* that will accommodate a *structure* of the *same gross floor area* as the *legal nonconforming structure,* the *structure* must not be repaired or replaced within the *floodway.* The footprint of the replacement *structure* must be sized to minimize *flood* hazard and must not exceed the *gross floor area* or the footprint of the *legal nonconforming structure;*

(4) If the *legal nonconforming structure* was located within the *floodway,* and there is no other site on the *property* that will accommodate a *structure* of the same *gross floor area,* the *structure* may be repaired or replaced in the *floodway.* The repaired or replacement *structure* must not exceed the *gross floor area* or the footprint of the *legal nonconforming structure* and the footprint must be sized to minimize *flood* hazard;

(5) A *structure* that is repaired or replaced within the *special flood hazard area* shall comply with all applicable FEMA requirements and all provisions of this Section 14-8.3 that are more stringent than FEMA requirements;

(6) A *structure* that is repaired or replaced in accordance with this Subsection 14-8.3(G) shall not require *a waiver* to be constructed in a *special flood hazard area;* provided that any necessary variance to other requirements of Chapter 14, including *setbacks* and terrain management, is granted; and

(7) As a condition of construction *permit* issuance for a replacement *structure,* any remaining portion of the *legal nonconforming structure* in the *special flood hazard area* shall be demolished or removed.

(H) Amendment to FIRM

(1) Amendments to the established *base flood elevations* and *special flood hazard areas* may be initiated either by the *floodplain administrator* or by any other person through *application* to FEMA. The *application* shall be accompanied by sufficient copies of supporting plans and reports as required by FEMA to meet the minimum requirements of the National Flood Insurance Program (NFIP). If the *application* is not made by the *floodplain administrator,* a copy of the submission to FEMA shall be forwarded to the *floodplain administrator.* Submission of inaccurate information with an *application* is grounds for denial from FEMA. The *floodplain administrator* may provide comments to FEMA on any submission for a map change.

(2) In addition to the change described in Subsection 14-8.3(H) and on the basis of hydrologic data, the *governing body* may establish additional *flood hazard zones* and modify these additional *flood hazard zones* by ordinance. The amendment may be for non-FEMA-approved changes but shall not be less restrictive than FEMA requirements. Where the change affects land owned by persons other than the *applicant,* all affected *property owners* shall be notified of the change by certified mail, return receipt requested. The signed receipts shall be submitted to the *floodplain administrator.*

(3) The *governing body's* decision to add or amend a *special flood hazard area* shall be based on appropriate information, including detailed engineering analysis and recommendations in reports and plans done by or for the *city* or other governing agencies, including those prepared for construction *permits* and subdivisions.

(4) If the *governing body* denies a change to the *flood hazard zone,* the reasons for denial shall be stated in a written report.

(5) Prior to approval by the *governing body,* the *floodplain administrator* shall notify the state coordinator for the NFIP at the New Mexico homeland security and emergency management department.

(6) If major *alterations* to a watercourse are proposed adjacent to the corporate limits of Santa Fe, the *floodplain administrator* shall notify the Santa Fe county manager and Santa Fe county *floodplain administrator* of such proposal.

(I) Warning and Disclaimer of Liability

The degree of *flood* protection intended to be provided by this Section 14-8.3 is considered reasonable for regulatory purposes and is based on engineering and scientific methods of study. Larger *floods* may occur on occasions or the *flood* height may be increased by natural or manmade causes. This Section 14-8.3 does not imply that areas outside the *special flood hazard area* or land uses allowed within such area will always be totally free from *flooding* or *flood* damages. This Section 14-8.3 does not create liability on the part of the *governing body* or any official, employee or agent of the *governing body* for any *flood* damages that result from reliance on this Section 14-8.3 or any administrative decision lawfully made pursuant to this Section 14-8.3.

14-8.4 LANDSCAPE AND SITE DESIGN

(Ord. No. 2011-37 § 10)

(A) Purpose and Intent

(1) It is the purpose and intent of this Section 14-8.4 to foster the creation of regionally appropriate, sustainable *landscapes*. This Section 14-8.4 requires *water harvesting* and encourages the *development* of alternate sources of *landscape* irrigation water, because potable water is an increasingly scarce resource. Water conservation, *water harvesting* and irrigation efficiency shall guide *landscape* design, installation and maintenance to foster a responsible and judicious use of our water and other natural resources.

(2) It is also the purpose of this Section 14-8.4 to protect and promote the health and beauty of natural settings and urban *landscapes*, to recognize and provide for appropriate changes in the urban context and to protect and preserve public and private *landscape* resources. This Section 14-8.4 is part of the purpose and intent of Chapter 14, which is to enhance the appearance

of Santa Fe's *streets* and public places in order to promote their role as community amenities and social spaces that contribute to civic pride and vitality.

(3) It is also the purpose and intent of this Section 14-8.4 to preserve existing healthy vegetation to the greatest extent possible as an important cultural, environmental and economic resource.

(B) Applicability

(1) This Section 14-8.4 applies to, and a *landscape* plan that demonstrates compliance of the entire *property* with this Section 14-8.4 is required with, the following: (Ord. No. 2013-16 § 47)

(a) *applications* for subdivision *plat* approval, except *lot* split and *resubdivision plats*;

(b) *applications* for *development* plan approval;

(c) *applications* for master plan approval;

(d) *applications for construction permits* and special use *permits* as follows:

(i) all new *nonresidential* and multiple-*family* construction resulting in an enclosed *structure* with a *gross floor area* greater than one thousand (1,000) square feet; and

(ii) for additions or remodeling of existing *nonresidential* and multiple-*family structures* with a construction valuation over one hundred thousand dollars ($100,000), *landscape* improvements to comply with this Section 14-8.4, as prioritized by the *land use director*, shall be required up to a total cost of twenty percent of the construction valuation; and

(e) *development* on *city*-owned land.

(2) The following requirements of this section apply to all *development*, including *applications* for construction of and exterior *alterations* to *single family dwellings* and apply to *landscaping* activities not directly associated with *development applications*:

(a) Subsections 14-8.4(E)(1)(b) (Passive Water Harvesting), (E)(3) (Water Features), and (E)(4) (Irrigation Standards); and

(b) Subsections 14-8.4(F)(3) (Controlled or Prohibited Plant Materials), (F)(4) (Turf Limitations), and (F)(5) (Preservation of Existing Vegetation).

(3) The requirements of this Section 14-8.4 other than those cited in Subsection 14-8.4(B)(2) do not apply to the following:

(a) *applications* for new or modified *single-family dwelling units*, except that they shall comply with applicable provisions of Subsections 14-8.4(E) (Water Harvesting and Irrigation Standards) and (F) (Plant Material Standards);

(b) interior *residential* remodeling.

(c) where standards of Section 14-7.4 (BCD) conflict with the provisions of this section, the BCD standards shall apply. In any other case in which more than one set of *landscape* requirements are applicable, the more stringent shall apply as provided in Section 14-1.7 (Conflicting Provisions).

(4) Additional *landscape* requirements may apply to *properties* subject to terrain management regulations as set forth in Section 14-8.2 (~~Terrain~~ Erosion Control and Post Construction Stormwater Management) and to those located in the escarpment overlay district as set forth in Section 14-5.6. Additional *landscaping* requirements applicable to outdoor and emergency water use are set forth in Chapter 25 SFCC 1987 (Water).

(5) Guidelines for design of medians and *planting strips* may be found in Resolution 2010-66. *Landscape* irrigation standards may be found in Resolution 2010-17.

(C) Compliance and Enforcement

(1) Construction *permits*, *development* plans, master plans and subdivision *plats* shall comply with this Section 14-8.4.

(2) If the requirements of this section cannot be met prior to the request for a *certificate of occupancy*, the *applicant* may provide a *financial guarantee* in accordance with Section 14-3.12(B) (Temporary Certificate of Occupancy) and with policies issued by the *land use director*.

(3) In the escarpment overlay district, compliance with both this Section 14-8.4 and Section 14-5.6 (Escarpment Overlay District) are required.

(4) The *land use director* shall have discretion to allow alternate means of compliance with the requirements of this section when the proposed alternate means satisfy the intent, and are equivalent to or exceed the requirements of, this Section 14-8.4 and when:

(a) site conditions, including the configuration of the *lot*, topography or existing vegetation, make full compliance impossible or impractical;

(b) the proposed alternate means of compliance are appropriate to the design intent, especially in response to *landscape* or site design consistent with the surrounding area or with the historic character of Santa Fe; and

(c) the proposed alternate means of compliance ~~promote good~~ comply with the stormwater management requirements of Subsection 14-8.2, and provide water conservation and *water harvesting* benefits equal to or greater than the original requirement.

(5) Existing *landscaping* or other improvements may meet the requirements of this Section 14-8.4.

(D) Landscaping Plan Submittal Requirements

When the requirements of this Section 14-8.4 apply, information shall be provided as required by the *land use director*. *Landscaping* plans shall be consistent with other required plans including terrain management, utilities and siting of *structures*.

(E) Water Harvesting and Irrigation Standards

Water conservation and stormwater management shall guide *landscape* and site planning, design, installation and management. *Landscape* planning shall begin early in the *development* process in conjunction with the requirements of Section 14-8.2 (~~Terrain~~ Erosion Control and Post Construction Stormwater Management). *Landscape* design shall apply the principles of *xeriscaping* and achieve the highest industry standards for irrigation efficiency. Alternative sources of irrigation water shall be developed, including harvested water from roof and site runoff. *Gray water* use is recommended where appropriate. Potable water shall be used only as a back-up or temporary irrigation water source to the greatest extent possible. The purpose of these strategies is to develop drought tolerant *landscapes* and to reduce the demand on the potable water system.

(1) Water Harvesting

(a) The *landscaping* plan shall include *passive water harvesting* for *landscape* irrigation purposes as a minimum requirement. *Active* ~~W~~*water harvesting* that is a primary component of stormwater management may qualify for *open space* reduction as provided in Section 14-7.5(D)(6).

---

(6) To encourage an increase in permeable surface area, to reduce stormwater runoff and erosion, to increase infiltration, and to encourage water conservation and water harvesting, the required open space may be reduced as follows:

(a) [8]~~The open space requirement for development that incorporates a passive water harvesting concept that is a primary component of stormwater management is twenty (20) percent of the total lot area.~~ The open space requirement for development that incorporates an active water harvesting and distribution system that is a primary component of stormwater management and that is a component of outdoor irrigation or suitably treated for indoor use is fifteen (15) percent of the total lot area. The credits shall be earned through the application of engineering calculations that are submitted as a part of the landscape plan and the ~~terrain~~ post-

[8] Now that a retention requirement is included as performance standard and IF THE RETENTION STANDARD THRESHOLD IS THE SAME AS FOR EXISING DRAINAGE REQUIREMENTS, incentive for passive harvesting may not be appropriate, however incentivizing ACTIVE harvesting could still be

construction stormwater management regulations provided in Section 14-8.2 ~~Terrain~~ Erosion Control and Post Construction Stormwater Management). The calculations shall show the percentage of water harvested and the estimated water conserved based on the required water budget provided in Section 14-8.4(E) Water Harvesting and Irrigation Standards; and

(b) the open space reduction shall not result in an increase in parking area.

(b) *Passive water harvesting* techniques include:

(i) surface collection, such as *swales*, parking *lot* islands, bar ditches, *detention* or *retention* ponds and constructed wetlands. *Detention* and *retention* ponds should be integrated *landscape* features, rather than single-purpose *flood* control ponds;

(ii) in-ground storage, such as soil amendments, constructed rain gardens, *French drains*, pumice wicks, permeable paving and collection *structures* with infiltration fields or galleries. In-ground *structures* shall use techniques and materials that have been proven effective, safe and structurally sound; and

(iii) low impact *development* and green *infrastructure* guidelines and techniques recommended by the Federal Environmental Protection Agency.

(~~c~~b) *Active water harvesting* systems include storage and distribution systems such as above-ground rain barrels and storage tanks and below-grade *cisterns* that use gravity or pumps to distribute water to an irrigation system;

(~~d~~c) *Active water harvesting* systems shall be maintained and the water used for *landscape* irrigation purposes. The *land use director* may inspect, test and monitor the components of *active water harvesting* systems, including tanks, pumps and controllers, as needed.

(2) Gray Water

Gray water irrigation is appropriate for some *landscape* installations. *Gray water* use is regulated by New Mexico department of environment liquid waste disposal regulations, which define minimum *lot* size and imposes other standards.

(3) Water Features

(a) *Water features*, are classified as high water use.

(b) The water surface area of the *water feature* shall not exceed twenty percent of the total allowable *cool season turf* area and shall be included in the total area of *cool season turf* allowed as specified in Subsection 14-8.4(F)(4).

(c) Water used in *water features* shall be re-circulated.

(d) The *water feature* shall be designed to prevent seepage and leaks.

(4) Irrigation Standards

Irrigation systems shall be provided for all *landscaped* areas. *Landscape* irrigation plans shall integrate *water harvesting* and stormwater management with the highest industry standards for efficient irrigation use. The *development* of alternative sources of irrigation water is recommended, including harvested water from *cistern* collection and *gray water*. Potable water irrigation may be used as a supplemental or temporary system. Irrigation designers and installers are encouraged to use the *City* Landscape Irrigation Systems Standards as a guide to minimum specifications for irrigation systems. All new irrigation systems and major renovation of existing systems shall comply with the following standards:

(a) a code-approved backflow prevention device is required for all irrigation systems connected to the *city* water system, including existing irrigation systems. Atmospheric vacuum breakers are the minimum required standard for above grade systems such as those connected to hose bibs and frost-free hydrants;

(b) an automatic, digital multi-programmable controller is required for all irrigation systems with an irrigated *landscaped* area larger than one thousand (1,000) square feet installed in commercial, industrial and multiple-*family residential development*.

(c) hand watering for commercial, industrial and multiple-*family* installations of less than one thousand (1,000) square feet of *landscaped* area is allowed. Shut-off nozzles are required on hoses used for hand watering;

(d) irrigation system operation information, including recommended monthly and seasonal irrigation schedules, and water budgets based on gallons used for *landscape* plantings for years one and three, shall be included on the irrigation plan or with attached documentation;

(e) irrigation systems shall be designed for the site-specific topography, site orientation, microclimate, prevailing winds and soil type so as to prevent runoff, minimize evaporation and promote infiltration;

(f) irrigation systems shall be designed to prevent water waste, over-watering and overspray or drainage of water onto any paved or unplanted surface;

(g) planting beds shall be *swaled, sloped* or recessed below grade to prevent *fugitive water*;

(h) irrigation systems shall be zoned by levels of water use. For the most efficient water use, plants with similar water use requirements shall be grouped together. Separate zones are required for permanent and temporary irrigation lines;

(i) overhead spray irrigation is prohibited for watering trees and shrubs, but is allowed for turf and ground cover plants and for temporary irrigation systems for revegetation with drought tolerant plant species. Spray irrigation is prohibited in areas where any dimension is less than ten (10) feet;

(j) temporary irrigation systems are allowed and encouraged in conjunction with the use of revegetation with drought tolerant plant material. Temporary irrigation systems shall be reviewed on a case-by-case basis and removed after the vegetation is established;

(k) turf, sod or grass seeding of *cool season turf* species shall not be planted on *slopes* greater than twenty-five percent or in areas where any dimension is less than ten (10) feet. Revegetation using temporary irrigation, with annual plant species used for *erosion* control to meet the requirements set forth in Section 14-8.2 (Terrain and Stormwater Management) is exempt from this restriction.

(F) Plant Material Standards

(1) Plant Material Selection

Plant material selection shall emphasize drought tolerant plant species and shall limit the use of high water use plant species. All required plant material shall be cold hardy to USDA Classification Zone 5 , which is minus fifteen degrees Fahrenheit, or colder.

(2) Installation

Required plant material shall be installed as follows:

(a) all required deciduous trees shall be two (2) inch *caliper* minimum;

(b) all required shrubs shall be five gallon minimum except as noted on the City of Santa Fe Recommended Plant List;

(c) all required evergreen trees shall be a minimum of six (6) feet in height.

(d) when more than ten trees are required by this Section 14-8.4, more than one species shall be provided unless otherwise approved by the *land use director*;

(e) stormwater *detention ponds* and *retention ponds* shall be planted with appropriate trees, shrubs and grasses ,with a minimum of one tree and three shrubs per five hundred (500) square feet of required ponding area. Plants located in the bottom third of the *detention pond* or *retention pond* must be adaptable to periods of submersion and may require replacement during periodic maintenance to remove silt;

(f) any plant material required by this Section 14-8.4 that fails to show healthy growth due to damage, pest, disease or neglect shall be promptly replaced with a similar plant;

(g) required new plant material shall be protected from damage by vehicles;

(h) new plant material shall be *mulched* to a minimum depth of two (2) inches and the *mulch* renewed yearly or as needed. *Mulch* may be of organic or inorganic material.

(i) plastic sheeting is not permitted as weed barrier; and

(j) the *owner* shall properly maintain all materials and installation required by this Section 14-8.4, including proper pruning, soil testing, fertilizing and weeding.

(3) Controlled or Prohibited Plant Materials

(a) Turf grass sod or turf grass seed mixes installed within the city limits shall contain no more than twenty-five percent Kentucky Bluegrass.

(b) Russian Olive (Elaeagnus angustifolia) and Salt Cedar (Tamarix spp) shall not be sold or installed within the city limits.

(4) Turf Limitations

Warm season grasses are recommended for most turf applications. The installation of *cool season turf* grasses is discouraged, as they require greater quantities of irrigation water. Refer to the City of Santa Fe Recommended Plant List for specific information on grass species. *Cool season turf* shall be limited to areas with relatively low evaporation from wind and heat or in locations used for active or *passive recreational use*. The total area of *cool season turf* shall be limited as follows:

(a) s*ingle-family dwelling units* shall not have *cool season turf* in excess of one thousand (1,000) square feet or ten percent of the total *lot* area, whichever is less;

(b) multiple-*family residential developments* shall not have *cool season turf* in excess of twenty per cent of the required *common open space*;

(c) industrial and *commercial developments* shall not have *cool season turf* in excess of one thousand (1,000) square feet or three percent of the required *open space*, whichever is greater; and

(d) public parks and *commercial recreational uses* are exempt from this restriction, but shall install only the minimum *cool season turf* required for the active recreational use.

(5) Preservation of Existing Vegetation

(Ord. No. 2014-31 § 30)

(a) The *land use director* may require the preservation, relocation or replacement of existing *significant trees* as provided in Subsection 14-8.4(B), except that the public works director may determine the requirements for *significant trees* located within *public right-of-way*, within *city* parks or on other land owned by the *city*. Determinations shall be made in accordance with the following criteria:

(i) priority is given to preserving *significant trees* that provide *screening*, buffering, wildlife habitat or linkages to wildlife habitat;

(ii) *significant trees* that are to be preserved or relocated shall be healthy and free from serious insect or parasite infestation;

(iii) *significant trees* to be relocated shall be selected from areas with adequate soil conditions for successful relocation;

(iv) the recommended season for relocation of piñon (Pinus edulis) trees is September 15 to May 15;

(v) if relocation of existing *significant trees* is not possible within these guidelines, then equivalent plant material shall be provided. Replacement evergreen trees shall be six (6) feet tall or taller, replacement deciduous trees shall be two (2) inches *caliper* or greater; and

(vi) relocated or replacement trees shall be irrigated until they are established.

(b) A minimum of forty percent of piñon *significant trees* shall be preserved, relocated on site or replaced as specified in this Section 14-8.4. Piñon trees that are preserved or relocated on site and are a minimum of eight (8) feet tall shall substitute for two trees required elsewhere in this Section 14-8.4.

(c) No existing deciduous tree with a six (6) inch *caliper* or greater or evergreen tree over eight (8) feet tall shall be removed without the approval of the *land use director* or public works director as provided in Subsection (F)(5)(a) above. Trees classified by the New Mexico department of agriculture as *noxious weeds* that are smaller than a twelve (12) inch *caliper* are exempt from this review, including Russian olive (Elaeagnus angustifolia), Siberian elm (Ulmus pumila), tree of heaven (Ailanthus altissisima) and salt cedar (Tamarix species).

(d) During construction, existing plant material to be preserved shall be enclosed by a temporary fence at least five (5) feet outside the dripline. In no case shall vehicles be parked or materials or equipment be stored or stockpiled within the enclosed area.

(e) All areas with exposed soil surfaces disturbed by construction shall be revegetated to minimize *erosion* and stormwater runoff and to improve the infiltration of precipitation.

(f) Destroyed vegetation shall be removed promptly to prevent insect infestation of healthy vegetation.

(g) The preservation of plant species classified as *noxious weeds* is discouraged.

(h) Topsoil removed during construction shall be stockpiled on site and reused on site in *landscaped* areas or areas to be revegetated. Stockpile protection shall be used consistent with the requirements found in Subsection 14-8.2(D.

(G) Street Tree Standards

(1) *Street trees* are required to reduce heat, dust, *glare* and the need for cooling or heating; to help clean and oxygenate the air; to reduce road noise; to promote continuity between *developments*; and to enhance the appearance of Santa Fe's *streets*. Consideration should be given to urban density, historic or vernacular character of the location; continuity with native vegetation and the natural *landscape*; and the ability to provide water for irrigation.

(2) Required *street trees* do not substitute for required *landscape* material in parking *lots*, except as provided in Subsection 14-8.4(I)(2) (Parking Lots – Perimeter Screening). *Street trees* shall be located as follows:

(a) on major and secondary arterials, one tree an average of every thirty (30) to forty (40) feet;

(b) on all other *streets*, one tree an average of every twenty-five (25) to thirty-five (35) feet; and

(c) where *street trees* or *planting strips* are required but not practical, the equivalent area in square feet and amount of plant material may be provided elsewhere on the site, with approval of the *land use director* and based on existing conditions or design intent.

(3) Location of Street Trees:

(Ord. No. 2013-16 § 48; Ord. No. 2014-31 § 31)

(a) on streets, other than major and secondary arterials, *street trees* shall be located on the subject *property* adjacent to the *property* line or within the *right of way* as approved by the planning commission or the public works director. *Street trees* located within the *right of way* shall be planted in compliance with Chapter 23 SFCC 1987 Streets, Sidewalks and Public Places and in compliance with adopted median and *parkway* standards;

(b) on major and secondary arterials, trees shall be planted in a minimum ten (10) foot wide *parkway* that includes the width of the sidewalk or other pedestrian way. If existing *development* precludes provision of the ten (10) foot wide *parkway*, trees shall be planted in a space no smaller than five (5) feet by thirteen (13) feet and preferably multiple trees in longer *planting strips*;

(c) *street trees* should be planted to the greatest extent possible in *swales* or basins that collect run-off and precipitation;

(d) *street trees* shall be located at least fifteen (15) feet from light standards, so as not to impede outdoor illumination;

(e) *street trees* shall be located at least fifteen (15) feet from fire hydrants so as not to interfere with hydrant operation;

(f) *street trees* located under utility lines shall be a species that maintains a minimum of five (5) feet of clearance from overhead utility lines at maturity; and

(g) *street trees* shall not be required on single-*family residential lots*.

(H) Open Space Planting Requirements

(Ord. No. 2014-31 § 32)

(1) Required *open space* shall be planted with a minimum of one tree and two shrubs every five hundred (500) square feet, exclusive of areas developed with patios, game courts, swimming pools or similar hardscape recreational features.

(2) In addition to required trees and shrubs, *open space* areas shall be *landscaped* with groundcover plants or decorative *mulch* or naturally occurring groundcover plants shall be maintained.

(3) *Street trees* and *landscaping* required for parking *lots* may be counted toward meeting the minimum planting requirements for *open space*.

(4) At least twenty-five percent of required trees and shrubs shall be evergreen. Existing trees and shrubs shall be accepted for required *landscaping* if they otherwise meet the requirements of this Section 14-8.4.

(5) Areas used to comply with the stormwater management requirements found in Subsection 14-8.2(D)(4) may be counted toward meeting the minimum planting requirements for *open space*.

(I) Parking Lots

(1) Purpose and General Requirements

Parking *lots* are transitional spaces where users change modes of travel from car, bus or bicycle to pedestrian or assisted movement in wheel chairs or by other means. Parking *lots* shall safely and attractively serve all transportation modes, especially pedestrian. Parking *lots* shall complement and define the *buildings* they serve by the use of roadways, pedestrian ways and interior *landscaping* to emphasize *open space, building* entrances and other site or architectural elements. Parking *lots* shall use stormwater *harvesting* in parking *lot* islands and perimeter *screening* strips to reduce the use of potable water irrigation.

(2) Perimeter Screening

(Ord. No. 2014-31 § 33)

(a) When three or more *off-street parking* spaces are required, perimeter *screening* shall be provided. The purpose of perimeter *screening* of parking *lots* is to define parking areas, mitigate the view of cars and pavement, help direct traffic flow, provide continuity to *streetscapes*, ~~and~~ obtain the environmental benefits of increased planting and reduce and control stormwater runoff.

(b) in commercial districts, wherever there is a parking *lot* for more than three motor vehicles and any part of the parking *lot* is within twenty-five (25) feet of a *residential* area and not separated by a *public right of way*, a solid masonry *wall* not less than four (4) feet in height shall be erected between the parking *lot* and the *residential* district boundaries.

(c) The parking *lot* shall be *screened* from all public *streets* and adjacent *properties* by a continuous *wall* or berm four (4) feet or more in height, a hedge a minimum four (4) feet high at maturity, other vegetative *screening* appropriate to the *landscape design intent* or any combination of these so long as the *screening* objective is achieved. Topography and adjacent uses shall be taken into account to determine the most effective means of *screening*. Screening areas may be used to meet the stormwater management requirements found in Subsection 14-8.2(D)(4).

(d) A continuous *planting strip* must be provided where a parking *lot* abuts or occupies a *street yard*. The *planting* strip must be at least five (5) feet wide. Trees shall be planted an average of twenty-five (25) feet on center, in an area with a minimum dimension of five (5) feet and containing a minimum of seventy-five (75) square feet of permeable surface exclusive of curbing. Street trees may be counted toward the tree planting requirement of this Subsection (I)(2)(d). *Planting strips* may be used to meet the stormwater management requirements found in Subsection 14-8.2(D)(4).

(3) Interior Parking Lot Landscape Requirements

(Ord. No. 2014-31 § 34)

(a) The purpose of interior planting requirements in parking *lots* is to provide visual relief from large expanses of cars and pavement, provide shade to reduce heat and *glare*, help direct traffic flow and reduce and control stormwater runoff.

(b) When ~~forty~~ twenty-five[9] or more *off-street parking* spaces are provided, interior *lot landscaping* shall be provided.

[9] Lowering threshold for interior islands will provide more opportunities for passive harvesting to meet retention performance standard while getting other benefits of islands, i.e. shade, pedestrian safety, etc. ALB requires tree for every 10 spaces regardless of parking lot size.

(c) No single parking area shall exceed one hundred twenty spaces unless divided into two or more subareas by an internal *landscaped street* or *landscaped* pedestrian way that is a minimum ten (10) feet wide.

(d) A minimum of ten (10) square feet of permeable *landscaped* area shall be provided per parking space. A minimum of one deciduous tree shall be planted per ninety (90) square feet of *landscaped* area.

(e) Traffic islands shall have a minimum dimension of six (6) feet and contain a minimum of ninety (90) square feet of permeable surface, exclusive of curbing, and shall be distributed throughout the *lot*. As a component of a stormwater management plan, traffic islands may be combined to facilitate *water harvesting* and these combined islands shall be distributed within each subarea.

(f) No more than twenty cars shall be parked in a row without a planting island adjacent to the length of the parking space having a minimum area of ninety (90) square feet, and including at least one tree.

(4) Stormwater Management

(a) Stormwater runoff shall be used to provide irrigation for the perimeter and interior plantings to the greatest extent possible.

(b) Stormwater runoff water shall be harvested and infiltrated as close to where it falls as possible.

(c) The consolidation of planting islands is allowed to facilitate stormwater *harvesting* and promote plant growth. The consolidated planting islands shall be distributed in each subarea.

~~(d) The use of *biofiltration* techniques such as *constructed rain gardens* to filter pollutants carried by runoff and infiltrate stormwater for irrigation is recommended.~~

(5) Pedestrian Circulation

(Ord. No. 2014-31 § 35)

When forty *off-street parking* spaces are provided, sidewalks for primary pedestrian routes shall be provided. At a minimum this includes pedestrian ways from the primary off-site entrance or entrances to the primary building entrance or entrances.

(a) All pedestrian ways shall be *landscaped* with a minimum six (6) foot wide *planting strip* on at least one side, exclusive of curbs, and trees an average of twenty-five (25) feet on center, parallel to and adjacent to the walkway.

(b) If the *planting strip* abuts a row of parking, the tree planting areas may be included in the interior *lot landscape* requirements.

(6) Vehicle Overhangs

Vehicles may not overhang the minimum required *landscaped* area unless the following conditions are met, in which case adjacent parking spaces may also be reduced by the amount of the overhang:

(a) the planting islands have a minimum depth of five (5) feet plus the amount of the overhang for each side of parking, exclusive of curbing, as defined in Section 14-8.6 (Off-Street Parking and Loading);

(b) either curbing or wheel stops are provided; and

(c) plant material is located outside the overhang area or is no greater than twelve (12) inches in height at maturity;

(7) Compliance

Projects that do not require an increase in existing parking are not required to eliminate parking spaces to comply with the requirements of this Section 14-8.4. Projects that require an increase in existing parking are required to comply with the requirements of this Section 14-8.4.

(8) Display Lots and Flea Markets

Display *lots* and *flea markets* are exempt from interior pedestrian circulation requirements, but are required to include interior *landscape* islands or *swales* for stormwater management. Such islands shall be planted with one deciduous tree per one thousand (1,000) square feet of *impervious* surface area.

(J) Screening and Buffering

(1) Wall and Fences

For any project to which this Subsection 14-8.4(J) applies, publicly visible *walls* and fences shall be wrought iron or simulated wrought iron, wood or simulated wood, cedar pole, *adobe*, split-faced concrete block, stone, stuccoed or rectangular mesh wire on wooden posts in combination with vines or other climbing plant material.

(2) Residential Developments

(a) (Ord. No. 2014-31 § 36) *Residential development* on *residentially zoned property* that abuts major or secondary arterials shall be screened from those *streets* to mitigate noise and to promote *residential* privacy as follows:

(i) *Screening* shall be by *walls*, fences, the planting of trees and shrubs or a combination of these.

(ii) The provision of plant material shall, at a minimum, conform to the same requirements as for *open space* in Subsection 14-8.4(H) (Open Space Planting Requirements). Screening areas may be used to meet the stormwater management requirements found in Subsection 14-8.2(D)(4).

(iii) An alternative to *screening* shall be a twenty-five (25) foot *setback* of undisturbed trees, shrubs, grasses or *landscape treatment* consisting of appropriate vegetative cover.

(b) Walls and fences that are provided as subdivision improvements for a *residential* subdivision or at the time of initial *development* of a multi-*family residential development* comprising four or more *lots* or units, shall comply with the following:

(i) Any wall or fence that is more than three (3) feet in height above finished grade on the side facing the *street*, shall be set back from the *street right of way* line a distance equal to or greater than that height.

(ii) The setback area required by Subsection (b)(i) shall be *landscaped* with plant material that consists of predominantly thorny or other barrier plantings that will cover a minimum of seventy-five percent of the ground area of the planter and that will screen a minimum of seventy-five percent of the face of the fence or wall at maturity.

(iii) This Subsection (2)(b) does not apply within historic districts or to *residential developments* approved prior to March 1, 2012.

(iv) This Subsection (2)(b) does not apply to construction of walls or fences on individual *lots* with single-*family* dwellings subsequent to the initial construction of walls or fences as subdivision improvements.

(3) Buffer for Nonresidential Development Abutting Residential

(Ord. No. 2014-31 § 37)

(a) *Nonresidential development* that abuts a *residential development* on a *residentially zoned property* or an undeveloped *parcel* in a *residential* zoning district shall provide a continuous *landscaped* buffer strip not less than fifteen (15) feet wide.

(b) Plant material in the *landscaped* buffer shall, at a minimum, conform to the requirements for *open space* provided in Subsection 14-8.4(H).

(c) The *landscaped* buffer may be considered part of any required *open space* so long as all other conditions of the *open space* requirement are satisfied. Screening areas may be used to meet the stormwater management requirements found in Subsection 14-8.2(D)(4).

(4) Storage, Trash and Equipment

(a) All trash areas, dumpsters, outdoor storage, service areas, ground and wall-mounted mechanical and electrical equipment, excluding transformers, and pedestals shall be *screened* so that they are not substantially visible from any public *street*, way or *place* or any adjacent *residential property*.

(b) *Screening* shall be by *walls*, fences or planting of trees or shrubs sufficient to meet the *screening* objective within two years of installation, or any combination of these so long as the *screening* objective is achieved. Topography and adjacent uses shall be taken into account to determine the most effective means of *screening*. Screening areas may be used to meet the stormwater management requirements found in Subsection 14-8.2(D)(4).

(c) All trash areas, dumpsters, grease collection areas, outdoor storage, service areas and other uses that may contribute to stormwater pollution shall be constructed so as not to allow pollutants to be collected in runoff and discharged to the public stormwater system. Topography, adjacent uses and constructed barriers and stormwater treatment controls shall be taken into account and incorporated into the site design to provide the most effective means of preventing stormwater pollution.

14-8.5 WALLS AND FENCES

(Ord. No. 2011-37 § 10)

(A) Applicability

(1) The retaining *wall* height standards in this Section 14.8.5 apply to the portion of a *wall*, fence or similar *structure* that supports a higher finished grade on one side than on the other. The height of the retaining *wall* is measured from the finished grade at the base of the *wall* to the finished grade at the top of the *wall*. (Ord. No. 2012-11 § 22)

(2) The fence height standards in this Section 14-8.5 apply to fences, screen *walls* and similar *structures*, and hedges. Railings or similar barriers required by building or other codes to protect against falling hazards are exempt when built to the minimum height required by those codes and when constructed to maximize transparency. Fence height is measured from the finished grade at the base of the fence, excluding the height of any retaining *wall* upon which it is built.

(3) Additional regulations may apply to *walls* and fences, including Section 14-5.2 (Historic Districts), Section 14-5.4(A)(4) (South Central Highway Corridor Overlay District Standards) and Section 14-7.1(F) (Visibility at Driveways and Yards). If those or other provisions of Chapter 14 conflict with the requirements of this Section 14-8.5, conflicts shall be resolved pursuant to Section 14-1.7 (Conflicting Provisions).

(B) Maximum Height of Retaining Walls and Fences

(1) Maximum Height of Retaining Walls

(a) No retaining *wall* shall exceed six (6) feet in height.

(b) Retaining *walls* shall be stepped or terraced so that they are separated by a distance equal to the height of the higher *wall*.

(2) Maximum Height of Fences

(Ord. No. 2013-16 § 49)

(a) On a property developed for *residential* use or on undeveloped property zoned for *residential* use, no fence shall exceed six (6) feet in height except that:

(i) along the common *property* line with a *property* developed for or zoned for *nonresidential* use, the maximum height of fences is eight (8) feet; and

(ii) within a *residential compound*, the maximum height of fences is eight (8) feet.

(b) On a *property* developed for *nonresidentia*l use or on undeveloped *property* zoned for *nonresidential* use, no fence shall exceed eight (8) feet in height.

(c) *Walls* and fences may exceed the height limit over pedestrian or vehicular gates.

(3) Maximum Height of Fences Built on Retaining Walls

In addition to the height limits in Subsections 14-8.5(B)(1) and (2), the combined height of a fence built on a retaining *wall* shall not exceed the maximum fence height plus four (4) feet as measured above the finished grade on the downslopeside.

(C) Additional Fence Regulations for Specified Nonresidential Uses

(1) For neighborhood grocery stores or laundromats catering to local pedestrian trade in a *residential* district, there must be a solid masonry *wall* not less than six (6) feet in height erected along side and rear *lot* lines with adjoining *residential lots*.

(2) For a parking *lot* contiguous to a *residential* district or one or more of the RAC, AC, SC or I districts, a six (6) foot solid masonry *wall* shall be erected along edges of portions of the parking *lot* adjoining *property* in the *residential* district; provided, however, that in the *front required yard*, the maximum height of a *wall* or fence shall be three (3) feet.

(3) In *outdoor storage* yards or *salvage yards*, a solid *wall o*r fence at least six (6) feet in height, with access only through solid gates that are kept closed when not in use, shall be erected around the entire yard. No object shall be stacked or stored higher than the minimum height of the enclosing *wall* or fence.

14-8.6 OFF-STREET PARKING AND LOADING

(Ord. No. 2011-37 § 10; Ord. No. 2012-11 §23)

(A) Specific Parking Requirements

The minimum number of *off-street parking* spaces shall be provided in accordance with Table 14-8.6-1 Parking and Loading Requirements. [Editor's Note: Table is Exhibit A located in the Appendix following Section 14-12.]

(B) Standards for Off-Street Parking Spaces and Parking Lots

(1) General Standards

(Ord. No. 2014-4; Ord. No. 2014-31 § 38)

All *off-street parking* spaces and *lots* shall meet the standards set forth in this Subsection 14-8.6(B) and any additional standards shown on an approved site plan:

(a) they shall be designed, maintained and regulated so that no parking or maneuvering incidental to parking shall be on any *street*, walk or alley; provided that the public works director may approve parking *lots* serving one or two *dwelling units* and comprising four or fewer parking spaces designed to allow vehicles to back onto a *street* classified as a subcollector or lane, onto a walk or alley, or in exceptional circumstances onto a *street* classified as an arterial or collector;

(b) they shall be designed so that vehicles may be removed without moving another vehicle except in attended *lots*, or *single-family dwellings* where not more than two spaces assigned for use to the same *dwelling unit* may be arranged in tandem;

(c) they shall have barriers that prevent vehicles from extending over the public sidewalks, abutting *lots* or the minimum required *landscaped* area, and that prevent vehicles from obstructing *building* entries and ADA accessible routes;

(d) they shall be designed to discourage parking *lot* traffic from accessing directly onto major arterial *streets*, unless no reasonable alternative is available;

(e) they shall be appropriately marked to indicate the location of the spaces;

(f) they shall be surfaced with concrete, asphalt, paving blocks, brick, other similar impervious materials or pervious surfacing systems which are intended for outdoor motor vehicle use. The use of gravel, slag, or cinder shall be prohibited. The permeable surfacing system shall be designed to meet the requirements of the *city engineer* and shall be installed and maintained according to manufacturer's specifications.

(~~f~~g) if they are required parking spaces, they shall be available at all times for parking the personal vehicles of *employees* and customers or residents and guests for which the spaces are required. Required parking spaces shall be unobstructed and shall not be used for storage, display, sales or parking of commercial or other vehicles used by *employees* in the conduct of the use for which the spaces are required, unless an itinerant vending *permit* or special use *permit* has been issued. Required *off-street loading spaces* shall not be included as *off-street parking* spaces in the computation of required *off-street parking*.

(gh) To the extent feasible, driveway or parking lot aisles shall not direct vehicle traffic toward a primary pedestrian entryway to a *nonresidential* or *multiple family residential building*.

(i) A driveway or parking lot aisle that is oriented toward a primary pedestrian entryway to a *nonresidential* or *multiple family residential building* shall have bollards or other safety barriers that prevent accidental vehicle collisions with the entryway and pedestrians in front of the entryway.

(ii) Compliance with the provisions of this Subsection 14-8.6(B)(1)(g) is required for the types of *projects* identified in Subsection 14-8.4(B)(1) Landscape and Site Design Applicability. For additions or *remodeling projects* as described in Subsection 14-8.4(B)(1)(d)(ii), the total cost for required safety barriers shall not exceed twenty percent of the *project's* construction valuation, in addition to the cost of *landscape* improvements.

(2) Parking Space Requirements

(a) Required parking spaces shall be arranged and constructed in accordance with parking and driveway standards contained in Illustrations 14-8.6-1, 2 and 3. [Editor's Note: Illustrations are Exhibit B Illustrations of Parking Space Layout and Dimensional Standards located in the Appendix following Section 14-12.].

(b) No required *off-street parking* space shall be located within the *right-of-way* of any *street,* roadway or public alley.

(c) Calculations of the number of spaces required shall be rounded up to the next whole number.

(3) Changes in Use

(a) When the type or *intensity* of use of any *building*, *structure* or *premises* is increased by any means, including through addition of *dwelling units*, *gross floor area* or seating capacity, *off-street parking* shall be supplemented to accommodate the intensified use. Likewise, if the type or intensity is decreased by any means, off-street parking may be reduced by approval of the *land use director*. [10]

(b) For a use that is *legally nonconforming* with regard to the number of parking spaces provided, the number of spaces that are lacking may be subtracted from the number of required *off-street parking* spaces for a new use at the same location so that the degree of nonconformity is maintained but is not increased.

[10] This will be necessary if fee structure is changed to impervious cover-based.

(4) Combined Uses; Shared Parking (Ord. No. 2016-39 § 5)

(a) Combined uses on the same *premises* shall provide the combined total number of spaces required for each use separately, unless a shared parking plan is approved.

(b) Uses on *premises* comprising more than one *legal lot of record* may provide shared parking in accordance with an approved shared parking plan.

(c) Parking required for uses located on adjoining *lots* in RAC, C, BCD, BIP, MU, SC or I districts, for institutional uses located on adjoining *lots* in *residential* districts, or for a *qualifying project* within the Midtown LINC Overlay District, may be provided on a joint basis. Within the joint parking areas, the spaces required for each of the participating uses shall be marked on the parking plan and maintained as allocated to the individual use, unless a shared parking plan is approved. (Ord. No. 2013-16 § 50)

(d) Cumulative parking space requirements for *mixed-use* occupancies or adjoining *mixed uses* may be reduced if the *applicant* demonstrates that the peak requirements of the several occupancies occur at different times, such as mid-day for office uses and evening for *residential* uses, as supported by a parking demand study.

(e) Reduction in the total number of spaces required by the addition of all uses in the BCD or as specified in Subsection 14-8.6(A) may be approved by a *land use board* pursuant to a special use *permit* or *development* plan if the reduction is supported by a parking demand study.

(f) Reduction in the total number of spaces required by this Section 14-8.6 for *qualifying projects* within the Midtown LINC Overlay District shall be approved by the *land use director* pursuant to Subsection 14-3.8(B)(9) if the reduction is supported by a parking demand study prepared by the *qualifying project applicant*. In addition to the shared parking provisions of this Subsection, the total number of spaces required as determined by a shared parking plan or parking demand study may be reduced by the number of on-street parking spaces present in the Midtown LINC Overlay District adjacent to a *qualifying project*.

(5) Parking Spaces Designated for Persons with Disabilities

Parking *lots* shall comply with applicable standards for provision of parking spaces designated for persons with disabilities contained in construction codes adopted pursuant to Chapter 7 SFCC 1987 (Building and Housing) and pursuant to New Mexico laws and regulations, including standards for compliance with the federal Americans with Disabilities Act.

(6) Parking Structures

(a) Parking *structures* shall have architecturally compatible, articulated *façades* designed to screen the view of parked vehicles from all floors above the ground floor except on *façades* abutting an alley.

(b) In a MU district, if eighty percent of the ground floor of any side of an above-grade parking *structure* is adjacent to a public *street*, except an alley, or adjacent to a public *open space* or plaza, it shall be constructed to an adequate depth to allow future occupancy by a *commercial* or other non-parking permitted use allowed in the MU district.

(7) Reduction of Parking Requirements for Transit Facility

The off-street parking requirements set forth in Subsection 14-8.6(B) may be reduced up to five percent if the property owner enters into an agreement with the City wherein the property owner grants the City the right to use a portion of the property for a City transit facility.

(a) Whether or not the site is a suitable location for a transit facility is at the sole discretion of the City.

(b) The amount of reduction and the terms of the agreement shall be subject to review and recommendation by the Land Use Department, the Transit Division and the City Attorney's Office and shall be based upon the City's specific transit needs at the site, the anticipated reduction in parking demand due to the facility and specific characteristics and considerations of the site.

(c) The agreement may be in the form of an easement, dedication or long term lease approved by the Governing Body.

…

(F) Procedures for Securing Approval

(1) Applications; Parking Plan

Applications for construction *permits*, special use *permits*, *development* plans or other *development* approvals shall include parking plans that show compliance with applicable requirements of this Section 14-8.6, adopted parking and driveway standards and other applicable provisions of Chapter 14 as required by the *land use director*. The *applicant* shall also obtain any access *permits* required by Chapter 23 SFCC 1987 (Streets, Highways and Public Places) or required by *state* or federal law or regulation.

(2) Review of Plans

Parking plans, including shared parking plans, shall be reviewed by the *land use director* for compliance with this Section 14-8.6.

(3) Special Provisions for Shared Parking Plans

(a) An *application* for a shared parking plan shall contain a parking demand study or other information required by the *land use director* and shall include plans showing the proposed shared parking facilities in relation to the uses for which they are to be provided.

(b) Pursuant to the same procedure and subject to the same limitations and requirements by which the shared parking plan is approved, a shared parking plan may be amended or withdrawn, either partially or completely, if all land and *structures* remaining under the special plan and if all land and *structures* withdrawn from the shared parking plan comply with the provisions of this article.

(c) Upon approval of a shared parking plan, a copy of the plan shall be recorded in the office of the *county* clerk and its contents shall:

(i) be binding upon the *applicants*, their heirs, successors and assigns;

(ii) limit and control the issuance and validity of all construction *permits* and certificates; and

(iii) restrict and limit the use and operation of all land and *structures* included within the shared-use plan to conditions and limitations specified in the plan.

25-2.7 OUTDOOR CONSERVATION.

A. Outdoor Irrigating Periods. Outdoor irrigation is prohibited between 10:00 a.m. and 6:00 p.m. from May 1 through October 31. It is recommended that outdoor irrigation be limited to no more than three (3) days per week, recognizing that low-water use plants and native vegetation require less irrigation. The use of grey water meeting applicable standards or water harvested from precipitation is encouraged.

B. Exemptions:

(1) Nursery stock. Plants being irrigated for retail or wholesale sale are exempt from paragraph A, above.

(2) Licensed landscape maintenance and contracting companies. All manual watering by landscape maintenance and contracting companies licensed with the state of New Mexico construction industries division and registered with the city of Santa Fe business registration unit are exempt from paragraph A, above. Landscape companies setting timed irrigation systems shall ensure that the systems comply with paragraph A.

(3) Acequias. Irrigation from acequias is exempt from paragraph A, above.

C. Potable Water Use for Certain Construction and Landscaping Purposes. For those construction and landscaping purposes permitted by the New Mexico environment department to use treated wastewater, potable water use from a fire hydrant is prohibited. Treated wastewater from the city's effluent fill station or other facility shall be used for such purposes.

D. Swimming Pools. Swimming pools located outside shall be covered when not in use. Kiddy pools less than twelve (12") inches in depth and less than five (5') feet in diameter are exempt from this provision.

E. Vehicle Washing: All manual car washing shall use a hose equipped with a positive shut-off nozzle.

(1) All vehicle washing at residences is limited to once-per month per vehicle; and

(2) Commercial car sale lots and other commercial and governmental entities with on-site vehicle washing facilities are limited to washing each vehicle one (1) time per month unless there is a demonstrated public health or safety reason for more frequent washings. Commercial car sale lots shall be allowed to wash cars at time of sale and prior to placing in a showroom.

F. Hard Surface Cleaning. Using water to clean hard surfaces with a hose or power washer, including but not limited to, the cleaning of tennis courts, sidewalks, driveways, walls, parking areas and outdoor eating areas is prohibited except to prevent or abate public health, safety or accident hazards when alternative methods are not available.

G. Turf. The planting of cool season grass is strongly discouraged. For further restrictions see subsection 14-8.4(F)(4) SFCC 1987.

H. Authority to Permit Exceptions. The city water division director has the authority to permit exceptions to this subsection provided the water conservation objective is not compromised.

(Ord. #1997-17, §8; Ord. #2001-34, §4; Ord. #2003-12, §1; Ord. #2006-53, §7)

25-2.11 OTHER WATER CONSERVATION PROGRAMS.

The governing body may adopt other water conservation programs, including but not limited to, rebates or vouchers for water saving devices. Such programs shall be adopted by resolution and shall not exceed funds allocated by the governing body each fiscal year. No water user shall be eligible for both a rebate or voucher and a retrofit credit for any specific water saving device. (Ord. #2003-29, §2)

ARTICLE 14-9: INFRASTRUCTURE DESIGN, IMPROVEMENT, AND DEDICATION STANDARDS

(Ord. No. 2011-37 § 12)

14-9.1 GENERAL PURPOSE AND APPLICABILITY

(A) Purpose

The provisions of this article are intended to:

(1) ensure that improvements to city infrastructure that are necessary to directly serve specific new development projects are coordinated with the occurrence of that development;

(2) ensure that infrastructure is constructed in accordance with applicable provisions of Chapter 14;

(3) ensure that infrastructure is constructed in a manner that is consistent with applicable provisions of adopted policies, including the general plan; and

(4) coordinate the provision of infrastructure that directly serves specific new development projects with the provision of facilities needed to remedy existing deficiencies and with the provision of facilities that are subject to impact fees as provided in Section 14-8.14.

(B) Applicability

All developments approved pursuant to the provisions of Chapter 14 must dedicate land and easements and must construct, or provide funding for the city to construct, the public and quasi-public infrastructure improvements required by Chapter 14 to address effects on existing and new infrastructure that serves the new development, including:

(1) fire hydrants, fire lanes, emergency access roads and access gates as required by Chapter 12 SFCC 1987 (Fire Prevention and Protection);

(2) streets, curbs, gutters, sidewalks, signing, striping, traffic control devices and street lighting consistent with the standards in this article and Chapter 23 SFCC 1987 (Streets, Sidewalks and Public Places);

(3) grading and retaining walls within the right-of-way and adjacent to the right of way;

(4) fences, walls and landscaping required for screening facilities from public view as required by Articles 14-7 (Building Envelope and Open Space Standards and Measurements) and 14-8 (Development and Design Standards);

(5) solid waste enclosures required by Section 21-4 SFCC 1987 (Refuse Collection);

(6) landscaping, irrigation, stormwater control measures and other improvements to common open space required by Articles 14-7 and 14-8;

(7) drainage or other stormwater management facilities necessary to comply with Sections 14-8.2 (~~Terrain~~ Erosion Control and Post Construction Stormwater Management) and 14-8.3 (Flood Regulations) and Chapter 13 SFCC 1987 (Stormwater Utility);

(8) connections to and extensions of sewer mains as provided in Chapter 22 SFCC 1987 (Sewers);

(9) connections to and extensions of water mains as provided in Chapter 25 SFCC 1987 (Water);

(10) parks, trails and other facilities required by Section 14-8.15 (Dedication and Development of Land for Parks, Open Space, Trails and Recreational Facilities);

(11) other required utilities, including natural gas and electricity; and

(12) other improvements determined to be necessary in accordance with written policies of the land use director.

…

14-9.2 STREET IMPROVEMENT AND DESIGN STANDARDS

…

(C) Street Design Engineering Standards

(1) Public and private streets and lot access driveways shall be designed and constructed in accordance with the provisions of this chapter; Chapter 12 SFCC (Fire Prevention and Protection) and any engineering standards adopted pursuant to this chapter.

(2) Where no specific standard has been adopted, streets shall be designed in accordance with applicable standards adopted by national engineering organizations such as the American Association of State Highway and Transportation Officials and the Institute of Transportation Engineers.

(3) Where no specific standard has been adopted, construction must comply with the current edition of the "New Mexico Department of Transportation Standard Specifications for Road and Bridge Construction."

(4) A private street built and subsequently proposed to be dedicated to the city must meet all applicable public street standards set forth in this Section 14-9.2.

(5) The city shall not maintain private streets.

(6) Following are specific construction and engineering standards:

(a) each street shall terminate in a cul-de-sac or other approved turnaround, except where the planning commission or summary committee requires a street to be stubbed out at a property boundary in anticipation of future extension;

(b) property lines at street intersections shall be rounded with a radius of ten feet, or a greater radius when necessary to allow the construction of a curb having a desirable radius. Sidewalks may not be curtailed at street corners to less than normal width. The planning commission may allow comparable cutoffs or chords in place of rounded corners;

(c) new streets shall be dedicated and improved to the full width for which they are planned, except where a land use board or the governing body determines that an interim width or level of improvements provides safe and adequate service as part of an enforceable plan for the phased completion of the improvements;

(d) when a tract to be developed borders an existing street having a right-of-way width insufficient to conform to the minimum width standards required by these regulations, the necessary additional right-of-way shall be platted and dedicated in such a way to make the resulting street conform;

(e) street names shall not duplicate or be so similar as to be confusing with existing street names. Where a proposed street is to be a continuation of an existing named street, the proposed street shall have the name of the existing street. Street names must be approved by the planning commission;

(f) curbs at intersections shall be designed with a minimum radius of twenty-five (25) feet. The planning commission may approve a smaller radius;

(g) in areas zoned for residential development, planting strips are required between the edge of pavement and the edge of the required sidewalks. Planting strips must have a width of not less than five (5) feet;

(h) the planning commission may approve street access to adjoining property, requiring proposed streets to be extended by dedication to the boundary of that property. Such streets shall be improved in the same manner as prescribed for other streets in the development; and

(i) street grades shall not exceed the following, with allowances for vertical curves:

(i) major and secondary arterial streets or highways, six percent;

(ii) collector and subcollector streets, ten percent;

(iii) lanes, fifteen percent except when a lesser grade is required by the fire marshal pursuant to fire apparatus access road standards; and

(iv) no street grade shall be less than one half of one percent.

(7) All new streets must be paved either with asphalt or an approved permeable surfacing system; provided, however, that the planning commission may approve gravel surfaces for roadways classified as private lanes or shared private driveways if it finds, based on substantial evidence, that:

(a) vegetation or topographical maps or other evidence shows that dust from the roadways will not be a problem for residents living next to the roadway;

(b) the gravel lane is an important consideration in the area's streetscape or in the overall project design; and

(c) the gravel lane will not cause erosion or sediment problems or those problems will be eliminated by the use of accepted engineering methods.

(8) Specific construction and engineering standards, lot access driveways and streets classified as lanes and certain subcollectors: (Ord. No. 2013-16 § 56)

(a) streets classified as "lanes" shall be laid out so that use by through traffic is minimized;

(b) lot access driveways shall be private. Streets classified as "lanes" or "subcollectors" may be constructed as private streets;

(c) lot access driveways and private streets classified as "lanes" or "subcollectors" may be approved for access to newly created lots where the planning commission or summary committee determines that no public street is needed to provide access to the property being subdivided or to surrounding properties, based on existing and planned future uses of the properties.

(d) a roadway classified as a lane must meet the following standards:

(i) paved lanes; and

(ii) unpaved lanes that are approved for construction with gravel surfacing as provided in Subsection (B)(7) above

A. twenty-two (22) feet driving surface width;

B. eight (8) feet shoulder and drainage on each side;

C. six (6) inch crushed gravel base course surfacing material; and

D. thirty-eight (38) feet total right of way or access easement.

(e) A lot access driveway that is required to provide emergency vehicle access pursuant to Chapter XII SFCC (Fire Prevention and Protection) must meet the standards of that chapter. Otherwise, a lot access driveway must have an all-weather driving surface at least ten (10) feet in width, must be no steeper than fifteen percent grade, or as required by the fire marshal and must accommodate drainage and utility facilities and easements.

(D) Access and Traffic Calming

(1) Where a development abuts or contains an existing or proposed arterial street, a land use board may require marginal access for collector or local streets, reverse frontage with screen planting or walls contained in a non-access reservation along the rear property line, lots with rear service alleys or such other treatment as may be necessary for adequate protection of residential properties and to afford separation of through and local traffic.

(2) Where a development borders on or contains a railroad right-of-way or limited access highway right-of-way, a land use board may require a street approximately parallel to and on each side or on either side of such right-of-way, at a distance suitable for the appropriate use of the intervening land for park or recreational purposes when such purposes are appropriate in the relevant area. Such distances also shall be determined with due regard for the requirements of approach grades and future grade separations.

(3) At least one through street that traverses the entire developed area shall be provided for each one thousand (1,000) feet of developed area. (Ord. No. 2012-11 § 26)

(4) At least two connections to the existing road network points shall be provided for every ten acres of development. (Ord. No. 2012-11 § 26)

(5) Where a trail network exists or is planned, access to the trail network must be provided every five hundred (500) feet, where feasible. (Ord. No. 2012-11 § 26)

(6) Reserve strips controlling access to streets are prohibited unless the city controls the reserve strip under conditions approved by the planning commission.

(7) Traffic calming measures are allowed in new developments and specific measures may be required by the planning commission to ensure traffic safety in new neighborhoods.

(8) Cul-de-sacs and other dead-end streets, both public and private, may be constructed only if topography, lot configuration, previous development patterns or other natural or built features prevent continuation of the street.

(E) Sidewalks

(Ord. No. 2013-16 § 57)

(1) If a subdivision plat or development plan approval is required, curb, gutter and sidewalk locations shall be dedicated when the subdivision plat or development plan is recorded and constructed in accordance with applicable standards as part of the subdivision or development plan infrastructure.

(2) If a subdivision plat or development plan is not required, curbs, gutter and sidewalks shall be constructed in accordance with applicable standards and dedicated to the city prior to issuance of a certificate of occupancy for:

(a) construction of a new principal building;

(b) all additions over five hundred (500) square feet gross floor area;

(c) remodeling or renovations over five (500) hundred square feet gross floor area for multiple-family residential and nonresidential permits; and

(3) sidewalk construction is not required to exceed twenty percent of the value of the other construction covered by the permit for additions and remodeling.

(4) Sidewalks shall be located in a city right-of-way or, if adequate right-of-way is not available, sidewalks shall be located in a public access easement dedicated to the city on an approved plat. The sidewalk shall be consistent with the street standards of Subsection 14-9.2(C) and located along each street frontage immediately adjacent to the development.

(5) New sidewalks, drive pads and curb ramps required pursuant to Subsection 14-9.2(E)(1) or (2) must comply with the Americans with Disabilities Act Accessibility Guidelines (ADAAG)

and with New Mexico department of transportation pedestrian access details (NMDOTPAD) and must be constructed of concrete, meeting standards approved by the city or alternative materials approved by the land use director. New sidewalks constructed pursuant to Subsection 14-9.2(E)(1) must be free of any structures, signs, landscaping, above ground utility elements or other items that prevent free passage along the sidewalk. New sidewalks constructed pursuant to Subsection 14-9.2(E)(2) must be free of any structures, signs, landscaping, above ground utility elements or other items that result from the new construction and that prevent free passage along the sidewalk.

(6) Replacement of existing sidewalks is not required if they are in good condition and substantially in compliance with ADAAG. Existing sidewalks shall be free of any structures, signs, landscaping, above ground utility elements or other items that prevent free passage along the sidewalk. However, in the situations described in Subsection 14-9.2 (E)(1) and (E)(2), the land use director may allow the sidewalk barrier to remain or approve an alternate sidewalk alignment creating free passage if the removal of the sidewalk barrier is deemed not feasible.

(7) A new sidewalk that connects to an existing sidewalk shall be the wider of:

(a) the width of the existing sidewalk;

(b) the required minimum width set forth in Table 14-9.2-1;

(c) the NMDOTPAD as may be amended by the city; or

(d) the minimum width required by ADAAG.

(8) A curb/access ramp meeting NMDOTPAD and city standards shall be constructed where two paved streets with curb, gutter and sidewalk intersect.

(9) Drive pads shall comply with NMDOTPAD and any city street standard details.

(10) If there is no curb or gutter, an alternative pedestrian route may be approved as part of a subdivision plat or development plan. The alternative pedestrian route shall comply with ADAAG. Consideration shall be given to future maintenance, the surrounding uses, density and the location and type of the street.

(11) Colored concrete shall be required in the city's historic districts according to the color palette approved by the historic districts review board available from the city historic preservation division. Alternative materials may also be required by the historic districts review board. In addition, the city reserves the right to specify sidewalk color or alternative materials in other sections of the city as may be appropriate.

(12) Construction of sidewalks shall comply with Section 23-3 SFCC 1987 (Construction and Maintenance of Curbs, Gutters and Sidewalks) unless alternative permeable materials are approved by the land use director.

(F) Pedestrian Crosswalks

Pedestrian crosswalks shall be included in the design of each signalized intersection and at any other street crossing locations required by the land use director and they must meet engineering standards adopted by the city. Crosswalks must connect sidewalks and must have sidewalk wheelchair ramps on each side of the street. Crosswalks shall be installed at the time of intersection construction.

(G) Curbs and Gutters

(1) All new streets must have curbs and gutters that meet city standards, except ~~for roadways classified as lanes or shared private driveways~~ if the planning commission finds, based on substantial evidence, that the following conditions are met:[11]

(a) absence of curbs and gutters will not contribute to the deterioration of the pavement edge, particularly on streets where on-street parking is allowed;

(b) curbs and gutters are not necessary to channel stormwater, as shown by a site-specific drainage and stormwater control plan analysis or other means; and

(c) curbs and gutters are not necessary to confine driveway access to specific locations and to maintain the appearance of the streetscape.

(2) Colored concrete is required in the historic districts according to the color palette approved by the historic districts review board available from the city historic preservation division.

(H) Maintenance of Public Parkways

Maintenance of the public parkway, generally comprised of the sidewalk setback and the sidewalk itself, is the responsibility of the person owning or in charge or control of the lot or property contiguous to the parkway, exclusive of controlled access arterials. Maintenance shall be to eliminate public nuisances and ensure pedestrian and vehicular safety and visibility, and shall include the eradication of weeds and the trimming of trees and shrubs. Maintenance shall comply with Sections 10.3 SFCC 1987 (Weeds) and 23-3 SFCC 1987 (Construction and Maintenance of Curbs, Gutters and Sidewalks).

(I) Alleys

Alleys shall comply with the following provisions:

(1) the right-of-way width of an alley shall not be less than twenty (20) feet;

(2) alley intersections and sharp changes in alignment are not allowed and, where necessary, corners shall be cut off sufficiently to allow safe vehicular movement; ~~and~~

(3) dead-end alleys are not allowed; and~~.~~

[11] Would allow use of swales for any road which these conditions are met.

(4) all new alleys must be paved either with asphalt or an approved permeable surfacing system.

(J) Easements

(1) Easements across lots or centered on rear or side lot lines shall be provided for utilities if the planning commission or the city engineer finds that they are necessary for adequate and necessary utility service to the subdivision or surrounding areas. Such easements shall be at least ten (10) feet wide and may be located over a lot line so that there is a five (5) foot easement on each lot; and

(2) Where a subdivision is traversed by a watercourse, drainageway, channel or stream, the owner shall provide a stormwater drainage easement or right-of-way conforming substantially with the lines of the watercourse, drainageway, channel or stream and of such width and construction the planning commission finds is adequate for the purpose. Parallel streets or parkways may be required by the planning commission in connection with the drainage easement or right-of-way.

(3) Easements required by this Section 14-9.2 shall not interfere with other easements or uses of the property on which the easement exists.

(K) Utilities, Storm Drainage and Street Improvements

(Ord. No. 2013-16 § 58)

Utilities, storm drainage facilities and street improvements shall be provided as follows.

(1) Standards and Specifications:

(a) connection to city water service except as provided in Section 25-1.10 SFCC 1987 (Regulations for the Drilling of New Domestic Water Wells);

(b) connection to city sewer services except as provided in Section 22- 3.1 SFCC 1987 (Sewers — Connection to the Public System);

(c) approval of storm sewer system and ~~other drainage improvement plans~~ stormwater management controls required by Section 14-8.2 by the city engineer;

(d) approval of grading and centerline gradients by the city engineer;

(e) approval of major and secondary arterial street cross-section by the city engineer; provided, however, that the cost of improvement to the developer shall not exceed that which is required for improving a collector street.

(f) installation of street name signs of a material and design approved by the governing body at all street intersections;

(g) approval of complete street lighting facilities by the city engineer; and

(h) landscaping as required by Section 14-8.4 (Landscape and Site Design).

(2) Design Details, Construction Standards and Specifications

Design details, construction standards and specifications for utilities and storm drainage shall conform to standard details and specifications adopted by the governing body.

(L) Landscaping

Landscaping plans shall be submitted for all roadway medians and all parkway strips. Landscaping plans shall include proposed location, size and type of vegetation or xeriscaping, including street trees, shrubs, ground cover or other proposed ground treatment in conformance with the city's landscaping regulations. Location of proposed landscaping shall meet sight distance and other safety criteria as determined by the land use director. Landscaping plans shall show any irrigation system necessary to maintain the roadway landscaping and shall describe all maintenance requirements for medians and parkway strips. The final approved landscaping plans shall be implemented at the developer's cost as part of road construction and all materials shall be maintained and guaranteed by the developer for a minimum of one year ~~or until established~~. Landscaping plans should comply with Resolution 2010-66, Landscape Design Guidelines for Medians and Planting Strips, as amended.

…

14-9.4 UTILITY AND STORM DRAINAGE IMPROVEMENT AND DESIGN STANDARDS [RESERVED]

14-9.5 INFRASTRUCTURE DEDICATION, COMPLETION AND GUARANTEES

(A) Dedication of Rights of Way and Easements

(Ord. No. 2013-16 § 60)

(1) On-site and off-site rights of way and easements required for public and quasi-public infrastructure shall be dedicated before or concurrently with recording a subdivision plat or filing a development plan or issuance of a construction permit for any development for which no development plan or subdivision plat is required.

(2) All quasi-public infrastructure and land designated for ownership in undivided interest, such as private roads and ~~drainage facilities~~ stormwater control measures and common open space, must be dedicated to and perpetually maintained by an owners' association or similar legal entity. An article of incorporation and bylaws for the owners' association along with a declaration of restrictions and covenants must be submitted for review and approval by the city attorney.

(B) Infrastructure Completion or Agreement to Construct Improvements Required

The public or quasi-public infrastructure required for any development shall be completed by the developer in accordance with plans approved by the city prior to commencing other aspects of the development, or the developer must enter into an agreement with the city to construct improvements as described in Subsection 14-9.5(C). The infrastructure must be completed or the agreement to construct improvements must be executed prior to the earliest of the following:

(1) recording the plat for development that requires a subdivision plat other than a plat for a family transfer subdivision, a summary procedure lot split or a resubdivision;

(2) recording or filing in city archives an approved development plan;

(3) issuance of a construction permit for any construction other than the infrastructure, for development for which a plat for an inheritance or family transfer subdivision, a summary procedure lot split or a resubdivision is required; and

(4) issuance of a construction permit for any construction other than the infrastructure, for development for which no subdivision plat or development plan is required.

(C) Agreement to Construct Improvements, Financial Guarantee

(1) The agreement to construct improvements must be executed by the developer according to infrastructure completion policies approved by the land use director.

(2) The agreement to construct improvements establishes the sequence of permitting, construction, completion and acceptance of infrastructure relative to the permitting, construction, completion and occupancy of buildings and other development activities, consistent with the requirements of Chapter 14 and applicable provisions of other chapters of the Santa Fe City Code and consistent with city infrastructure completion policies, including requirements for:

(a) partial completion of infrastructure prior to issuance of a construction permit for a building; and

(b) substantial completion of the infrastructure prior to issuance of a certificate of occupancy.

(3) The agreement to construct improvements shall include a financial guarantee in a form acceptable to the land use director for the construction cost of the infrastructure as estimated according to Subsection 14-9.5(G). If the financial guarantee uses an out-of-state financial institution, an additional contingency fee is required to reflect potential costs of possible out-of-state legal action.

(4) All required improvements shall be completed within two years after construction begins, unless a longer time period is approved by a land use board or by the land use director for a project that is to be constructed in phases.

(5) The developer may request a reduction in the amount of the financial guarantee when specific improvements are completed. To qualify for a financial guarantee reduction:

(a) the improvements must be completed according to approved plans and inspected by the land use director; and

(b) a written request for the reduction must be made using Form AIA G702 or approved equivalent format and certified by the architect or professional engineer of record.

(D) Completion and Warranty Period Financial Guarantee

(Ord. No. 2013-16 § 61)

(1) All infrastructure improvements shall be completed in accordance with the requirements of city regulations and approvals, and the land use director must inspect and accept all work.

(2) The developer shall warranty the infrastructure improvements for a period of at least one year after acceptance and must repair or replace defects at no cost to the city during the warranty period. The land use director may extend the warranty period when necessary to insure that actual or potential defects are corrected.

(3) During the warranty period, the developer shall maintain on file with the city a construction financial guarantee in an amount equal to ten percent of the cost estimate in Subsection 14-9.5(G) and it shall remain in effect until the required infrastructure has passed a final warranty inspection by the land use director. If there is no agreement to construct improvements, a separate financial guarantee for the warranty period consistent with city infrastructure completion policies shall be provided.

(E) Use of Funds by City

If the required improvements are not completed in accordance with the agreement to construct improvements or the required repairs are not completed satisfactorily within the warranty period, the city may use the financial guarantee funds in any manner and in any combination it deems necessary to complete or repair the required improvements. This provision does not relieve the applicant of the obligation to complete the improvements or repairs according to the schedule in the agreement, using other funds.

(F) Refund

If all conditions of this Section 14-9.5 have been met, including acceptance of improvements, and the warranty period has passed, the city shall refund all money not called for within thirty days of a written request from the applicant.

(G) Construction Cost Estimate

A construction cost estimate, prepared by a professional engineer or other qualified person approved by the land use director shall be provided for all public or quasi-public improvements that are required as a condition of approval or that will be maintained by the city, unless such improvements are built out prior to plat recordation. Required improvements include those described in Section 14-9.2 (Street Improvement and Design Standards) and as listed in the city infrastructure completion policies. The construction cost estimate is the basis for the financial guarantees required by Subsections 14-9.5(C) and (D). The estimate and guarantees must include a ten percent contingency; provided that a five percent contingency is acceptable for nonprofit housing and economic development organizations approved by the community services department.

H. REGULATORY CONSIDERATIONS CHECKLIST

TRA TECH

MEMO

To:	Leroy Pacheco, City of Santa Fe Melissa McDonald, City of Santa Fe
Cc:	Troy Dorman, Tetra Tech
From:	Christy Williams, Tetra Tech
Date:	August 8, 2018
Subject:	Regulatory Considerations for Design of Green Infrastructure Practices

The City of Santa Fe supports the use of green infrastructure practices to manage stormwater on private and public projects. There are a variety of regulatory conditions when selecting and designing green infrastructure practices. Tetra Tech was tasked with developing a checklist for designers and plan reviewers to identify these considerations.

The Tetra Tech team compiled potential requirements from federal and state regulations as well as the draft City of Santa Fe Municipal Code[1]. The resulting checklist is intended as general guidance. Specific requirements will vary based on type of green infrastructure practice, location, etc.

"No" responses could indicate a need for further evaluation of the practice.

1.0 FEDERAL REGULATIONS

Clean Water Act Section 404	
☐ Yes ☐ No ☐ N/A	Has the need for a Section 404/401 Permits from the U.S. Army Corps of Engineers been evaluated if the construction of the practice will impact a wetland?
Endangered Species Act	
☐ Yes ☐ No ☐ N/A	Has the need for an ESA determination been evaluated?
National Historic Preservation Act	
☐ Yes ☐ No ☐ N/A	Has the need for a NHPA/SHPA evaluation been considered?
Americans with Disabilities Act	
☐ Yes ☐ No ☐ N/A	If proposing alternative sidewalk or trail treatments, have all ADA requirements been met?

[1] Redline version prepared by Tetra Tech and submitted on March 2, 2018.

2.0 STATE REGULATIONS

NPDES Construction General Permit	
☐ Yes ☐ No ☐ N/A	If part of a project which is one acre or more, has the project submitted a notice of intent (NOI) for coverage under the New Mexico Construction General Permit (NMR100000)?
☐ Yes ☐ No ☐ N/A	If part of a project which is one acre or more, is the practice a part of an approved Storm Water Pollution Prevention Plan (SWPPP)?
Office of State Engineer (OSE) Requirements	
☐ Yes ☐ No ☐ N/A	If harvesting rainwater from roof surfaces, will the practice allow the same runoff from the site to occur that would in its natural, predevelopment state?
☐ Yes ☐ No ☐ N/A	If the practice captures and infiltrates stormwater (especially if it is a large project whose purpose is to infiltrate stormwater for aquifer storage and recovery), has OSE been consulted to determine if groundwater permitting applies?
New Mexico Environment Department (NMED)	
☐ Yes ☐ No ☐ N/A	Has NMED been contacted to determine if a groundwater discharge permit is required for infiltration practices which capture parking lot or other potentially polluted runoff?

3.0 LOCAL REGULATIONS

Post Construction Stormwater Management	
☐ Yes ☐ No ☐ N/A	Does the practice(s) proposed comply with retention performance standards?
☐ Yes ☐ No ☐ N/A	Do cisterns comply with grading requirements, landscape and site design requirements and building and housing Municipal Code requirements?
☐ Yes ☐ No ☐ N/A	Are easements included on site plan for all green infrastructure practices?
☐ Yes ☐ No ☐ N/A	Have operation and maintenance considerations been included for all green infrastructure practices and responsible parties been identified?
Landscape and Site Design	
☐ Yes ☐ No ☐ N/A	As determined by the applicability described on 14-8.4, have open space reductions been considered when utilizing water harvesting?
☐ Yes ☐ No ☐ N/A	Has the project been designed such that no increase in parking will occur as a result of open space reductions?
Parking, Sidewalks, and Streets	
☐ Yes ☐ No ☐ N/A	Do off-street parking/loading permeable surface designs meet the requirements of the City Engineer?
☐ Yes ☐ No ☐ N/A	Is rainwater harvesting being used in parking lot islands and perimeter screening strips to reduce the use of potable water irrigation.
☐ Yes ☐ No ☐ N/A	Where a parking lot abuts or occupies a street yard, is perimeter screening included in parking lot design?

☐ Yes ☐ No ☐ N/A	Is the minimum square feet of permeable landscaped area per parking space provided?
☐ Yes ☐ No ☐ N/A	Are traffic islands the correct size, do they contain the correct amount of permeable surface, are distributed throughout the lot, and are combined (where needed) to facilitate water harvesting?
☒ Yes ☐ No ☐ N/A	As applicable, are alternative permeable surfaces proposed in place of sidewalks approved by the land use director?
☒ Yes ☐ No ☐ N/A	As applicable, has a street cut permit been obtained?
☒ Yes ☐ No ☐ N/A	As applicable, do site-specific drainage and stormwater control plan analysis supports plan to not include curb and gutter?
☐ Yes ☐ No ☐ N/A	As applicable, are alternative permeable surfaces used in alleys approved?
Wildlife	
☐ Yes ☐ No ☐ N/A	Are there prairie dogs on-site that will need to be relocated?

ADDITIONAL RESOURCES:

- An Infiltration Model for Enhanced Stormwater Management (City of Santa Fe, New Mexico- July 2016), https://www.santafenm.gov/media/archive_center/Prelim_Enhanced_Stormwater_Report_07_15_161.pdf
- Land Use & Urban Design Plan – draft 2017 https://www.santafenm.gov/land_use__urban_design_plan
- Impact Fee Capital Improvements Plan 2020 (adopted by CC 8/27/14), http://www.santafenm.gov/media/archive_center/IMPACT_FEE_CIP_2020.pdf
- NM DOT Design Criteria Manuel (July 2018), http://dot.state.nm.us/content/dam/nmdot/Infrastructure/Drain_Design_Manual.pdf
- Major Arroyos Map, https://www.santafenm.gov/media/archive_center/MajorArroyos.pdf
- Stormwater Management Model 5.1 (SWMM) https://www.epa.gov/water-research/storm-water-management-model-swmm
- SWMM Model User's Manual, file:///C:/Users/mamcdonald/Downloads/SWMM_5.1_Users_Manual_%20(1).PDF

TETRA TECH

Troy M. Dorman, PhD, PE, CFM
Principal in Charge

EXPERIENCE SUMMARY

Dr. Dorman has 18 years of civil/environmental engineering experience in water resources engineering, stormwater management, low impact development techniques, water quality BMPs, watershed master planning, land use planning, utility coordination, surface and groundwater hydrologic modeling, hydraulic design and erosion control. Dr. Dorman's roles have included client development, project management, engineering design/review and team leadership for clients ranging from the U.S. Army Corps of Engineers to state, county and local agencies.

RELEVANT EXPERIENCE

Sustainable Stormwater Engineering IDIQ, San Antonio River Authority (SARA). Program Manager for this on-call contract and also serves as Project Manager for several individual projects. Project manager, lead designer, field investigator and BMP optimization modeling task leader for an LID retrofit at SARA headquarters. Led a series of workshops and tours focused on LID BMP O&M for SARA, including participants from SARA, City of San Antonio DSD, City of San Antonio TCI, SAWS, CPS, and Bexar County. Principal author of the San Antonio River Basin LID Manual, a tailored local LID design manual for the four counties in SARA's jurisdiction. Project Manager for this on-call contract. Project manager, lead designer, field investigator and BMP optimization modeling task leader for an LID retrofit at SARA headquarters. Led a series of workshops and tours focused on LID BMP O&M for SARA, including participants from SARA, City of San Antonio DSD, City of San Antonio TCI, SAWS, CPS, and Bexar County. Principal author of the San Antonio River Basin LID Manual, a tailored local LID design manual for the four counties in SARA's jurisdiction. Project Manager to support the City of San Antonio and SARA in their joint effort to prepare a voluntary LID and Natural Channel Design Ordinance. Managing analysis, preliminary design and estimating for a series of proposed CIP projects for future bond funding for local watershed drainage master plans.

Bleiders/German Creek Stormwater Capital Improvement Project, New Braunfels, TX. Project manager to develop a preliminary engineering report to evaluate the feasibility of diverting water from Bleiders Creek through a natural overflow route that has been blocked by an active railroad line for more than 150 years. Managed Tetra Tech's efforts, working as a sub to a local engineer, to lead hydrology and hydraulic modeling, preliminary design, environmental permitting, and options analysis. Modeling included a combination of HEC-HMS and HEC-RAS models to show the benefit of proposed upstream dam by itself or with the diversion project. A 2-D unsteady XP-SWMM model was used to produce a corrected effective FEMA floodplain and evaluate downstream impacts on the Guadalupe River, including the timing of the diverted hydrograph. Project also includes establishing cross section survey locations, survey QC, and multiple public outreach efforts to evaluate options proposed by community groups and address significant landowner resistance.

SARA Drainage Local Watershed Master Plan Support. Managing analysis, preliminary design and estimating of a series of proposed CIP projects for future bond funding. Led development of a checklist that was used by team members from other design firms to evaluate LID and GI opportunities for the projects in Council Districts 4, 7 and 8. Led additional analysis of the LID/GI potential for up to 4 projects each from Council Districts 4, 7, and 8

EDUCATION

Ph.D., Water Resources and Environmental Engineering, Texas Tech University, 2003

M.S., Civil Engineering, Texas Tech University, 1996

B.S., Hydrology, Tarleton State University, 1993

REGISTRATIONS/LICENSES

Professional Engineer, Texas No. 92722, 2003

Certified Flood Plain Manager

ENV-SP

AREA OF EXPERTISE

Water resources engineering

Stormwater management

Low impact development

Water quality BMPs

Watershed master planning

Land use planning

Utility coordination

Surface and groundwater hydrologic modeling

Hydraulic design

Erosion control

YEARS OF EXPERIENCE

18

YEARS WITH FIRM

3

to prepare cost estimates and feasibility assessments. Developed proposed infrastructure improvements including storm drain systems, street improvements, upgraded culvert crossings and stream restoration design.

Drainage, Detention and Edwards Aquifer Water Quality Design, Buda, TX. Led design and preparation of an Edwards Aquifer Protection Plan for a site near Buda, TX, on behalf of a private client. Prepared analysis and design of temporary and permanent stormwater BMPs for an Aboveground Storage Tank site over the Edwards Aquifer, designed to meet both NPDES and dam safety needs. Prepared a drainage report for submittal to the City that analyzed 2-yr to 100-yr storm events to assess whether the site development would increase flows downstream of the site or negatively impact any existing public infrastructure.

New York Rising Community Reconstruction Program, New York State DEP. Supporting project for assisting local communities in developing flood hazard mitigation projects in response to Superstorm Sandy, Tropical Storm Irene, and Tropical Storm Lee. Serving as technical lead for hydrologic and hydraulic modeling in Margaretville, Shandaken, and Hardenburgh, NY. Providing program guidance to the communities while directing and reviewing work of staff engineers. Performing QC of HEC-RAS models and screening projects based on feasibility and hydraulic efficacy. The project will ultimately develop a list of projects for funding through various state and federal programs.

Wilson County Watershed Master Plan, SARA. Project manager for development of comprehensive watershed master plans to assess potential flood damage to buildings, roads and infrastructure within Wilson County. Managed review of each community's development regulations and made recommendations to update and strengthen drainage design criteria and overall floodplain management codes. The master plan identifies major flooding reaches, identifies target areas for flood mitigation and evaluates appropriate structural and nonstructural solutions for each target area. Along with flood solution strategies, areas were identified as suitable or not suitable for combining recommended improvements with multi-use facilities including environmental habitat restoration, community recreation and open space enhancement. A comprehensive report for each community will support efforts by the communities to acquire funding through federal hazard mitigation programming. Grant monies supplement each community budget to improve drainage infrastructure to protect citizens from property damage and physical injury or loss of life due to flooding.

Word Borchers Development, New Braunfels, TX. Served as Water Resources technical lead for a mixed-use, master planned community located on the 2,421-acre Word Borchers Ranch on Loop 337 north of the City of New Braunfels, TX. As part of the master planning process for a development agreement between the City of New Braunfels and the client, developed standards that will protect water quality, decrease flow, and mitigate downstream flooding problems. The development regulations far exceed current City of New Braunfels development code but will be used to govern development of the equivalent of a small city on 2400 acres during the next 20 to 25 years. Developed new approaches to assess sediment loading, erosion potential, stream protection, and water quality BMPs that integrate with overall land plan. Also incorporated modeling of LID features throughout the 20-year build-out, as well as sized wet ponds, extended detention and water quality measures to provide nondegradation from sediment.

San Antonio River Watershed Master Plan, San Antonio, TX. Over a 3 year period, led development of the Master Plan, which covered approximately 130 mi^2 of San Antonio including downtown, the River Walk and many neighborhoods that were built in the 1940s, 50s and 60s prior to establishment of FEMA regulations. The master plan addressed flooding, infrastructure conflicts, stream preservation/restoration potential and transportation impacts from impassable roads. Proposed solutions included detention, channel widening, buyouts, underground storm drain systems and bridge widening or removal. Over 50 different regional and localized drainage issues were investigated to develop conceptual solutions. Led the effort to present the technical basis, financial benefits and community improvements that could be realized by each project. Projects included unsteady 1D and 2D modeling, infrastructure sizing, environmental permitting assessment, cost estimating and utility conflict review.

Private Landowner Dispute, Boerne, TX. Principal-in-charge and QA/QC review for this project. His team was hired by a public homebuilder to review drainage plans designed by another engineering firm for a recently constructed subdivision. A commercial property owner downstream from the subdivision was damaged during an intense rainfall event. The City of Boerne was initially involved for their role in reviewing and approving construction. Reviewed street drainage, inlet capacity, channel capacity and detention sizing to verify compliance with Boerne's development regulations. The team determined that the detention basins were incorrectly sized and did not follow Boerne's regulations. The City of Boerne and our client were both exonerated.

TETRA TECH

Christy Williams
Senior Environmental Planner

EDUCATION

M.A., Urban and Environmental Planning, University of Virginia

B.A., Biology, Randolph-Macon College

AREAS OF EXPERTISE

Green infrastructure

Permitting

Regulation development

Integrated planning

Stakeholder involvement

Facilitation

Guidance development

Facility inspections/audits

YEARS OF EXPERIENCE

19

YEARS WITH FIRM

14

EXPERIENCE SUMMARY

Ms. Williams has worked in the water resources and land use planning and policy field for 22 years, having worked as an environmental specialist for a state department of transportation, a local county planner and storm water program manager, an outreach and environmental program coordinator for a national conservation non-profit, and as a storm water and erosion control construction inspector and plan reviewer for local governments. She has more than a decade of experience helping municipalities implement their stormwater programs, including conducting audits of more than 70 MS4 permitees around the country, writing numerous MS4 permits, and co-authoring national MS4 permit writer and audit guidance for USEPA. With a recent focus on green infrastructure, Ms. Williams has assisted numerous localities incorporate green infrastructure principles and practices into private property and public spaces. She has conducted code and ordinance reviews as well as assisted numerous localities with the revision and/or development of new local regulations to allow, support, incentivize and allow green infrastructure practices. In addition, Ms. Williams has helped municipalities assess green infrastructure financing options and develop private property green infrastructure incentive programs. Ms. Williams has provided a wide array of public education and outreach and training support related to stormwater management, water quality trading, and green infrastructure design throughout the country.

RELEVANT EXPERIENCE

Stormwater Management Program Development and Implementation, San Francisco Public Utilities Commission. Developed multiple stormwater management documents for City and County of San Francisco to comply with Phase II MS4 General Permit requirements. Wrote an illicit discharge enforcement response plan, a spill response plan and a construction activity enforcement response plan. Developed a source investigations and corrective actions plan for the City and County.

Green Infrastructure Plan Development, City of Detroit, MI. Reviewed the City's codes, ordinances and planning documents and developed a list of recommendations to remove barriers to green infrastructure implementation. Assisting in writing a new post-construction stormwater ordinance – the city's first – and updating the codes to provide additional support, incentives and requirements to implement multi-functioning landscapes. The development of these codes is being implemented as part of the City's CSO Long Term Control Program.

Green Infrastructure Incentive Program and Code Update for Burlington, NC. Supported the town of Burlington in the development of a green infrastructure incentive program that included a new grant program, a green infrastructure audit and public-private partnership model, public demonstration projects, and a variety of land use incentives that required updates to city codes and ordinances.

Building Blocks Workshops – Linking Land Use and Water Quality, USEPA OWM. Conducted numerous workshops for local governments interested in learning more about how to better link land use planning techniques and concepts with water quality impacts. Each workshop was 2-3 days and targeted government staff, elected officials and the general public. Performed cursory review of the municipality's local codes and ordinances to provide them some real-world examples about how their land use planning decisions impact water quality now and how they could be altered to protect water resources in the future while encouraging and support economic development in the community.

Update and Revision of Conservation Subdivision Land Use Pattern, San Antonio River Authority. Assisted SARA in update and revision of the City of San Antonio's existing conservation subdivision use pattern in the San Antonio Unified Development Code. Worked with SARA, City and outside stakeholders to update the language to include more incentives, specific conservation area management requirements and revised development to encourage the conservation of valuable open space in the City and the Extraterritorial Jurisdiction outside the City. Wrote multiple drafts of the code language for use during informal stakeholder meetings and the City's subsequent formal public involvement process. This effort was done in conjunction with Tetra Tech's assistance to SARA to develop a new LID/voluntary sustainable land-use and stormwater management alternative ordinance the combines the principles of LID and Natural Channel Design Protocols (NCDP).

Water Infrastructure and Resiliency Finance Center Database Development. Assisted EPA in conducting an inventory of existing financing resources available to communities with stormwater and green infrastructure needs. Helped to categorize the resources by geography, topic, target audience, and applicability. The database will be used as a user-friendly online clearinghouse of existing stormwater financing resources based on the research completed.

Integrated Planning Technical Assistance. Supported USEPA technical assistance project in support of the *Integrated Municipal Stormwater and Wastewater Planning Approach Framework*. Oversaw assistance to the City of Burlington, VT, City of Santa Maria, CA, and Onondaga County, NY, to support several of the key elements of the planning process described in the USEPA 2012 memorandum. Support included convening a stakeholder group; conducting an online poll to develop community criteria for evaluating alternatives; reviewing various stormwater, flow restoration, and CSO reduction projects; investigating options for phosphorus reduction at WWTPs; developing methods and an interactive spreadsheet tool to identify, evaluate, and select options for integrated water resource management; developing processes for engaging stakeholders; and developing a user-friendly spreadsheet for scoring individual stormwater and wastewater projects.

Phase II Stormwater Management Program Audits, Plan Development and Implementation, Puerto Rico. Conducted audits of and developed stormwater management program (SWMP) plans for five municipalities in Puerto Rico. Each plan was used as the notice of intent submittal for initial coverage under the Puerto Rico MS4 Phase II General Permit. Further assisting municipalities in implementation of their stormwater management programs. For example, has conducted municipal facilities inspections at four localities for the last two years.

NPDES MS4 Program Evaluation Guidance. Principal co-author of a USEPA guidance document drafted to assist permitting authorities in the evaluation of Phase I and Phase II MS4 stormwater management programs. The guidance includes checklists, worksheets, and numerous other resources and tools to prepare for and perform consistent program evaluations as well as conduct follow up activities.

Integrated Watershed-Based Storm Water Permitting for Minnesota Board of Water and Soil Resources (BWSR) and the Ramsey Washington Metro Watershed District. Participated in Phase One of this project and was a primary co-author of the framework analysis document. Support included identifying opportunities to streamline current Phase II municipal separate storm sewer system (MS4) requirements under the federal NPDES Storm Water Program with Minnesota requirements under the Metropolitan Water Management Program (Minnesota Statutes, Section 103B.201), Watershed District Law (M.S. Chapter 103D) and Minnesota Rules (Chapters 7050, 7090 and 8410). Project outputs are recommended measures for the integration of watershed-based storm water and watershed management planning requirements followed by agency and local government efficiencies in permit issuance and compliance concurrent with measurable environmental results.

NPDES Storm Water Public Education Program, TNRCC. Assisted with development of TNRCC stormwater outreach program by editing training and presentation materials. For a related contract, researched 20 different state Multi-sector General Permit (industrial storm water) programs and summarized the existing information for use by TNRCC in developing the TPDES industrial storm water program. Researched and summarized existing information regarding alternative industrial storm water monitoring techniques and programs around the country.

NPDES MS4 Storm Water Program, Arlington County, VA. Served as County stormwater program manager. Wrote Annual Reports. Wrote a grant application and acquired a grant from Chesapeake Bay Local Assistance Department to develop the first comprehensive watershed management plan for Arlington County. Developed a restoration, mitigation and storm water management plan that could be used to develop projects for the County's CIP. Reviewed site plans and water quality impact assessments for compliance with County Chesapeake Bay Preservation Ordinance, Virginia Erosion and Sediment Control Law, and Virginia Storm Water Regulations.

Rosemary Romero Consulting

building better communities through public involvement & decision-making, strategic planning, and conflict resolution

1350 San Juan Drive, Santa Fe NM 87505
505.982.9805 office 505.690.3016 cell romero.rosemary@gmail.com

---

For the past three decades, Ms. Romero has designed and facilitated numerous public involvement projects, assessed the potential for neutral conflict resolution services in diverse cases, consulted with public and private organizations on the use of alternative dispute resolution techniques, trained hundreds of persons in negotiation and mediation and public involvement skills and promoted the use of mediation and facilitation in the environmental field and other public policy arenas that affect communities. She has facilitated controversial issues with various federal, state, local governments and nonprofit organizations and lead strategic planning efforts for numerous entities. As a native New Mexican, she brings a heightened awareness of cross-cultural issues in the resolution of disputes. She is the former President of Western Network a non-profit organization that developed an extensive practice centered on conflict resolution specific to natural resource issues such as water planning and land use planning. Ms. Romero completed four years as an elected City of Santa Fe Councilor and in that capacity served on several regional boards including the Chairmanship of the North Central Regional Transit District, Santa Fe Solid Waste Management Agency, and Santa Fe Regional Planning Authority while also serving on key City of Santa Fe committees. Ms. Romero has also served in other national leadership roles including Past President and current member of the Association for Conflict Resolution (ACR) the largest ADR membership organization in the United States.

Select Project Work:

2004 - 2016: Interstate Stream Commission: As a consultant to the Office of the State Engineer and Interstate Stream Commission, organized and developed regional water planning efforts throughout the state. The final regional water plan was developed by Taos County and accepted by the ISC was, the recipient of a statewide award by the Regional Water Planning Dialogue for stellar public involvement.

1998 – 2016: Collaborative Forest Restoration Program. In 1998 Ms. Romero worked with two other conservation organizations to design and facilitate day-long workshops with representatives from the logging industry, livestock associations, community organizations and other interested parties to develop a vision for forest health and restoration. The process allowed the diverse interest groups to share their individual perspectives in a constructive, non-threatening environment that helped build trust and working relationships. The process was the first of this type used by congressional staff to develop legislation in 2000. Romero continues her involvement through facilitation of the annual CFRP workshop for grantees and facilitation of the annual FACA (Federal Advisory Committee Act) Technical Advisory Committee reviewing proposals focused on forest health.

2012-2016: **American Friends Service Committee-New Mexico.** Evaluation of a 4 year long evaluation of a Kellogg Foundation project "Thriving Community Farmers, Healthy New Mexico Children" grant. The grant seeks to help the AFSC farmers training program improve community food environments affecting poor children of color and low-income families in three project areas in New Mexico.

2014 - 2016: Cibola/Carson/Lincoln National Forests. Travel Management Public Involvement; Forest Plan Revisions; endangered species; livestock; fire management.

2007-2008: Environmental Justice Taskforce - Facilitation of the Bernalillo County/City of Albuquerque Environmental Justice Taskforce. The Scope of the EJ Task Force was to develop recommendations to implement the EJ objectives of the Taskforce, i.e., immediate, short-term, and long-term recommendations; identify any barriers to implement recommendations; identify/develop check list or other qualitative analysis for EJ regarding air quality; identify existing models for analyzing cumulative effects. This has been a seven month long project and the final report was submitted March 2008.

2008: MolyCorp/Chevron Public Involvement. Co-Facilitator for an EPA funded project to facilitate public meetings in Questa, NM for development of a Remediation Plan for the Questa mine. In addition, Ms. Romero worked closely with MolyCorp staff and the Taos Community Foundation to develop a long-term community based fund for post-mine closure projects.

2005 – 2006: Upper Rio Grande Watershed: Development of a watershed restoration action strategy (WRAS) for the Upper Rio Grande Watershed. The project has included meeting with community members throughout Taos County, facilitation of agency meetings, interviews, and focused meetings in order to gather information on future projects that can be funded through NMED 319 grant monies to address water quality issues. The WRAS includes six sub-wrases (Rio Fernando, Rio Hondo, Pilar, Greater World, Rio Pueblo, Ranchos de Taos) that have been implemented at various degrees.

Educational Background: Associate of Arts Degree from Santa Fe Community College, attended the College of Santa Fe, Environmental Management Program and Antioch University, Yellow Springs, Ohio, Masters in Art Program for Environment & Community. Ms. Romero has received over 200 hours of mediation/facilitation/strategic planning training including Environmental Public Policy Mediation from CDR Associates; Collaborative Leadership for Community Problem-Solving and Visioning at SFCC; ICR Associates Strategic Planning.

TETRA TECH

Jesse Dillon Roach, PhD, PE
Hydrologist

EXPERIENCE SUMMARY

Jesse Roach is a Hydrologist with a background in water resources and operations modeling, and high level analysis of integrated hydrologic systems. At Tetra Tech, Jesse has supported development of the Upper Rio Grande Water Operations Model, a RiverWare based accounting and operations model for the Rio Grande from headwaters to El Paso, Texas which includes water rights based operations. Jesse was also the lead and primary developer of a Powersim based monthly timestep systems model for the upper Rio Grande basin known as the Upper Rio Grande Simulation Model (URGSiM), and a state level mass balance model for New Mexico. Prior to joining Tetra Tech, Jesse worked at Sandia National Laboratories on quantitative analysis of the relationship between water resources and the human and natural demands they serve. Jesse has worked as a lead modeler on integrated systems level models that incorporate climate, surface water, groundwater, reservoir, human demand, and environmental demand dynamics for a variety of hydrologic systems. Such models can be built in a collaborative manner in order to involve and educate parties with an interest in the resource management outcome. Recent and notable projects include analysis of post-wildfire hydrologic response in Whitewater Creek and the Pecos River, hydrologic and hydraulic analysis of watershed areas in and around the Pueblos of Santa Ana and San Felipe, analysis of potential climate change impacts in the Upper Rio Grande using URGSiM, and collaborative development of system dynamics models of water systems in the Tigris-Euphrates basin in Turkey, Syria and Iraq. Jesse is skilled in use of Matlab, Excel, ARC-GIS, HEC-HMS, HEC-RAS, Powersim, and RiverWare softwares for application to resource management analysis. Jesse is an adjunct professor at the University of New Mexico, and teaches a graduate level course there on hydrologic modeling.

EDUCATION

Ph.D., Hydrology and Water Resources; University of Arizona, 2007

M.S., Civil and Environmental Engineering, Stanford University, 1997

B.S., Civil Engineering, Stanford University, 1995

B.S., Biological Sciences, Stanford University, 1995

AREAS OF EXPERTISE

Hydrologic and hydraulic analysis

Water resources modeling

LICENSES/REGISTRATIONS

Professional Engineer, New Mexico, License No. 23277 (2015)

Adjunct Lecturer, University of New Mexico, Water Resources Program

YEARS OF EXPERIENCE

10

YEARS WITH FIRM

2

RELEVANT EXPERIENCE

Post Wildfire Hydrology Whitewater Creek and Pecos River, New Mexico (2016). Development of HEC-HMS rainfall runoff models for pre- and post-wildfire conditions in two burn scarred watersheds.

Reconstruction of 1850-1920 Sacramento and San Juaquin Rim Inflows & Valley Precipitation (2016). Provided technical oversight for data gathering and analysis to reconstruct precipitation in California's Sacramento and San Juaquin basins from correlations between tree ring records, PRISM synthetic data, and observed records.

URGWOM Model Development; USACE, Albuquerque District; Albuquerque, NM (2014-Present). Senior Water Resources Engineer. Provided RiverWare model development of the Upper Rio Grande Water Operations Model (URGWOM), including rule writing, accounting, and suggestions for physical model improvements.

New Mexico Dynamic Statewide Water Budget (2014-Present). Synthesis of water supply and demand data and modeled values from across New Mexico into a single, easily accessible platform that provides hydrologic mass balance information at a variety of spatial scales including County, Water Planning Region, river basin, or the entire state.

Upper Rio Grande Simulation Model (URGSiM) Development; USACE; Albuquerque, NM (2014-2016). Lead Model Developer. Development and maintenance of a monthly timestep system level mass balance and operations model known as the Upper Rio Grande Simulation Model (URGSiM).

San Felipe Section 203 Watershed Management Plan; USACE, Albuquerque District; Albuquerque, NM (2014-2015). Developed HEC-HMS models and resulting flood magnitude and frequency estimates for seven tributaries to the Rio Grande between Cochiti and Bernalillo representing over 350 square miles of drainage area.

Upper Rio Grande Impacts Assessment; Bureau of Reclamation; Albuquerque, NM (2012-2013). Technical Lead. Investigation of potential climate change impacts on water supply and demand in the Upper Rio Grande system. Contractor to Bureau of Reclamation. Technical lead.

Water, Energy, & Carbon Sequestration Simulation Model (WECSsim); U.S. DoE; Albuquerque, NM (2011-2014). Technical Lead. Development of a simulation model to evaluate water demand and supply impacts from national scale implementation of carbon dioxide capture and storage. Technical lead.

Expected Hydrologic Impacts Associated with Increased Conservation Storage at El Vado Reservoir; Bureau of Reclamation; Albuquerque, NM (2011). Initial assessment of potential hydrologic impacts of raising the spillway at El Vado to allow for additional conservation storage. Sole provider for contracting, technical analysis, and reporting.

Evaluating Water Supply and Consumption by Sector in a National Water Resources Framework; U.S. Department of State; Iraq, Jordan, Turkey (2008-2011). Interacted with engineers from the Iraq Ministry of Water Resources to collaboratively build a systems level model of the Tigris-Euphrates system so that users could visualize likely impacts to Iraq of upstream water development and climate change, and experiment with potential strategies for coping with those impacts. Technical lead.

Stochastic Hydrologic Analysis of the Upper Rio Grande Surface Water System; Project Owner; Albuquerque, NM (2009). Ran a monthly timestep mass balance model of the Rio Grande built by Dr. Roach with thousands of tree ring based hydro-climatological scenarios. Sole provider of all aspects of study.

PAPERS AND PRESENTATIONS

First Author:

- Expected Hydrologic Impacts Associated with Increased Conservation Storage at El Vado Reservoir, New Mexico. 2011 Report to U.S. Bureau of Reclamation.
- A Compartmental–Spatial System Dynamics Approach to Ground Water Modeling. 2009. Coauthor: V. Tidwell. Ground Water Vol. 47 (Sept-Oct), No. 5 pp 686–698
- Stochastic Hydrologic Analysis of the Upper Rio Grande Surface Water System in New Mexico. Report to URGWOM Technical Team. 79pp. SAND2009-6529P July 1, 2009.
- Strategy for Water and Land Resources in Iraq (SWLRI) Water Systems Planning Model (WSPM) Final Report. With: H. Passell, M. Reno, G. Klise, & V. Tidwell. Sandia National Laboratories SAND2009-3063P. May 2009.
- Integrated Surface Water Groundwater Modeling in the Upper Rio Grande in Support of Scenario Analysis. Department of Hydrology and Water Resources, University of Arizona. 341 p. (PhD dissertation).

TETRA TECH

Richard L. Schaefer, PE, LEED AP

Civil Engineer

EXPERIENCE SUMMARY

Mr. Schaefer is an experienced manager of planning, design and construction of infrastructure projects and program development for municipalities. His technical experience emphasizes storm and surface water management, wastewater and CSO infrastructure. Rick assists cities in developing stormwater programs that both address locally-driven initiatives and achieve regulatory compliance. Mr. Schaefer prepares comprehensive stormwater plans and basin plans providing municipalities with capital improvement programming, maintenance and operational planning, regulatory guidance, and funding strategies to retrofit watersheds, upgrade and expand drainage and wastewater infrastructure, and to manage/protect local water resources. He develops funding strategies and assists with establishing stormwater utilities and related revenue structures to implement water programs.

RELEVANT EXPERIENCE

Stormwater Master Plan Update, Bothell, Washington, City of Bothell. Updated the comprehensive stormwater plan to address current physical, policy, regulatory and fiscal conditions affecting the city's stormwater program. The project used a phased, interactive approach to evaluate intermediate findings and adaptively reallocated analytical resources to assure the city greatest return on its planning investment. The update focused on optimizing levels of service (capital, operations, and maintenance) and achieving regulatory compliance within the city's available personnel and fiscal resources.

Stormwater Program Implementation, Blaine, Washington, City of Blaine. Managed a grant-supported project to implement a stormwater management program in Blaine directed at addressing local drainage problems, improving water quality in sensitive receiving waters, and achieving regulatory compliance. Keys to the success of the program were regional cooperation and funding. Employed RNA type-matching technology identifying the range of fecal coliform sources to Drayton Harbor as an aid in prioritizing control strategies both in the city and in surrounding Whatcom County. The project also formed a stormwater utility and system development charge to fund efforts addressing surface water needs. Formed and coordinated with a citizen advisory committee to develop policies and recommendations presented to the City Council for adoption.

EDUCATION

M.S., Civil Engineering, North Carolina State University, 1982

B.S., Civil Engineering, University of Michigan, 1977

AREAS OF EXPERTISE

Stormwater program development

Utility development

Stormater management

LICENSES/REGISTRATIONS

Professional Engineer (Washington #19988, 1981; California #41430, 1987)

LEED Accredited Professional (2009)

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers (ASCE)

American Public Works Association (APWA)

American Council of Engineering Companies (ACEC)

YEARS OF EXPERIENCE

39

YEARS WITH FIRM

5

Stormwater Program Implementation, Snohomish, Washington, City of Snohomish. Project Manager for reassessment of the city's stormwater program and related CSO control needs, and plan to implement a funding mechanism moving the program forward. Worked extensively with a citizen advisory committee to fund a program that addresses local flooding, water quality and habitat needs and complies with state and federal regulations.

Comprehensive Storm Drainage Plan, University Place, Washington, City of University Place. Project manager responsible for preparing the first comprehensive stormwater plan for the newly incorporated city of University Place. The plan prepared an inventory of existing infrastructure, completed hydrologic and hydraulic assessment of drainage systems throughout the city, assessed local needs and regulatory mandates, developed capital and maintenance programs, and produced a revenue requirements model. Development of the plan was fast-tracked, completing the draft plan along with recommendations for implementing a stormwater utility within three months. Utility rate structure and fee schedule were promptly adopted one month later.

Stormwater Quality Management Plan, Anacortes, Washington, City of Anacortes. Managed preparation of grant-funded comprehensive stormwater plan for the city and adjoining areas of Skagit County. Plan established a prioritized capital improvement program, O&M plan, water quality assessment, regulatory analysis, financing strategy, and proposed development standards and ordinances. This plan specifically addressed allocation of funding and improvement responsibilities between the city and new development.

Waterways Asset Management Planning, San Jose, CA, Santa Clara Valley Water District. Technical Lead developing an approach to prepare asset management plans and long-term funding strategies for the waterways in nine watersheds. Conducted multiple workshops with staff across the District's stakeholder divisions: Maintenance, Engineering, Vegetation Management, Environmental Stewardship, Water Supply Operations, and Fisheries). Developed a framework for defining Level of Service (LOS) that connects Strategic Drivers (Board Ends Policies and Objectives), through LOS Standards, to Performance Measures. Also designed and led a multi-workshop process to generate and evaluate alternative management strategies for waterway assets along reaches of the Guadalupe River posing certain risk if not maintained and entailing significant costs.

Funding Development for Watershed Implementation Plan, Prince George's County, MD. Senior Technical Consultant guiding the County in developing new funding to implement a $1.2 billion program retrofitting drainage across the county to reduce phosphorous and nitrogen loading to the Chesapeake estuary. Developed an efficient means utilizing available tax account data with analyses prepared from the County's GIS to define the ratepayer base; defined criteria and evaluated alternative fee structures compliant with provisions of Maryland's House Bill 987; provided for on-site BMP credits and fee adjustments; and leveraged debt-financing approaches. Developed a recommended fee structure through workshops with multiple county departments over 4 months, and implemented the fees for distribution in July 2013. Project completed on an accelerated 11-month schedule.

Stormwater Utility Feasibility Study. Dover, New Hampshire, City of Dover. Technical Director for study assessing feasibility and implementation requirements for an enterprise stormwater utility to operate, maintain and improve stormwater infrastructure and programs needed to safeguard the city from flooding and meet new regulatory obligations. Using the City's GIS database, directed development of rate base model and alternative fee structures. Initiated advisory committee process engaging city council representatives and stakeholders to evaluate alternative policies and forward recommendations to the full Council.

Stormwater Utilities Comparison, Tacoma, Washington, Pierce County. Managed evaluation of County's water programs and performed comparisons with other Washington state jurisdictions subject to Phase I NPDES stormwater regulations. Assessed the various components of Pierce County's projects and activities and made side-by-side comparisons with other counties, major municipalities and the state Department of Transportation.

Surface Water Design Manual, Seattle, Washington, King County. As Project Manager, completed 1990 King County Surface Water Design Manual drafts and conducted public review and workshops. Later retained to manage consultant support to the county in preparing the 1992 interim updates, and key issue papers. Supervised the development of complementary software, (KCRTS), the county's BMP manual, and associated training program. The project work culminated in publication of the 1998 Surface Water Design Manual.

Stormwater Funding Implementation, Arlington, Washington, City of Arlington. Managed the evaluation of a stormwater utility and fee structure to fund the city's stormwater management activities to control flooding, protect water quality, construct and maintain the drainage infrastructure. Updated Arlington's prior Stormwater Management Plan by expanding program activities to include recent annexations and to comply with evolving state and federal NPDES and ESA regulations. Worked with a representative advisory committee to develop an equitable and acceptable fee structure that included both an impervious area-based fee structure and a system development charge.

Stormwater Utility Formation, Kirkland, Washington, City of Kirkland. Project Manager responsible for both developing Kirkland's Surface Water Master Plan and the subsequent enterprise utility formation process to fund the recommended program of capital improvements, maintenance, operations, policy enforcement, and regulatory compliance. Assisted the City in securing and administering state grant to support the utility formation process.

EPA TECHNICAL ASSISTANCE (DRAFT)

City of Santa Fe, New Mexico

[DRAFT] A Guide to Incorporating Green Infrastructure into Roadway Projects in Santa Fe

Why should you read this document? This document provides Santa Fe with information that can be shared among city departments/staff to encourage them to consider incorporating green infrastructure practices into roadway improvement projects. It is a basic primer. It will be available for the public to view, and may be shared with private developers and their engineers as part of a standard informational packet.
Who should read this document? City departments/staff and private developers/engineers involved in road redesign and reconstruction projects, redevelopment and urban renewal/revitalization, streetscape design, and maintenance of roadways and landscaping.

Table of Contents

1. Introduction

2. Considering Green Infrastructure within the Broader Project Development Process

3. Green Stormwater Infrastructure Practices

4. General Design Considerations

5. Maintenance of Green Infrastructure practices

6. Permitting/regulatory considerations

7. Example Design Concepts for Santa Fe Sites

8. References

Tree Trench

A tree trench is a type of infiltration trench containing one or multiple trees, which is located within street right-of-way (ROW) between the street and the sidewalk (2, 7). It combines the benefits of a street tree with the efficiency of a stormwater infrastructure element, providing multiple benefits to the surrounding human and natural environment using only minimal surface space. Most importantly, it provides an opportunity to infiltrate and evapotranspire stormwater and recharge the aquifer, reduce pollutants delivered to receiving waters, and reduce the burden that landscaping can have on potable water sources for irrigation. Tree trenches are typically designed for water quality treatment and to promote healthier tree growth (2, 7). With adequate space, the practice can provide modest flood reduction benefit (9). In a ROW, stormwater runoff enters the practice through the catch basins, passes through crushed stone, is conveyed through an underdrain to one or more tree plantings, fills void space, and exits back through the catch basin (7).

Benefits

- ✓ Recharges groundwater.
- ✓ Reduces pollutants/ improves water quality.
- ✓ Improves aesthetics.
- ✓ Increases habitat value.
- ✓ Provides shade / reduces urban heat island effects.
- ✓ Provides carbon sequestration.
- ✓ Improves air quality.
- ✓ Reduces long term irrigation needs/ potable water dependency.
- ✓ Uses minimal surface space.

Roadway/Transportation Application

- ✓ Roadway medians
- ✓ Roundabouts
- ✓ Rights-of-way/ vegetated roadway edge
- ✓ Curb and gutter roadways
- ✓ Pedestrian/ bike/multi-use paths
- ✓ ‘Complete’ streets for multi-modal transportation
- ✓ Parking lot islands/edges
- ✓ Cul-de-sacs
- ✓ Courtyards/patios

Design Considerations

Physical Site Characteristics

- ✓ Challenging on steep slopes. If slopes are greater 4-5%, then consider using a terraced approach.
- ✓ Consider if the site has shallow bedrock or high groundwater. A separation distance of 3 feet is recommended between the bottom of the practice and the seasonally high ground water table.

Design Elements

- ✓ Center the tree trench approximately 4-6 feet behind the back of curb to preserve the step-out zone on the curb side of the trees and the sidewalk on the other.
- ✓ Typical size of the soil media is 3 to 4 feet in width by 6-8 feet in length and up to 4 feet in depth, and when combined with a stone storage reservoir, cobbles, or porous rubber, it typically provides adequate space for tree roots to grow and expand. Proper sizing will help prevent sidewalk upheaval from root growth.
- ✓ Permeable pavement is an option above the tree trench to intercept additional stormwater and help to provide oxygen to the roots of the tree.
- ✓ Tree trench sections can be constructed back to back for any length desired. However, an inlet and water control structure is recommended for every three trees.

Soils

- ✓ Suitable soil infiltration rates required to prevent tree roots from drowning, or overflow mechanism needed for larger rain events.

Vegetation

- ✓ Aboveground or subsurface utilities can provide challenges. Select trees with maximum growth potential less than the height of the utility (usually about 30 ft). Factor in enough space so underground utilities are protected from roots and water.
- ✓ Tree selection should be well suited to tree trench size and distance to adjacent structures, to avoid conflicts or restrictions on root growth.
- ✓ Use xeriscaping. Xeriscaping uses vegetation compatible with the New Mexico environment and offers cooling and habitat, while using less water than other vegetation types.
- ✓ Water for trees should be applied as efficiently as possible and only when necessary. Drip, bubbler, and micro-spray systems or soaker hoses are appropriate for trees.

(1, 2, 4, 5, 6)

Pretreatment

- Pretreatment filter designed with media (e.g., pea gravel). (7)

Construction considerations

- Do not over-compact soil during the delivery of plants to the planting locations, digging of planting holes and installing plants. Compaction can reduce infiltration rates by increasing bulk density of the soil.
- Examine the surface grades and soil conditions; only plant when weather and soil conditions are suitable for planting the specified materials in accordance with locally accepted practices.
- When applicable, plant trees before other plants are installed. (13)

Maintenance

- Remove sediment and trash from the catch basin, and remove trash and dead vegetation from tree trench regularly.
- Upkeep of vegetation includes occasional weeding, pruning, removal of invasive species/pests.
- If mulch is used, check to see if it needs to be replaced.
- Turn or till soil if compaction occurs.
- Check for signs of erosion and improper root growth.
- Check that the irrigation system is functioning properly, and adjusting automatic irrigation systems as the seasons change. (4, 5, 7)
- Inspect underdrain for obstructions.

Planning level costs

Moderate cost/acre ($$). (17)

Graphics showing examples (to be inserted during page layout)

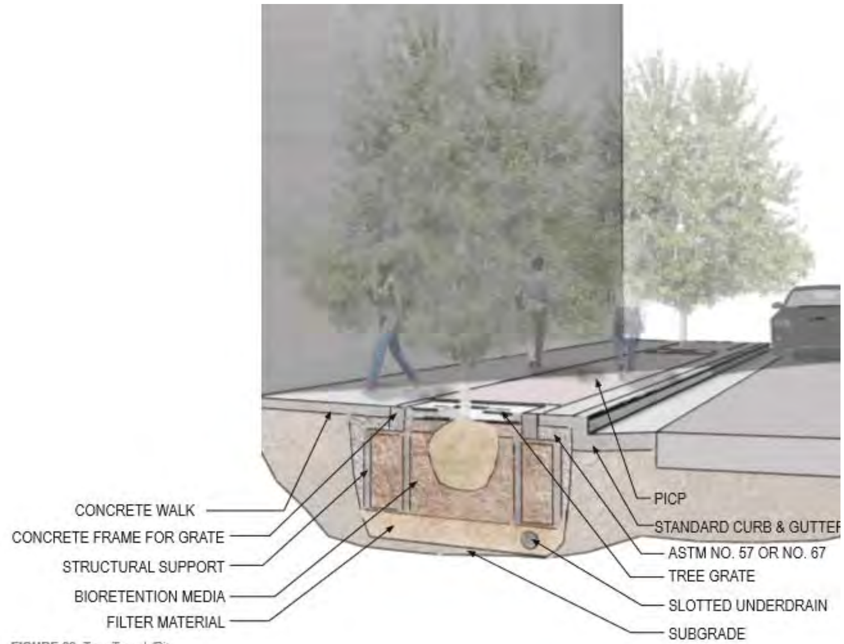


FIGURE 29. Tree Trench/Pit
(Source: Stream Design. 2015.)

Tree trench design (6)

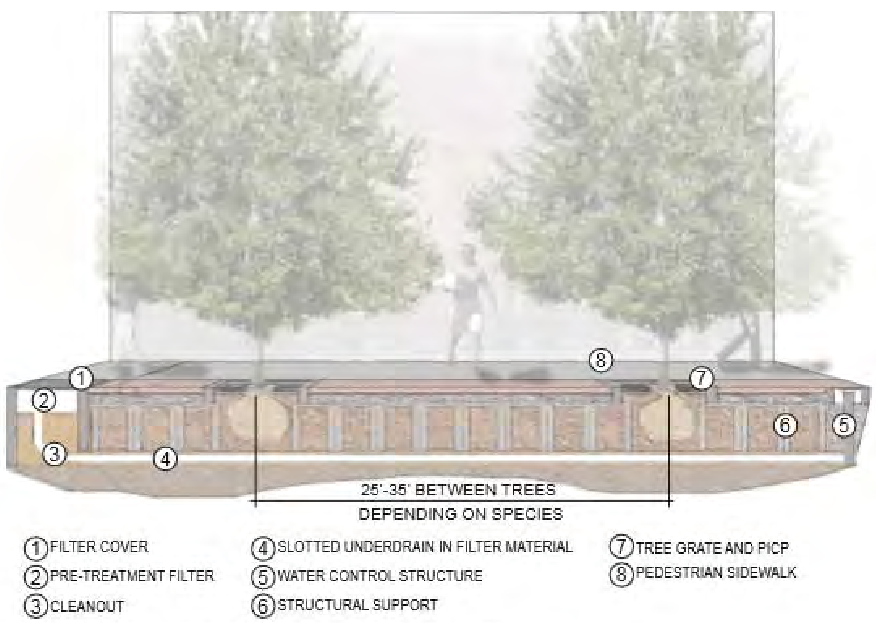


FIGURE 30 . Tree Trench/Pit Profile View (Source: Stream Design. 2015.)

Tree trench design (6)

Curb inlets to tree trench pavilions in parking lot in Albuquerque, NM (2)

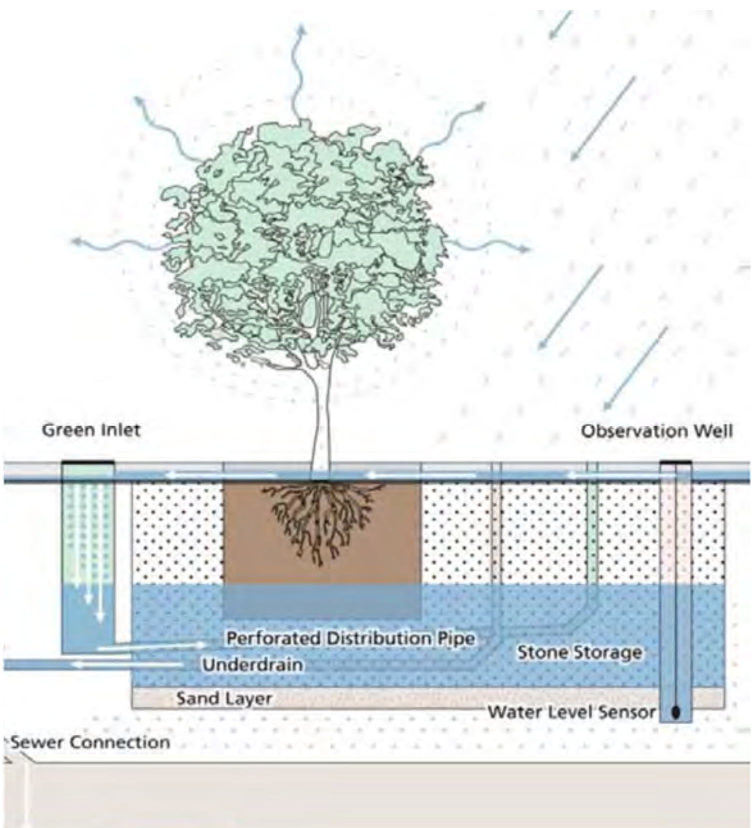


Diagram of tree trench (2)

Permeable Pavement

Permeable pavement is any paving material that allows rainfall to infiltrate where it falls, including permeable pavers, porous asphalt, pervious concrete, and supported gravel/aggregate soils (1, 2, 13). It provides the benefits of a stormwater infrastructure element without losing the functionality of traditional pavement. Most importantly, it provides an opportunity to infiltrate/retain stormwater, recharge the aquifer and reduce pollutants delivered to receiving waters. The porous paving materials are underlain by a designed sub-base that allows the percolation of stormwater through the sub-strata for temporary storage and/or infiltration (1, 13). Examples include porous asphalt, permeable friction course, pervious concrete, pavers, permeable interlocking concrete pavement, and concrete grid pavement.

Benefits

- ✓ Recharges groundwater
- ✓ Reduces pollutants/ improves water quality
- ✓ Prevents surface ponding during small rain events
- ✓ Reduces runoff temperatures
- ✓ Uses minimal surface space
- ✓ Reduces road noise
- ✓ Reduces roadway splash and spray, and reduces pollutant washoff from auto undercarriages
- ✓ Improves safety by reducing hydroplaning

Roadway/Transportation Applications

- ✓ Roadways
- ✓ Pedestrian/ bike/multi-use paths
- ✓ Parking lots
- ✓ Cul-de-sacs
- ✓ Courtyards/patios
- ✓ Areas with light traffic within commercial and residential sites

Design considerations

Physical Site Characteristics

- ✓ Permeable pavement is only recommended for gentle slopes (< 5%). The bottom of the infiltration bed should be flat, so consider terracing if needed.
- ✓ Consider potential groundwater contamination and depth to water table. Consider other solutions for drainage areas with gas stations, chemical storage areas, and other areas that could potentially have hazardous spills.
- ✓ Appropriate for use in light traffic areas where heavy loads are limited, due to the lower resistance to stress than traditional pavement.

Design Elements

- ✓ All permeable pavements have a similar structure, consisting of a surface pavement layer, an underlying stone aggregate reservoir layer, optional underdrains and geotextile over uncompacted soil subgrade, though details may vary; Design per manufacturer recommendation.
- ✓ Snow management should be considered. Avoid applying sand for traction since this can clog the surface material. Do not use as a storage area for plowed snow.
- ✓ Permeable pavement is appropriate for infiltrating the precipitation that falls directly on it. Directing additional accumulated runoff from adjacent impervious areas is not recommended, as it typically carries sediment and organics, and can easily clog the system and reduce infiltration capacity. However, if this approach is taken, the runoff should be pretreated to remove sediments and other pollutants that can potentially clog the system. For installations adjacent to traditional pavement, consider elevating the permeable areas to avoid runon.
- ✓ Run-off from adjacent vegetated areas is not recommended. However, it is not always avoidable. If it occurs, vegetated area must be stabilized and not generate sediment which could contribute to clogging of the permeable pavement.

Soils

- ✓ Suitable soil infiltration rates are required, or overflow mechanism needed for larger rain events. Amend or replace soils to improve permeability. For storms in excess of the infiltration/storage capabilities of the pavement the design should ensure that the excess runoff does not negatively impact downstream water bodies.
- ✓ Consider designs to address clay soils with high shrink-swell capacity. Increase the subbase depth and/or add geogrids to provide additional support.

(1, 2, 9, 11, 13, 19)

Pretreatment

- N/A

Construction considerations

- Do not over-compact basin soils, where relying on existing soils for infiltration. Compaction can reduce infiltration rates by increasing bulk density of the soil.
- Ensure that subgrades are properly installed to prevent the finish surface from becoming uneven over time.
- Identify appropriate materials and hold points for inspection and approval. Failure to follow the recommendations will likely cause premature structural failure.
  (1)

Maintenance

- Regular sweeping or vacuuming with a vacuum sweeper is required to ensure that clogging does not occur.
- Inspect for proper drainage and to identify any deterioration, cracks and settling.
- Inspect adjacent areas for sources of sediment like erosion of uphill areas and surrounding vegetation management activities that could impact performance like grass clippings, etc.
- Pervious pavements can reduce winter maintenance needs. Sand should not be used for winter maintenance, and environmentally friendly deicers should be used, and only as needed. Icing rarely occurs because water infiltrates instead of ponding and freezing.
- Snow plowing should be done with care to prevent chipping of pavement. Snow piles should not be stored on the surface because the generally contain sediment and debris which will clog the system as the snow melts.

(2, 13)

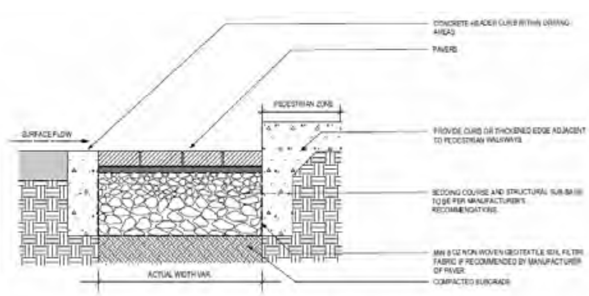
Cost considerations

Moderate to high cost/acre ($$$) (1)

Graphics showing examples (to be inserted during page layout)

Permeable pavement is combined with bioretention systems in this example from Gresham, Oregon. (photo credit: City of Gresham, https://www.sightline.org/2012/02/22/surprisingly-ambitious-permeable-projects/)

Permeable pavement design cross section (1)



Permeable pavement detail (1)

Urban example of permeable pavement (1)

Rural example of permeable pavement (1)

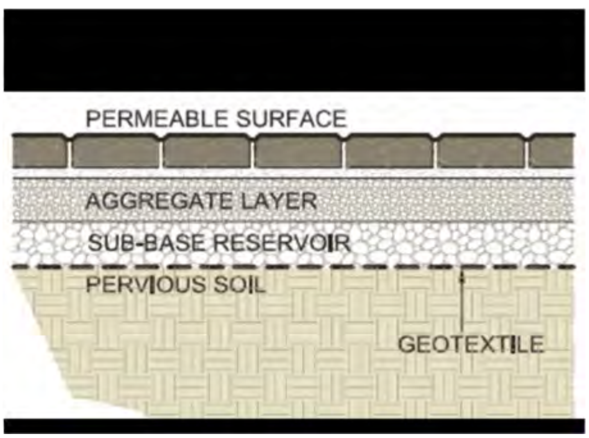


Diagram of permeable pavement (2)

Allston Way in Berkeley, California was completely renovated with permeable interlocking concrete pavers. (Photo Source: https://www.cleanwaterprogram.org/index.php/programs/green-infrastructure/greenstreets-examples.html)

Pavement Reduction

Reducing the area of pavement on a site, either by retrofitting an existing property or revising the initial design, reduces the volume of stormwater runoff generated at the site. It is the most effective way to preserve a site's predevelopment stormwater runoff characteristics (13). Through pavement reduction, remaining pervious areas on a site can absorb and infiltrate stormwater runoff (6, 13, 14). Impervious areas, such as roads, parking lots, building surfaces, walkways, and driveways, increase stormwater runoff volumes, and can contribute to flooding and streambank erosion (13). Impervious surfaces also facilitate the wash-off and transport of pollutants like oil, grease, nutrients, and sediment into downstream rivers, lakes and wetlands (13). A practical, simple, and cost-effective tool is to identify and remove unnecessary pavement in the design phase of a new development or during the retrofit phase of a redeveloped site (13). Pavement reduction occurs through the reduction in size of streets, sidewalks, driveways, parking spaces, and other impervious surfaces, which is also frequently employed for the purpose of improving roadway safety (13). Replacement surface treatment may include: hydroseeding, artificial turf, planting beds, washed gravel, permeable pavement/pavers, or vegetated stormwater management practices (6, 9). Pavement reduction can help protect or restore the natural hydrological conditions of a site and therefore reduces the stress that is put on downstream waters.

Benefits

- ✓ Recharges groundwater
- ✓ Reduces runoff rate and volume
- ✓ Reduces pollutants/ improves water quality
- ✓ Improves aesthetics
- ✓ Reduces the burden on/ size of downstream stormwater management systems
- ✓ Increases habitat value
- ✓ Improves public safety

Roadway/Transportation Applications

- ✓ Roadway medians
- ✓ Roundabouts
- ✓ Rights-of-way/ hell strips
- ✓ Curb and gutter roadways
- ✓ Pedestrian/ bike/multi-use paths
- ✓ 'Complete' streets for multi-modal transportation
- ✓ Parking lot islands/edges
- ✓ Cul-de-sacs
- ✓ Courtyards/patios

Design considerations

- ✓ Relies on small, distributed onsite practices
- ✓ Reduces area available for parking, travel lanes

  (14)

Narrow Streets

- Reduce street widths and improve traffic safety where feasible by eliminating underutilized on-street parking or reducing lane width
- Largely applicable in residential neighborhood roads.
- Local public works, police and fire departments, and residents who fear losing parking spaces and accessibility may object to narrower streets.

  (6, 13)

Slimmer Sidewalks

- Install sidewalks on one side of roads or combine them with multi-use paths located in backyard easements or natural areas where suitable to meet pedestrian needs. Whenever possible, these paths should be made of pervious materials.
- Use alternative development designs, such as cluster development, to reduce the length of roads, sidewalks, and other impervious areas.

  (6)

Right Sized Cul-de-sacs

- Minimize the diameter of residential street cul-de-sacs, consider hammerhead turnarounds or loop roads and/or incorporate landscaped islands. (13)

Right Sized Parking Lots

- Evaluate parking requirements considering average demand as well as peak demand.
- Consider the application of smaller parking stalls and/or compact parking spaces.
- Analyze parking lot layout to evaluate the applicability of narrowed traffic lanes and slanted parking stalls.
- Where appropriate, minimize impervious parking area by utilizing overflow parking areas constructed of pervious paving materials.
- Encourage shared parking arrangements with adjacent land uses.
- Enable owners/developers to provide proof of parking for required number of parking spaces while constructing only those that the owner/developer demonstrates are necessary.

  (10, 13)

Pretreatment

Not applicable

Construction considerations

Not applicable

Maintenance

- Dependent on the type of pervious surface installed.
- Examples: sweep periodically to remove accumulated debris, prune vegetation, mow turf, sweep gravel, and inspect drainage paths to ensure that adjacent conveyance structures are operable. (13)

Cost considerations

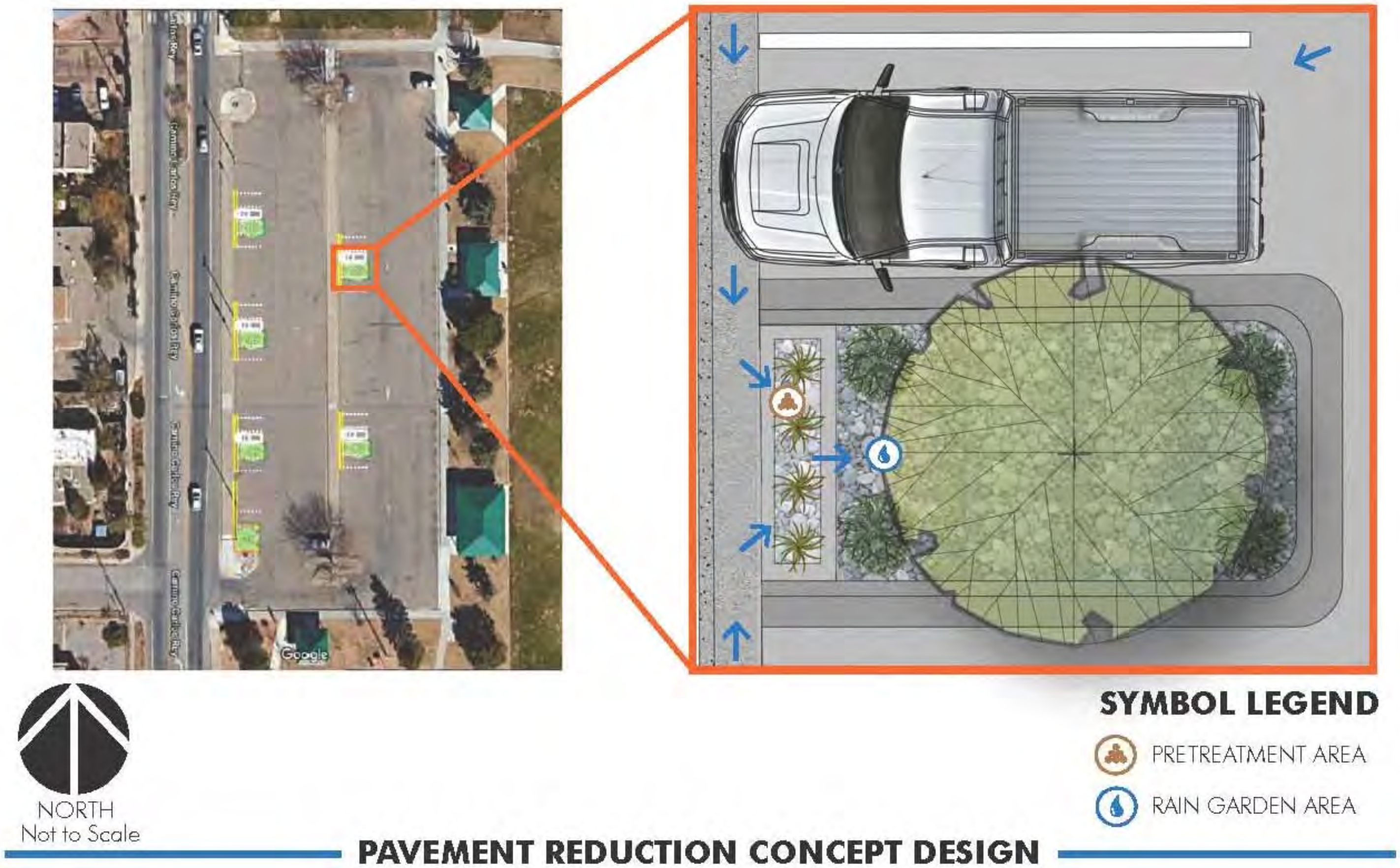
Low cost/acre ($), especially when incorporated into the initial design rather than removing pavement after construction.

If the natural, pervious surface is retained during the design phase, costs are comparatively lower than if an existing impervious surface is removed and re-vegetated.

Graphics showing examples (to be inserted during page layout)

Example of Removal of Impervious Surface (1)

Pavement from underutilized parking spaces being removed in General Miles Park and replaced with rain gardens to promote infiltration. (Photo credit: Santa Fe Watershed Association)



Pavement from underutilized parking spaces being removed in General Miles Park and replaced with rain gardens to promote infiltration. (Graphics credit: Initial concept plans were produced by Southwest Urban Hydrology for use by Santa Fe Watershed Association)

Bioswales

Bioswales are broad, shallow, vegetated depressions designed to convey, treat and infiltrate stormwater runoff. They serve as both an attractive, sustainable landscaping element within a roadway setting and a stormwater infrastructure element, and they provide multiple benefits to the surrounding human and natural environment. Most importantly, they provide an opportunity to infiltrate stormwater and recharge the aquifer, reduce pollutants delivered to receiving waters, and reduce the burden of landscaping on potable water sources for irrigation. They are similar in function to bioretention systems except that they are linear and provide some conveyance of runoff. In the arid southwest, swales can be designed with a hard edge to promote linear conveyance of stormwater runoff from impervious surfaces to localized basins (1, 2). Check dams incorporated into the swale design allow water to pool and infiltrate into the underlying soil or engineered media, thus increasing the volume of water treated, especially in areas with steeper slopes (13).

Benefits

- ✓ Recharges groundwater.
- ✓ Reduces runoff rate and volume.
- ✓ Reduces pollutants/ improves water quality.
- ✓ Prevents surface ponding during small rain events.
- ✓ Improves aesthetics.
- ✓ Increases habitat value.
- ✓ Provides shade / reduces urban heat island effects.
- ✓ Provides carbon sequestration.
- ✓ Improves air quality.
- ✓ Reduces long term irrigation needs/ potable water dependency.

Roadway/ Transportation Applications

- ✓ Roadway medians
- ✓ Rights-of-way/ vegetated roadway edge
- ✓ Curb and gutter roadways
- ✓ Pedestrian/ bike/multi-use paths
- ✓ 'Complete' streets for multi-modal transportation
- ✓ Parking lot islands/edges

Design Considerations

Physical Site Characteristics

- ✓ Challenging on steep slopes. Make longitudinal slope as flat as possible, and not greater than 5%. Check dams or V-weirs can be incorporated in steep-sloped settings to prevent erosion by reducing flow velocity. Check dams or weirs can also enhance treatment by increasing the volume of water retained and increasing the contact time between soil or media and runoff water.
- ✓ Consider if the site has shallow bedrock or high groundwater. Avoid groundwater contamination by separating the practice from the groundwater table. A separation distance of 3 feet is recommended between the bottom of the excavated bioretention area and the seasonally high ground water table.
- ✓ Consider using other solutions for drainage areas with gas stations, chemical storage areas, and other areas that could potentially have hazardous spills.

Design Elements

- ✓ Consider amount of nearby pedestrian activity and provide walkways or bridges across the practice if needed to allow for unimpeded movement.
- ✓ Design to avoid conflicts to subsurface utilities.
- ✓ Install appropriate erosion and flow dissipaters at the entry and exit points of the swale.

Soils

- ✓ Soils must have a suitable infiltration rate (>0.5 inches/hour). If the infiltration rate is low (<0.5 inches/hour) consider including a perforated underdrain connected to the drainage network to reduce overflows and increase safety. Other alternatives include amending soils, installing a minimum 12" sand layer under the basin, or using a dry swale with engineering media instead.
- ✓ Not suitable for highly erodible soils.
- ✓ Soils must be native or amended soils suitable to sustain the selected vegetation.

Vegetation

- ✓ Vegetation should be native, drought tolerant, salt tolerant, and able to withstand periodic inundation. (1, 2, 8, 12, 13)

Pretreatment

- Sediment forebay, vegetated filter strips/side slopes, water quality inlets.
- Bioswales can also serve as pretreatment to a bioretention or bioinfiltration system (12, 13).

Construction considerations

- Do not over-compact basin soils, where relying on existing soils for infiltration. Compaction can reduce infiltration rates by increasing bulk density of the soil. Avoid using heavy equipment directly on bioswale soils during site preparation and construction.
- Identify appropriate materials and specify times for inspection and approval.
- During construction, avoid use sediment and erosion control measures to prevent sedimentation from upgradient construction activities to avoid clogging of the swale. When practical, complete upgradient work prior to swale installation.
(1, 13)

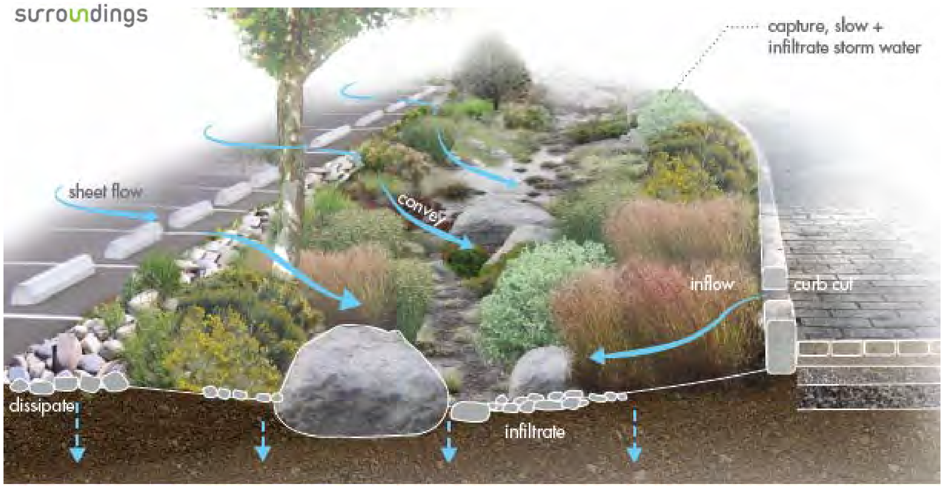
Maintenance

- Inspect at least annually for adequate perennial vegetation coverage, erosion and degradation of side slopes.
- Remove sediment, trash and dead vegetation at inlets and outlets to avoid clogging.
- Manage vegetation by regular weeding, pruning, removing invasive species, and revegetating as needed.
(1, 12, 13, 14)

Cost considerations

- Low to moderate cost/acre ($$) (1).
- Potentially less expensive installation costs than expensive curb and gutter systems (13).

Graphics showing examples (to be inserted during page layout)



Concepts provided by Surroundings Studio, Santa Fe, New Mexcio

Example design of a vegetated swale/ bioswale (1)

Example of a bioswale with bioretention/bioinfiltration taking stormwater from a parking Lot (2)

Bioretention System

A bioretention system is a shallow landscape depression sited at a low point and designed to collect and treat (and sometimes infiltrate) stormwater runoff (1, 2). It serves as both an aesthetically pleasing, sustainable landscaping element within a roadway setting and a stormwater infrastructure element, and it provides multiple benefits to the surrounding human and natural environment. Most importantly, bioretention systems provide an opportunity to retain or infiltrate stormwater and recharge the aquifer, reduce pollutants delivered to receiving waters, and reduce the burden of landscaping on potable water sources for irrigation. Bioretention practices are typically designed for water quality treatment through filtration, biological uptake and microbial activity (1, 2, 9). With adequate space, they can provide some flood storage (9). They can also be designed for double duty as roadway bump-outs that provide traffic calming and improve pedestrian safety by reducing the length of cross-walks.

Benefits

- ✓ Recharges groundwater.
- ✓ Prevents surface ponding during small rain events, but must include an overflow mechanism to accommodate heavy rainfall events.
- ✓ Reduces pollutants/ improves water quality.
- ✓ Improves aesthetics.
- ✓ Increases habitat value.
- ✓ Provides shade / reduces urban heat island effects.
- ✓ Provides carbon sequestration.
- ✓ Improves air quality.
- ✓ Reduces long term irrigation needs/ potable water dependency.

Roadway/Transportation Applications

- ✓ Roadway medians
- ✓ Roundabouts
- ✓ Rights-of-way/ vegetated roadway edge
- ✓ Curb and gutter roadways
- ✓ Pedestrian sidewalks/ bike/multi-use paths
- ✓ 'Complete' streets for multi-modal transportation
- ✓ Parking lot islands/edges
- ✓ Cul-de-sacs
- ✓ Courtyards/patios

Design considerations

Physical Site Characteristics

- ✓ Challenging on steep slopes. Incorporate diversion berms, check dams, or terraces so bottom is relatively flat sloped (1-5%).
- ✓ Consider if the site has shallow bedrock or high groundwater. Use in areas where porous underground material (i.e. tuff) is at least 18" below the bottom of the practice (1). Avoid groundwater contamination by separating the practice from the groundwater table. A separation distance of 2 feet is recommended between the bottom of the excavated bioretention area and the seasonally high ground water table.
- ✓ Consider potential groundwater contamination. Consider using other solutions for drainage areas with gas stations, chemical storage areas, and other areas that could potentially have

hazardous spills.
- ✓ Consider the drainage area. The practice typically serves a highly impervious area less than 2 acres in size, and the surface area of the practice should be approximately 3-6% of the contributing drainage area. Sediment trap or forebay should be sized to contain 5 percent of the total detention volume.

Design Elements
- ✓ Top elevation of sediment trap interior wall should be a minimum of 4” below gutter inlet elevation.
- ✓ Interior wall at planting area should be a maximum 4” below gutter inlet elevation.
- ✓ Consider amount of nearby pedestrian activity and provide walkways or bridges across the practice if needed to allow for unimpeded movement.
- ✓ Design to avoid conflicts to subsurface utilities.

Soils
- ✓ Soils must have a suitable infiltration rate (>0.5 inches/hour). If the infiltration rate is low (<0.5 inches/hour) consider amending soils, including an underdrain to allow overflow, or installing a minimum 12” sand layer under the basin.
- ✓ Reduce soil compaction by either mixing with soil amendments or replacing with structural soils or other suitable soil media.
- ✓ Soils must be suitable to sustain the selected plantings. In general, tree soils require more moisture holding capacity than soils that support herbaceous plants or xeriscape.

Vegetation
- ✓ Vegetation should be drought tolerant, able to withstand periodic inundation, and salt tolerant.
- ✓ Planting zone should be stabilized with 3” depth of shredded wood or rock mulch (crushed rock, pea gravel, or small stones).

  (1, 3, 4, 6, 9, 13, 18)

Pretreatment
- Sediment forebay/sediment trap, bioswale, gravel or stone diaphragm.

Construction considerations
- Where relying on existing soils for infiltration, do not over-compact basin soils. Compaction can reduce infiltration rates by increasing bulk density of the soil.
- Identify appropriate materials and hold points for inspection and approval.

  Ensure maintenance access is included in the design and construction of the practice.(1, 13)

Maintenance
- Inspect for the following at least annually, and repair as needed:
  - adequate perennial vegetation coverage; erosion; degradation of check dams and others structures; debris, trash and sediment accumulations; and to ensure runoff flows through the full length of the practice
- Prune trees and shrubs, remove dead vegetation, and remove plantings as needed to avoid overcrowding.
- Check for and remove invasive species.
- Do not mow vegetation.

- Remove sediment from the forebay regularly.
- Remove trash and dead vegetation regularly.
- Stabilize any areas to prevent erosion.
- If soils become compacted, turn or till soils.

(1)

Cost Considerations

- Low cost/acre for rural applications ($-$$). Can be moderate to high for urban locations ($$$). (1)

Graphics showing examples (to be inserted during page layout)

Example of a Bioretention Basin, Acequia Underpass (Photo Credit: Leroy Pacheco, City of Santa Fe)

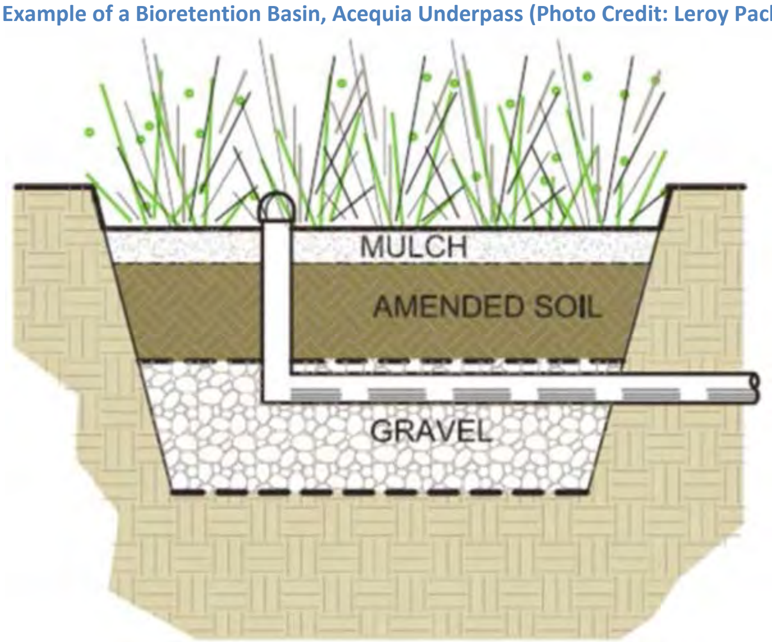


Diagram of bioretention system with under-drain and infiltration into the subsurface (2)


A small bioretention system was constructed in 2016 by retrofitting an existing vacant curb median at the intersection of Espinacitas and Hopewell streets in Santa Fe. (Photo credit: Santa Fe Watershed Association).

West Alameda rain garden, near Sicomoro Street, in Santa Fe, NM (Photo credit: Santa Fe Watershed Association).

DESIGN NARRATIVE

There is merit for both new development and retrofit efforts for this application. With respect to retrofitting an existing parking lot, the process begins by identifying under utilized space. Taking initiative to reduce pavement and adding multi-purpose green space improves the parks sense of place while reducing environmental impacts. For new development projects, integrating green infrastructure early in the process often results in a more successful installation. Discussing maintenace expectations and capabilities, while also using green infrastructure features as an educational amentity, or to reinforce sight lines, or even as a buffer for incompatible uses. Often times green infrastructure is value-engineered out of public improvements projects for a multitude of reasons. Including stakeholders and community members within the design process by outlining the benefits may increase the likelihood of funding beautiful, successful, and high-performing landscape features.

BENEFITS

Reduces Under Utilized Pavement
Provides Canopy Cover
May Reduce Heat Island Effect
Potential for Education
Provides Wildlife Habitat
Captures and Infiltrates Runoff On-site
Straight Forward Maintenance Access
Improves Aesthetics
Softens Park Entrance

CONSIDERATIONS

Ornamental grasses require additional water and care
Cool season grasses require deep, root watering weekly
Sediment traps should be designed for easy maintenance
Provide sediment protection during construction
Remove silt from surface to improve drainage

RAIN GARDEN BUMP OUT CONCEPT DESIGN

Potentilla fruticosa - Potentilla

Spiraea japonica - Spiraea 'Goldflame'

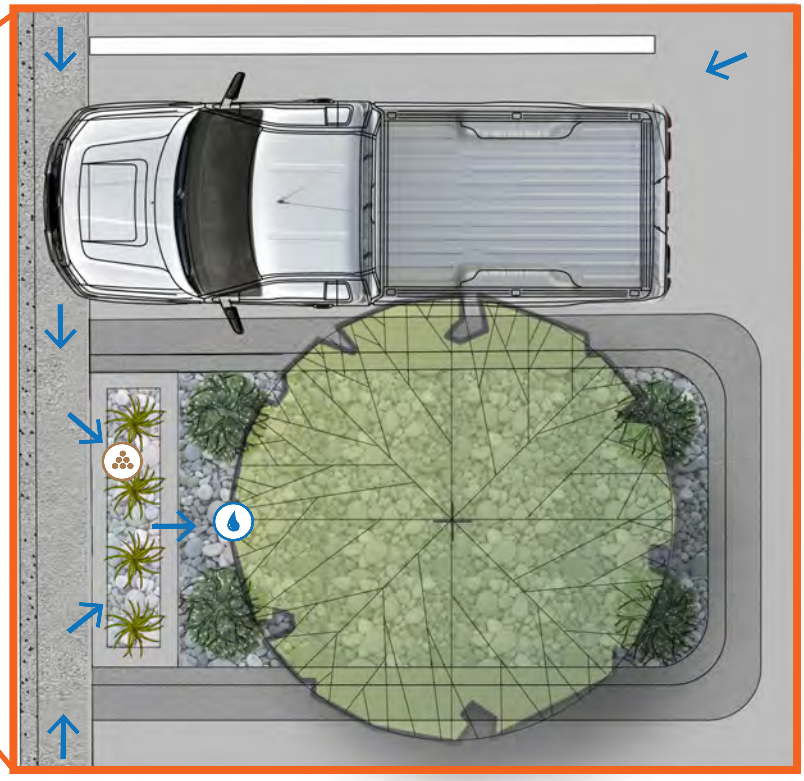
Juniperus sabina - Buffalo Juniper

Festuca ovina 'Glauca' - Blue Fescue

Calamagrostis x acutiflora - Feather Reed

Helictotrichon semperirens - Blue Oatgrass

SUGGESTED RAIN GARDEN PLANTING PALETTE



NORTH
Not to Scale

SYMBOL LEGEND

- PRETREATMENT AREA
- RAIN GARDEN AREA

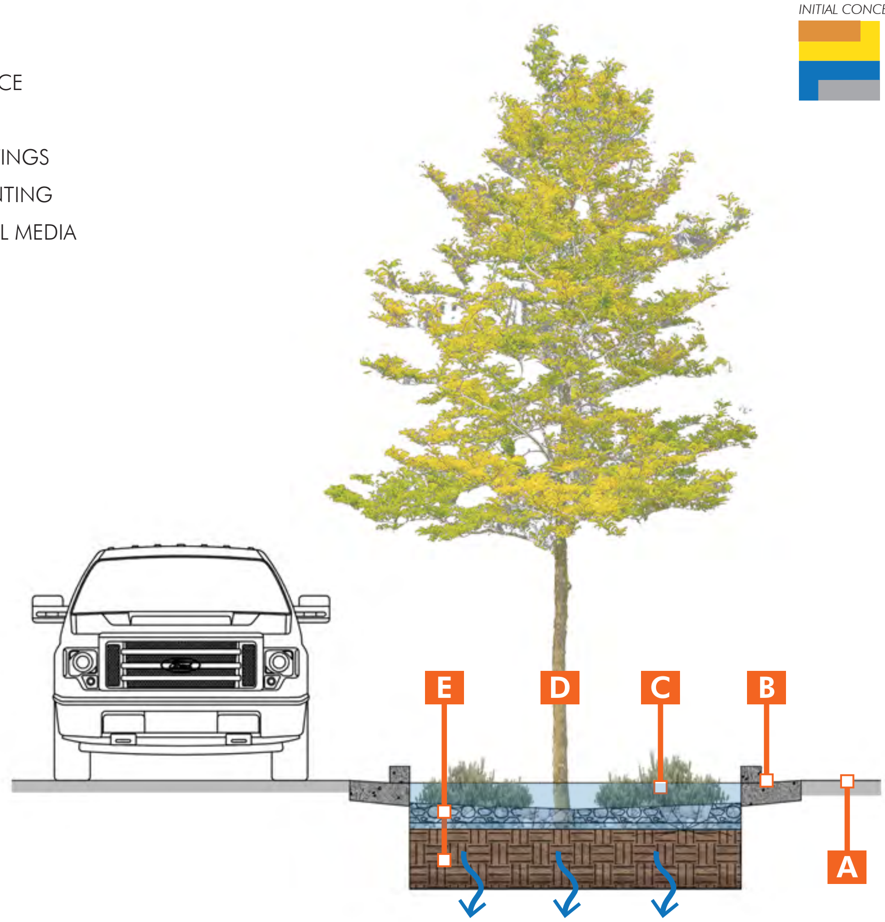
PAVEMENT REDUCTION CONCEPT DESIGN

INITIAL CONCEPT PLANS WERE PRODCUED BY:
Southwest UrbanHydrology

CALLOUTS

- **A** PARKING / ROADWAY SURFACE
- **B** CURB BORDER
- **C** DROUGHT TOLERANT PLANTINGS
- **D** URBAN TOLERANT TREE PLANTING
- **E** STONE COVER & SANDY SOIL MEDIA

** GEOMEMBRANE LINER ON SIDEWALLS ONLY*



RAIN GARDEN BUMP OUT TYPICAL CONSTRUCTION DETAIL

DESIGN NARRATIVE

Locating a bioretention area within the center circle requires superelevating the roundabout inward. The current design concept illustrates three inlets, all directing runoff into sediment forebays. All three forebays are given adequate shoulder space for maintenance The flat forebay should be designed with a hard, porous surface. A weir will detain the first flush of runoff to trap trash and debris. Runoff is then conveyed over the weir and into the bioretention area. Bioretention areas should be planted with drought tolerant, native plants which can tolerate temporary inundation. To increase public safety, this concept includes a perforated underdrain and heavy-duty overflow structure to convey excess runoff to the drainage network.

BENEFITS

Improves Aesthetics
Creates Wildlife Habitat
Emergency Overflow Connections
Lower Comparative Install Call
Potential for Education
Activates Under Utilized Space
May Reduce Flooding
Maintenance Access Via Turnout Bays
May Provide Canopy Cover

CONSIDERATIONS

Requires Traffic Safety Evolutions
Higher Comparative Maintenance Cost & Effort
Concentrates Runoff to One Location
Cost Varies Depending on Material Selection
May Interfere with Subsurface Utilities

BIORETENTION CONCEPT DESIGN

Nolina microcarpa - Beargrass

Nassella tenuissima - Threadgrass

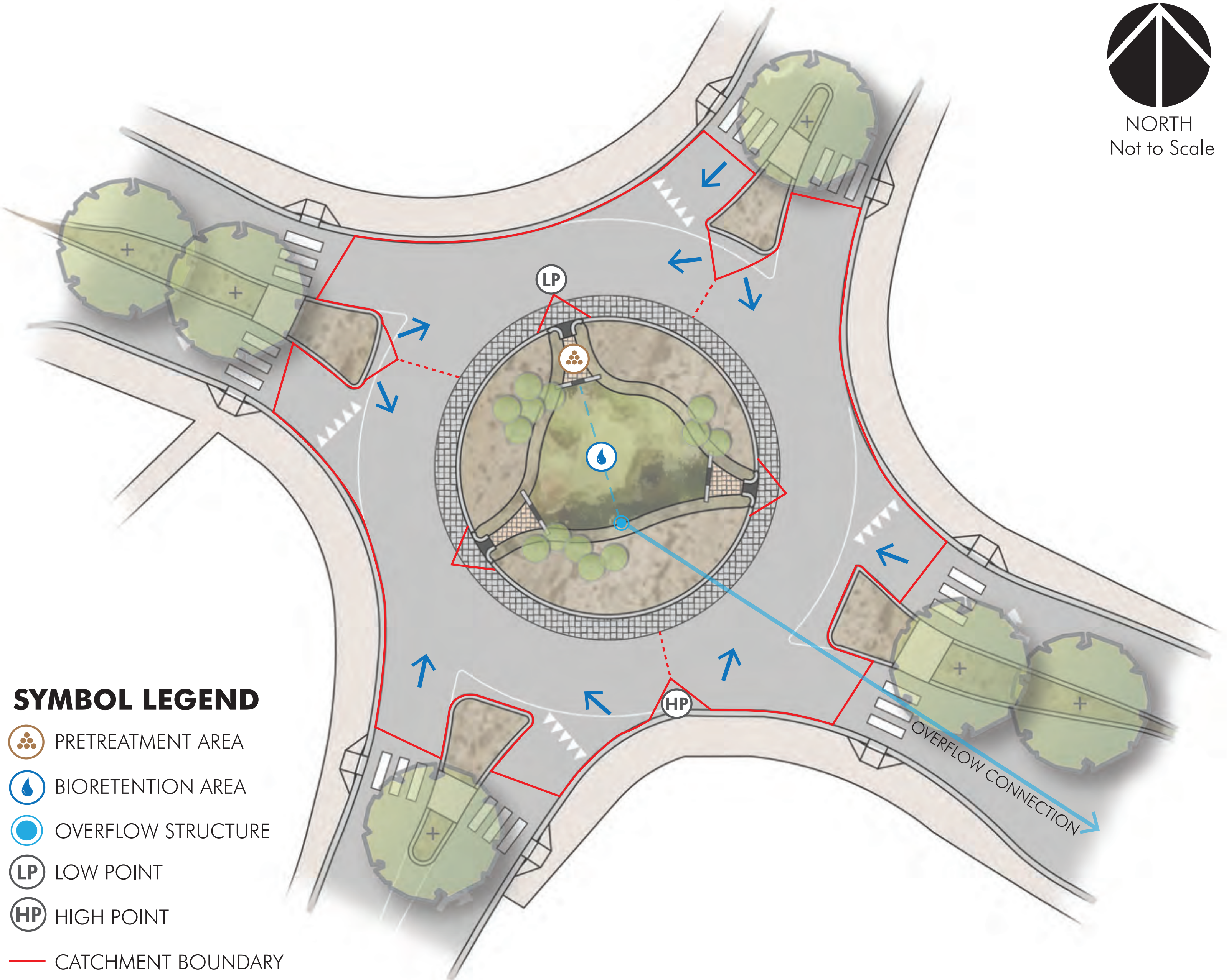
Fallugia paradoxa - Apache Plume

Dasylirion wheeleri - Sotol

Ericameria nauseosa - Chamisa

Hesperaloe parviflora - Red Yucca

SUGGESTED BIORETENTION PLANTING PALETTE

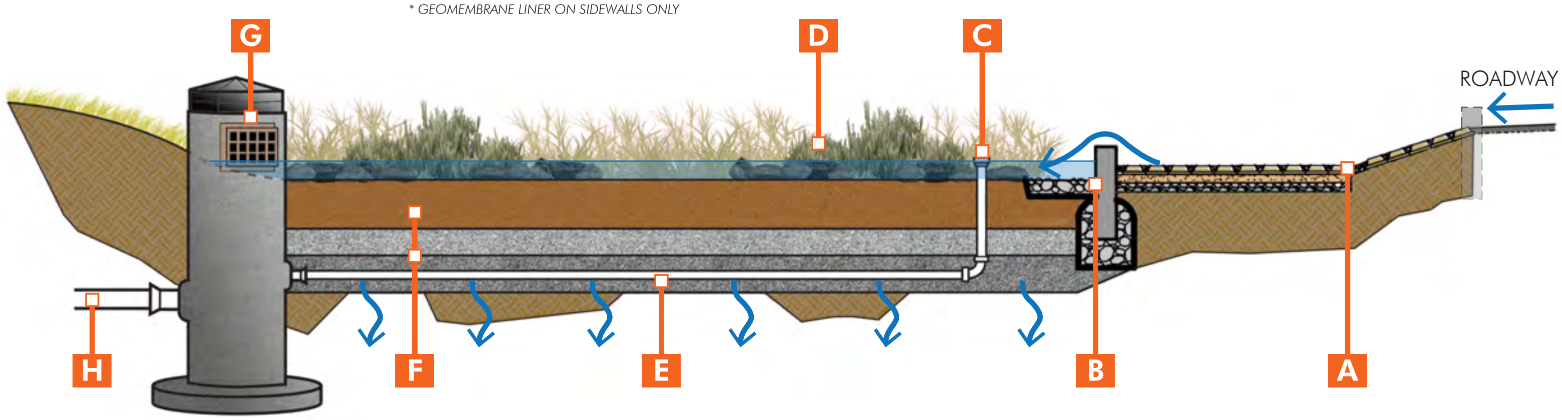


BIORETENTION CONCEPT DESIGN

CALLOUTS

- **A** PERMEABLE SEDIMENT FOREBAY
- **B** WEIR & STONE SPLASH PAD
- **C** CLEANOUT / OBSERVATION PORT
- **D** DROUGHT TOLERANT PLANTINGS
- **E** PERFORATED UNDERDRAIN
- **F** BIOSOIL & GRAVEL RESERVOIR
- **G** OVERFLOW STRUCTURE
- **H** OVERFLOW CONNECTION

** GEOMEMBRANE LINER ON SIDEWALLS ONLY*



BIORETENTION TYPICAL CONSTRUCTION DETAIL

DESIGN NARRATIVE

Utilizing tree trenches encourages smaller subcatchments. This eliminates the concentration of runoff to one collection area, unlike the bioretention concept. Tree trenches require pretreatment which is graphically shown as a deep sump catchbasin. Frequent sediment cleanout is required to maintain performance. A deep sump catchbasin is a small footprint, pretreatment option. Landscape maintenance is also simplified which may include pruning, removal of dead branches, and weeding at the base. Similar to the bioretention concept, each tree trench includes a perforated underdrain for emergency overflow situations to increase public safety during extreme storm events. Small rain events will enter the trench, irrigate the root zone and infiltrate downward through the filter media.

BENEFITS

Provides Canopy Cover
May Reduce Heat Island Effect
Distributes Runoff Load
Potential for Overflow Connections
Lower Comparative Maintenance Cost

CONSIDERATIONS

May Impede Sight Lines
Higher Comparative Installation Cost
Easy Maintenance with Vactor Truck
May Interfere with Subsurface Utilities

TREE TRENCH CONCEPT DESIGN

Quercus macrocarpa - Bur Oak

Ulmus carpinifolia x parvifolia 'Frontier' - Elm

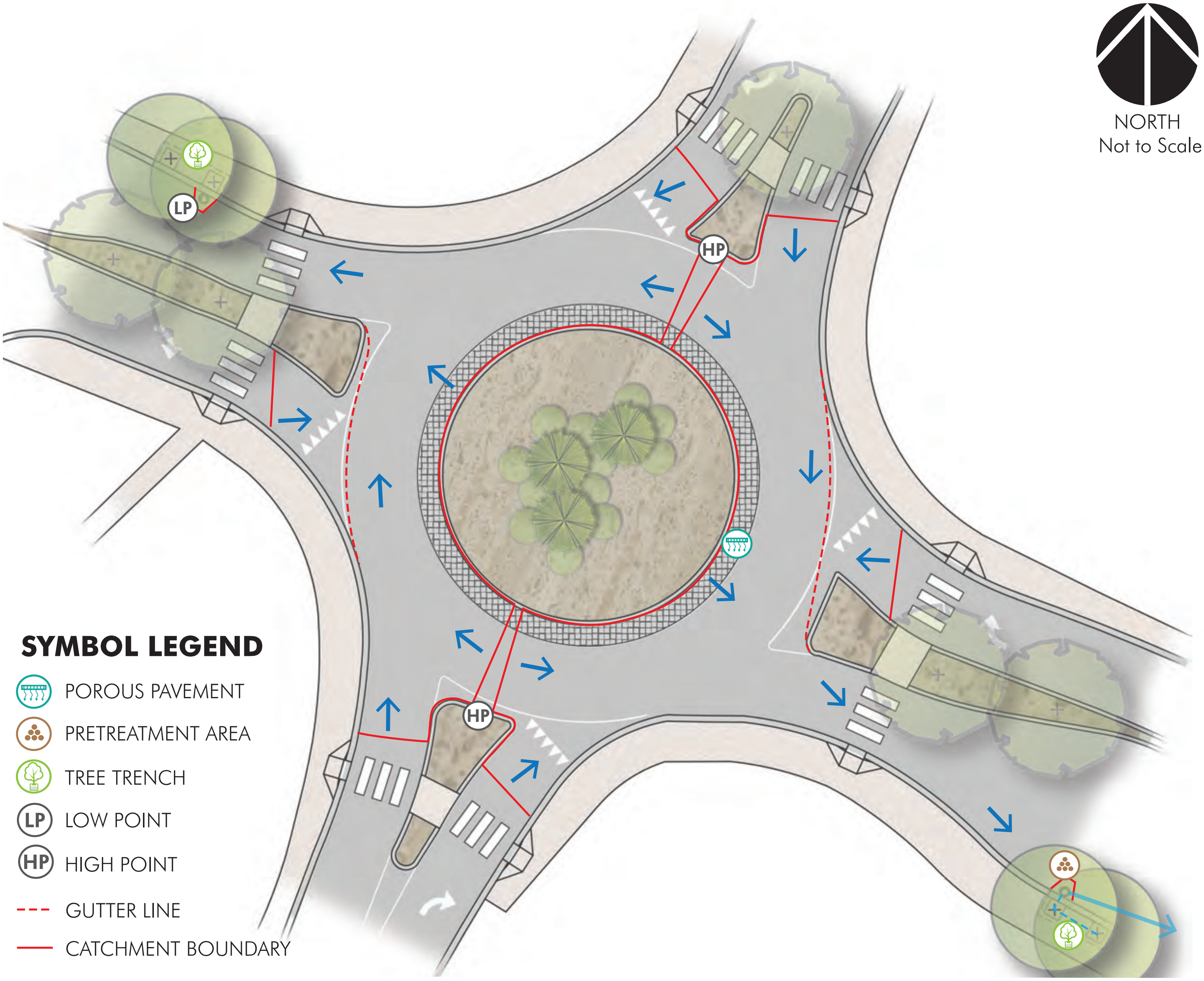
Gingko biloba - Maidenhair Gingko

Celtis occidentalis - Common Hackberry

Fraxinus americana 'Autumn Purple' - Ash

Gleditsia triacanthos - Honeylocust

SUGGESTED TREE TRENCH SPECIES

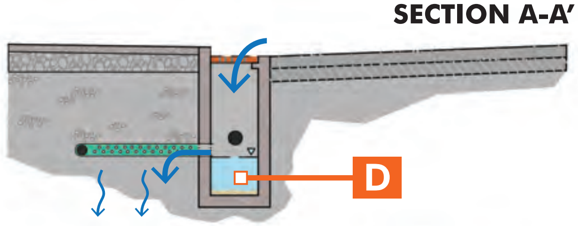


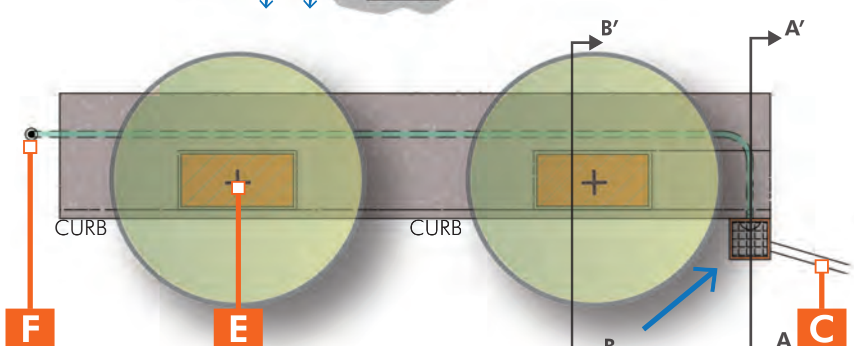
TREE TRENCH CONCEPT DESIGN

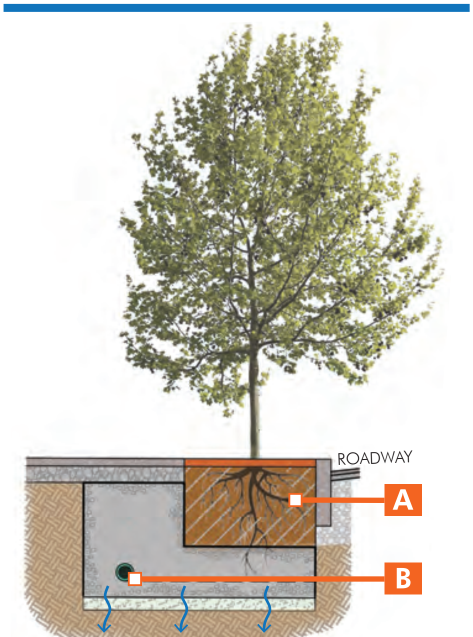
CALLOUTS

- **A** TREE PIT
- **B** PERFORATED UNDERDRAIN
- **C** EMERGENCY OVERFLOW PIPE
- **D** DEEP SUMP CATCHBASIN
- **E** TREE PLANTING
- **F** CLEANOUT / OBSERVATION PORT

SECTION A-A′

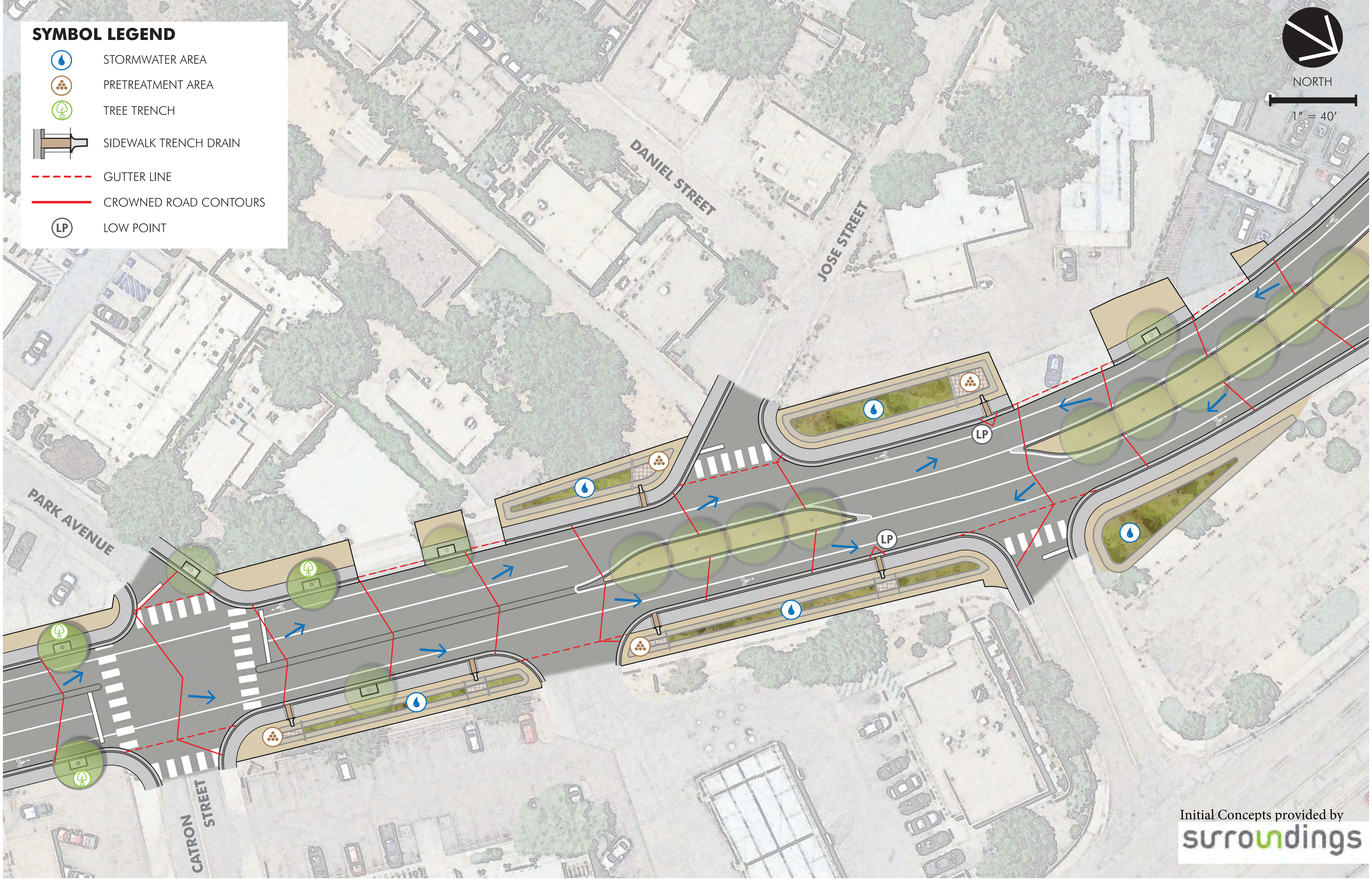




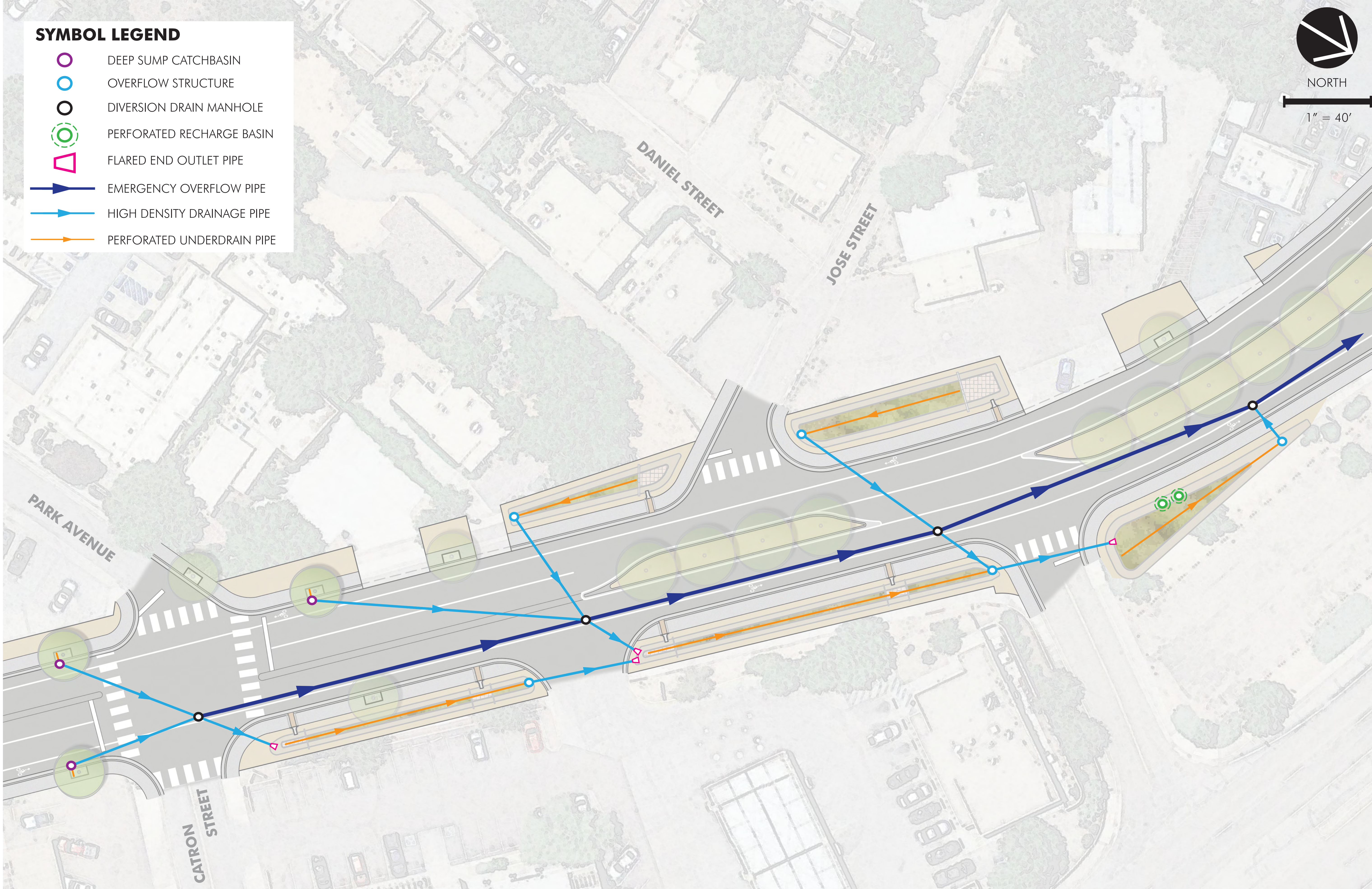


SECTION B-B′

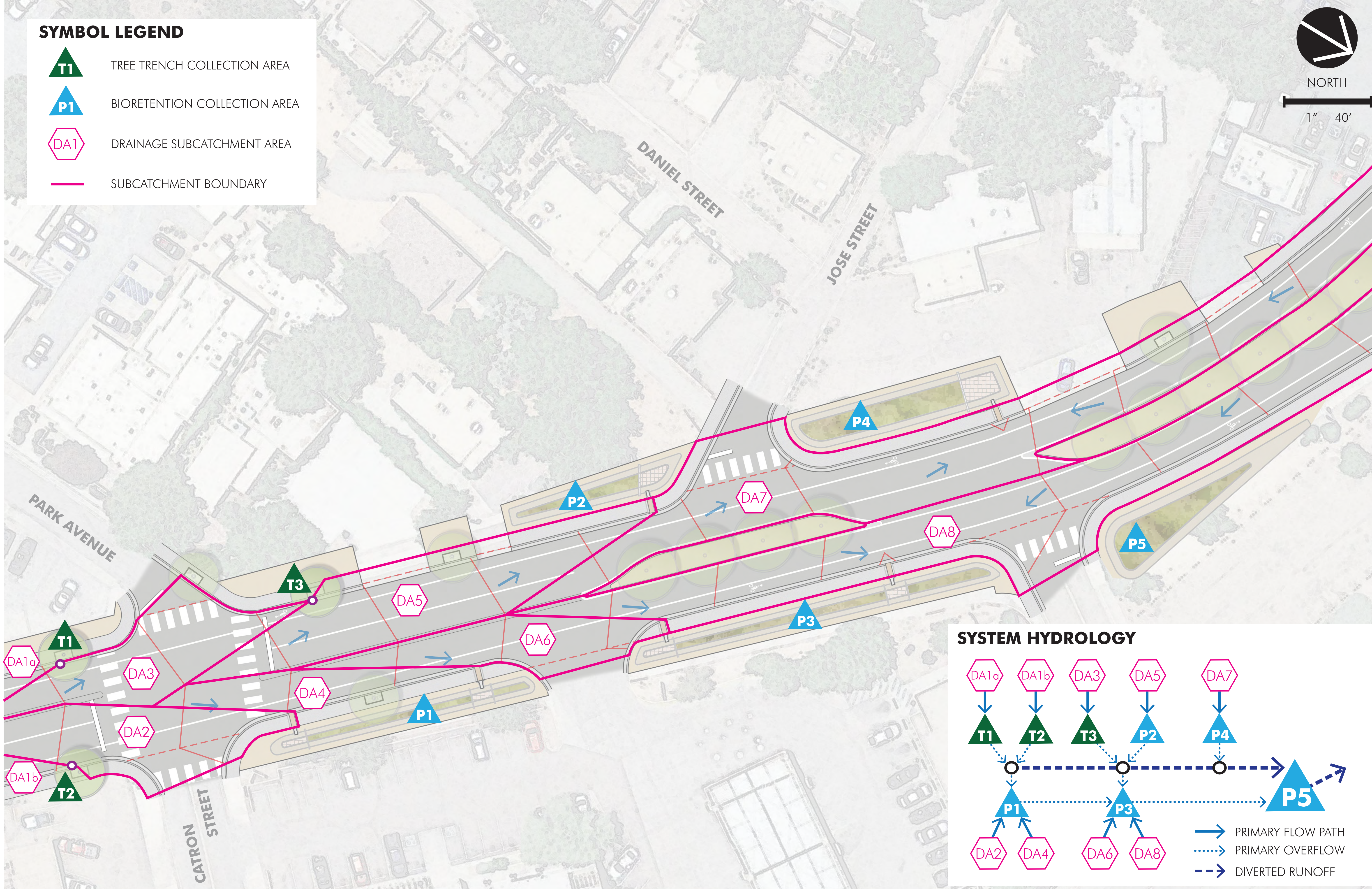
TREE TRENCH TYPICAL CONSTRUCTION DETAIL



CONCEPTUAL GREEN INFRASTRUCTURE DESIGN



CONCEPTUAL DRAINAGE NETWORK



CONCEPTUAL DRAINAGE AREAS

[DRAFT] GOVERNMENT FUNDING OPPORTUNITIES FOR STORMWATER MANAGEMENT IN SANTA FE

Photograph: Santa Fe River in the vicinity of El Alamo Park (Source: PG Environmental).

PREFACE

Long-term stormwater planning promotes effective stormwater management while also supporting a community's broader vision and goals, such as flooding reduction, increased neighborhood aesthetics, improved recreational opportunities through water quality improvement and public health protection. Long-term stormwater planning can also support a community's resilience, economic growth, infrastructure improvement, environmental compliance and overall quality of life. Establishing a vision and well-constructed plan for accomplishing stormwater program goals can also help open the door to potential new sources of funding by strategically identifying long-term community goals and better aligning activities with a comprehensive water resource management focus. Communities may be able to save money and find multiple benefits by looking comprehensively at multiple long-term planning efforts to incorporate stormwater early into planned projects.

Santa Fe, New Mexico is one of four communities that participated in a U.S. Environmental Protection Agency (EPA) voluntary technical assistance effort to improve long-term stormwater planning. These communities worked with EPA to explore ways to sync planned and future activities with long-term stormwater planning, utilizing the general process outlined in EPA's *draft* Community Solutions for Stormwater Management: A Guide for Voluntary Long-Term Planning.

Often, stormwater is dealt with in a reactive way. Problems are fixed when they arise until the next time it happens again with little thought being put into long-term solutions. This cycle prevents for a more proactive solution to be identified and implemented. Santa Fe decided to work on this long-term stormwater planning effort to break this cycle and be more proactive to look for ways to save their community money and make improvements to the community and its waters. With this new approach, Santa Fe is committing to looking for long-term solutions to make real improvements for Santa Feans that are based on the community's identified needs, wants, and vision.

Through the technical assistance effort, the city and EPA have worked together to identify and address several of the city's long-term stormwater goals, including developing a guidebook for design and implementing green infrastructure on roadway projects as well as information on pursuing government funding opportunities.

TABLE OF CONTENTS

INTRODUCTION 1
1. INTEGRATE STORMWATER MANAGEMENT INTO EXISTING CITY PLANNING EFFORTS 3
2. LEVERAGE STRATEGIC PARTNERSHIPS 5
State Partners and Opportunities 5
Regional and Local Partners and Resources 7
3. IDENTIFY FUNDING OPPORTUNITIES 9
Know the Value of Stormwater 9
Pick the Right Project 10
4. LEARN FROM PAST EXPERIENCE 12
Past Attempts 12
Lessons Learned 12
Making Improvements 12
Success Story: The Acequia Trail Underpass 13
5. POTENTIAL OPPORTUNITIES FOR SANTA FE 15
EPA Clean Water State Revolving Fund (CWSRF) 15
USDOT Better Utilizing Investments to Leverage Development (BUILD) Grant Program 19
U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) Program 22
EPA Section 319 Grant Program 24
REFERENCES 26

Appendix A: Case Study – Santa Fe Metropolitan Planning Organization 28
Project Planning and Funding 28
Integrating Stormwater into MPO Projects 29
MPO Projects in Santa Fe 30
Appendix B: Case Study – Southern Sandoval County Arroyo Flood Control Authority 31
Long-term Planning Approach 31
Federal Funding Portfolio 32
Project Example: Lower Montoyas Water Quality Feature 33
Appendix C: Summary of Potential Federal Funding Opportunities 34

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

BMP	Best management practice
BUILD	Better Utilizing Investments to Leverage Development
CDBG	Community Development Block Grant
CMAQ	Congestion Mitigation and Air Quality Improvement Program
CPB	Construction Programs Bureau
CWSRF	Clean Water State Revolving Fund
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GI	Green infrastructure
HSIP	Highway Safety Improvement Program
HUD	U.S. Department of Housing and Urban Development
MPO	Metropolitan Planning Organization
MS4	Municipal separate storm sewer system
MTP	Metropolitan Transportation Plan
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMFA	New Mexico Finance Authority
NPDES	National Pollutant Discharge Elimination System
RFP	Request for proposal
SAP	Special Appropriations Program
SSCAFCA	Southern Sandoval County Arroyo Flood Control Authority
SSFC	Sustainable Santa Fe Commission
SWQB	Surface Water Quality Bureau
TAP	Transportation Alternatives Program
TIGER	Transportation Investment Generating Economic Recovery
TIP	Transportation Improvement Program
TMDL	Total maximum daily load
WBP	Watershed-based plan
WIFIA	Water Infrastructure Finance and Innovation Act
WPF	Water Project Fund
WTB	Water Trust Board

INTRODUCTION

In December 2016, EPA and the City of Santa Fe began working together on an effort focusing on long-term stormwater planning to determine the city's long-term stormwater planning priorities and goals. This process included a series of meetings and conversations with city staff as well as external stakeholders to get input early on in the process that helped shape the vision of this effort. In September 2017, a core group of stakeholders consisting of EPA, City of Santa Fe municipal staff and contractors, and the New Mexico Environment Department (NMED) met to discuss objectives and priorities for the city's long-term stormwater planning effort. Participants engaged in site visits and a tour that highlighted Santa Fe's stormwater challenges and opportunities. The city and EPA also hosted a public forum where members of the community were invited to provide input to shape Santa Fe's long-term stormwater planning goals. An additional meeting was held with representatives from various city departments to discuss Santa Fe's stormwater-related challenges, discuss a long-term stormwater vision and begin developing long-term goals (Figure 1).

Photograph: September 2017 public forum participants (Source: PG Environmental).

Through this stakeholder engagement—a continuous process—residents and employees of the city expressed that all water in Santa Fe needs to be treated as a resource and the lifeblood of the community. There was a strong desire for increased stormwater capture and infiltration to maximize water table replenishment and an emphasis on low impact development (LID), green infrastructure (GI), and other stormwater controls that reduce the impacts of stormwater on the environment and public safety.

Considering the input provided, Santa Fe identified several goals that were prioritized. The first goal is described herein in this document.

- Generate **reliable funding** dedicated to the city's stormwater program.
- Incorporate **low impact development and green infrastructure** concepts into new development and redevelopment policies for public and private projects.
- **Align stormwater efforts** with the city's broader functions and responsibilities, including sustainability goals and targets.
- Effectively **plan, construct and maintain stormwater assets** over the long term to enhance opportunities to seamlessly incorporate stormwater into city projects.
- Define the stormwater **program structure and organizational hierarchy**.
- Continue **regional planning** efforts with Santa Fe County and the New Mexico Department of Transportation regarding the upcoming issuance of the NPDES-MS4 permit.

Figure 1. [*to be illustrated by* Graphics] Santa Fe's Long-term Stormwater Planning Goals

A sustainable stormwater program requires staff, financial resources, and an in-depth understanding of the true costs of providing services. Additionally, communities including Santa Fe need to plan for and finance capital improvements and other priority projects to benefit the community and provide essential services. Common funding options include dedicated revenue sources (e.g., stormwater fee) and outside financing (e.g., grants, loans). One of Santa Fe's long-term stormwater planning goals is to establish sustainable financing for its stormwater program and long-term priorities.

Santa Fe began pursuing this goal in the fall of 2017 with the help of its in-house consultant, Tetra Tech. The city conducted an in-depth evaluation of the city's stormwater program organization and resources, including an assessment of Santa Fe's stormwater fee implementation. The results are incorporated into Santa Fe's *Stormwater Management Strategic Plan*.

EPA has worked with the city to develop this complementary document to help identify potentially relevant government funding in the form of grants or loans for stormwater projects and priorities in Santa Fe.

What's in This Document?

This document primarily focuses on federal funding opportunities for projects and improvements that incorporate stormwater management strategies, such as GI and LID. It is also designed as a resource for the city to identify existing programs, plans, and projects that would align well with stormwater management priorities. This holistic approach can make Santa Fe eligible for more funding opportunities by using stormwater management to fulfill key funding program criteria as part of larger projects (e.g., transportation or other broad-scope community improvements). The document provides guidance on how to:

- Integrate stormwater management into existing city planning efforts (Section 1)
- Leverage strategic partnerships (Section 2)
- Identify funding opportunities (Section 3)
- Learn from past experience (Section 4)
- Case Study – Santa Fe MPO (Appendix A: Case Study – S)
- Case Study – Southern Sandoval County Arroyo Flood Control Authority (Appendix B: Case Study – Southern Sandoval County Arroyo Flood Control Authority)
- Summary of Potential Federal Funding Opportunities (Appendix C: Summary of Potential Federal Funding Opportunities)

This document can be shared with city department supervisors and decision-makers, as well as key external stakeholders, to demonstrate the advantage of pursuing stormwater management projects to improve public infrastructure, the environment, and the

1. INTEGRATE STORMWATER MANAGEMENT INTO EXISTING CITY PLANNING EFFORTS

To set up for success in obtaining project funding from outside sources, the city should integrate stormwater management into its current community and infrastructure planning efforts. Stormwater management by itself may not be the central focus of, nor meet all the qualifying criteria for, certain grant and loan programs. However, applicants can often still qualify for funding by strategically incorporating stormwater components into the scope of broader projects such as transportation and safety improvements, hazard mitigation, or community and quality of life enhancements. Projects that contribute to master planning efforts and larger-scale community improvements often receive higher consideration and ranking when applying for government grants and loans. Also, having challenges and potential solutions identified and documented in other existing documents can help show that the community is engaged and dedicated to fixing problems that arise.

Photograph: The Santa Fe Railyard was a collaborative city project that included several stormwater management features (Source: PG Environmental).

> *Stormwater projects work best when communities think about stormwater early in the design phase rather than later after homes and businesses are built. And the most successful plans start with a vision for the community forged by a collaborative process.*
>
> **- Long-term Stormwater Plans: Community Solutions for Clean Water and A Greener Future (EPA)**

A community can and should take several key actions to encourage local planners and developers to incorporate stormwater management practices into projects, thus increasing the likelihood of receiving outside funding:

- ✓ Ensure that local ordinances and design standards support stormwater management practices, including GI/LID.
- ✓ Increase interdepartmental communication related to project planning; identify opportunities to collaborate.
- ✓ Include stormwater management priorities in capital improvement planning.
- ✓ Educate local decision-makers and the local design community about the city's stormwater management priorities and the benefits of implementing these types of projects.

In Santa Fe, stakeholders specifically highlighted interdepartmental coordination and cooperation as an area for improvement. Decision-makers who do not typically work with stormwater management planning can benefit from education on the benefits and applicability of stormwater management in project design. Realizing that incorporating stormwater management into projects as a component – instead of a stand-alone piece – can often save limited public funding. Stormwater practices can also add value to projects and contribute to securing funding from outside sources. Planners and engineers who do not specialize in stormwater design may overlook or not be as-aware of the social and economic benefits that various stormwater management approaches can bring to a project and ultimately the community. A coordinated engagement and outreach effort, both internal to the city and its external partners, will increase the extent to which stormwater management practices are incorporated into project design, which will in turn create a larger pool of projects to choose from when pursuing funding.

The City of Santa Fe is currently engaged in numerous long-term and master planning efforts across several departments. Some of these efforts could be leveraged to promote the use of stormwater management practices in the city and to obtain external funding to do so. City departments such as Land Use[1] and Parks & Recreation[2] are adept at long-term planning and have already recognized the importance of responsible stormwater management. Other departments, such as Public Works and Transportation, have a long history of working with federal and state programs to fund infrastructure projects. The people in each of these entities provide unique perspectives and knowledge in their respective fields and offer an opportunity to partner and coordinate and could represent new potential avenues for project funding.

"Over 20,000 acre-feet of rain water falls within Santa Fe city limits during a typical year. That is more than the average annual usage for all urban use in the city. This runoff can be used to support plants and trees, reduce potable water demand and recharge the overtaxed ground water supplies. Uncontrolled runoff causes erosion and causes maintenance problems in the millions of dollars."

-City of Santa Fe Land Use & Urban Design Plan (draft 2017)

"The City's efforts to improve stormwater management provides an opportunity to capture water for park landscapes and to incorporate Low-Impact-Development (LID), measure water use and look for efficiencies."

-Santa Fe Parks, Open Space, Trails and Recreation Master Plan (2017)

Transportation projects are an especially promising mechanism for pursuing government grants and loans, as managing runoff from impervious roadways is necessary for flood control and safety, and new facility projects typically include some consideration for drainage improvements (quantity or quality). Further, GI and LID designs that incorporate natural and native vegetation can improve the aesthetics of new streetscapes, attracting pedestrians and businesses. By communicating and aligning stormwater management priorities with bigger-picture city planning, Santa Fe can improve its odds of securing external funding.

[1] City of Santa Fe Land Use & Urban Design Plan (draft 2017): https://www.santafenm.gov/land_use__urban_design_plan
[2] Santa Fe Parks, Open Space, Trails and Recreation Master Plan (2017): https://www.santafenm.gov/document_center/document/7643

2. LEVERAGE STRATEGIC PARTNERSHIPS

Obtaining funding through state or federal programs often requires the coordination and cooperation of multiple entities (either within a municipal organization or with regional, state, or federal partners). The city should give careful thought as to which entity will take the lead for a particular opportunity and which others can provide added value, support, and input to increase the odds of success.

In many cases, the city will be pursuing funding for its own local projects and working between multiple city departments. However, certain funding programs may target specific types of groups, such as watershed and regional planning organizations or state agencies. In these cases, the city could become a partner on a team of applicants or work to integrate city projects, goals, and priorities into regional- or state-level planning. Routine communication between all parties can help leverage opportunities as they become available.

State Partners and Opportunities

The City of Santa Fe and State of New Mexico have built relationships on several levels. For projects that are regionally significant and have broad watershed impacts, the state can be a direct partner in planning and execution. The state can also act as an advocate to help the city launch and fund significant local projects. In other cases, the state can be the source of grants or loans or responsible for distributing and overseeing funding from federal programs.

As it relates to stormwater management projects and funding, the city will likely find itself frequently engaging NMED. Funding, resources, and partnerships can also come from other entities, such as the State Water Trust Board and the New Mexico Department of Transportation (NMDOT). In many cases state and federal funding for transportation projects can be accessed through the Santa Fe Metropolitan Planning Organization (see *Regional and Local Partners*, below).

NMED Construction Programs Bureau (CPB)[3]

NMED is responsible for overseeing the state's water resources and management activities, including drinking water, wastewater, ground water, and surface water and related infrastructure assets. Stormwater management falls under NMED's Surface Water Quality Bureau (SWQB), Point Source Regulation Section. CPB provides water and wastewater project funding assistance in the form of grants and loans, most notably the Clean Water State Revolving Fund (CWSRF) and Capital Outlay Special Appropriations Program (SAP). Further, CPB provides in-person technical support and guidance related to the funding programs they sponsor, as well as during the construction and implementation process. The CPB website includes templates and guidance to help local communities pursue funding programs.

Figure 2. CWRSF logo.

[3] NMED CPB website: https://www.env.nm.gov/construction-programs/

NMED's Capital Outlay Special Appropriations Program (SAP) has been supporting environmental infrastructure projects (including stormwater improvements) since 1973 through the sale of severance tax bonds. As of the end of 2017, the state was actively overseeing 154 SAP projects with a total outstanding balance of more than $25 million. Eligible communities (e.g., municipalities, counties, special districts, Indian Tribes, Mutual Domestic Water Consumers Associations) can apply for funding through their legislative representative.

New Mexico State Water Trust Board (Water Project Fund)[4]

The New Mexico Finance Authority (NMFA) was established to provide a low-cost financing mechanism for city, county, and select state infrastructure projects. New Mexico's 2001 Water Project Finance Act specifically charged NMFA with administering a Water Project Fund (WPF) and corresponding Water Trust Board (WTB) to oversee it. WPF assistance was established to support five types of projects:

- Water conservation or recycling, treatment, or water use
- Flood prevention
- Endangered Species Act collaborative projects
- Water storage, conveyance, or delivery
- Watershed restoration and management

Funding selections are made annually; interested parties must submit a Notice of Intent and then complete a formal application. Submissions are screened for completeness and eligibility and evaluated against WTB's criteria (e.g., local contribution, regional nature of projects, leveraging of funds, contribution to water quality/watershed improvement, attention to human health and safety). The 16-member board is responsible for making funding recommendations to the State Legislature.

> *"Watershed health is a public health and safety issue and watershed restoration encompasses a suite of activities from forest thinning to riparian restoration projects to consideration of soil and substrate conditions. Projects that address long-term maintenance and overarching watershed restoration will be considered. Projects solely intended to monitor the efficacy of watershed restoration and maintenance are considered eligible for funding as long as it is part of a written long-term maintenance plan."*
>
> – Section V.A.1 of the Water Trust Board Water Project Fund Project Management Policies

[4]New Mexico State WTB WPF website: https://www.nmfa.net/financing/water-programs/water-project-fund/

WTB primarily recommends awards in loan/grant combinations, and all projects must provide a local match. Approximately $21.7 million in project funding was available in the 2018 cycle.

Regional and Local Partners and Resources

There are organizations in many areas that facilitate planning and coordination of efforts across municipalities and interested parties in a particular geographic region (cities, tribes, counties, etc.). These groups can take various forms, such as watershed groups (e.g., Santa Fe Watershed Association[5]) or regional transportation planning, and are often important resources. In some cases, these organizations may even provide the source of or access to funding.

Santa Fe Metropolitan Planning Organization (MPO)

One of the most prominent regional groups, of which Santa Fe is a member, is the Santa Fe MPO. The MPO has a direct relationship with and receives funding from NMDOT, the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). This funding is in turn extended to the MPO's members to pursue regionally-significant transportation projects. The Santa Fe MPO maintains a Metropolitan Transportation Plan (MTP)[6] that includes a prioritized list projects over a 25-year horizon. The current version was published in 2015 and extends through 2040. The document is informed by extensive public input and updated every five years.

Appendix A includes a more detailed case study about the Santa Fe MPO.

Photograph: The New Mexico Rail Runner Express passing through the Santa Fe Railyard area (Source: PG Environmental).

*"**Streets Are Ecosystems** – Streets should be designed as ecosystems where man-made systems interface with natural systems. From pervious pavements and bioswales that manage stormwater run-off to street trees that provide shade and are critical to the health of cities, ecology has the potential to act as a driver for long-term sustainable design."*

-Santa Fe MPO MTP

[5] Santa Fe Watershed Association website: http://www.santafewatershed.org/
[6] Santa Fe MPO MTP (2015–2040): http://santafempo.org/wp-content/uploads/2015/09/Santa-Fe-MPO-MTP_FINAL_Electronic.pdf

Sustainable Santa Fe Commission

The Sustainable Santa Fe Commission (SSFC)[7] is a 9-member citizen group that advises the Santa Fe city government on environmental policies, programs, and projects. Pursuant to City of Santa Fe Resolution No. 2015-57, the commission has overseen the development of a 25-Year Sustainability Plan for the city that provides recommendations on environmental initiatives in Santa Fe, with the goal of becoming carbon neutral by 2040. Promotion of healthy aquifers is listed as a top water-related priority in the plan, with a corresponding action item listed as, “shift the emphasis of stormwater infrastructure towards capture, infiltration, and utilization.” While SSFC may not have a direct line to government funding, engaging with the group and promoting the city’s stormwater priorities is just another way to ensure they get considered in larger planning efforts. Environmental sustainability is more and more becoming part of the key criteria and goals for a variety of funding programs.

Southern Sandoval County Arroyo Flood Control Authority

Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA) is another government agency located near Santa Fe that routinely applies for and is awarded funding through government programs. SSCAFCA is well-versed in the planning and application process involved in pursuing government funding (particularly for funding arroyo-related projects through the Federal Emergency Management Agency [FEMA]) and could serve as a valuable resource to the city for guidance on navigating the process. **Appendix B** includes a case study providing additional details on the SSCAFCA organization.

[7] Sustainable Santa Fe website: https://www.santafenm.gov/sustainable_santa_fe

3. IDENTIFY FUNDING OPPORTUNITIES

Once projects are identified and incorporated into planning, the city can focus on identifying funding and financing options. In addition to locally available funds, the State of New Mexico and the federal government offer a wide variety of funding opportunities that can help communities to achieve their stormwater goals. Some opportunities present a clear path for incorporating stormwater management (e.g., the CWSRF), whereas others may require more coordination.

Resources available to help communities and planners navigate the various funding options include EPA's website for *Green Infrastructure Funding Opportunities*[8] and the *Water Finance Clearinghouse*[9]. Being aware of available funding and funding cycles and engaging in long-term planning to identify specific projects that contribute to a cohesive community vision for the future will increase the chances of having projects in waiting.

It should be emphasized that government grant and loan programs are <u>supplements</u> to a well-structured and sustainable financing approach. Many government funding programs also include a local match or other financial contingencies, so a community should already be in a position to accommodate these requirements as opportunities become available. As mentioned previously, Santa Fe is already taking action to evaluate and improve the sustainability of its stormwater program financing.

Know the Value of Stormwater

As discussed in Section 1, stormwater projects may need to be incorporated into larger scopes of work, such as transportation and other capital improvement projects, to be eligible for external funding. A number of programs clearly outline the acceptance of stormwater and GI/LID practices. For example, the CWRSF has a long list of acceptable items related to stormwater that can be funded[10]. Even the U.S. Department of Transportation (DOT) Better Utilizing Investments to Leverage Development (BUILD) Grant Program has specific ranking criteria related to environmental protection, including reducing water pollution as well as stormwater mitigation. However, stormwater can also be incorporated into other programs that are less explicit about stormwater management.

Educating planners and decision-makers on the additional benefits of stormwater management (e.g., beyond water quality and quantity control) can be essential for achieving long-term stormwater goals in a community. Further, being able to identify and articulate the value stormwater management brings to a particular project and the community can help potential applicants target funding opportunities based on specific ranking criteria and metrics. For example, implementing stormwater management can offer social and economic benefits in areas such as:

---

[8] EPA Green Infrastructure Funding Opportunities website: https://www.epa.gov/green-infrastructure/green-infrastructure-funding-opportunities

[9] EPA Water Infrastructure and Resiliency Finance Center (WIRFC). The WIRFC Water Finance Clearinghouse is a searchable database for sanitary sewer, stormwater, drinking water, and other relevant funding sources from federal, state, local, and other programs. Resources and information on available funding sources, including state-specific contact information, are updated regularly.

[10] CWSRF Stormwater website: https://www.epa.gov/cwsrf/clean-water-state-revolving-fund-cwsrf-stormwater

- **Safety** – Implementing stormwater management can reduce runoff volume and velocity from roadways, prevent flooding in busy pedestrian areas, and reduce dangerous erosion that could undermine bridge footings or culverts.
- **Public Health and Quality of Life** – Beyond improving water quality, plants used to manage stormwater can contribute to improved air quality as well. Further, GI/LID practices implemented in places like parks, open spaces, and along roads and trails can beautify the area and enhance recreational experiences.
- **Local Economy** – GI and LID practices often incorporate natural landscapes and native plantings, both of which can be aesthetically pleasing in a streetscape setting. Incorporating these elements into areas that are home to local businesses can help attract patrons by providing a more beautiful setting.

More detailed information related to the value of stormwater management can be found in two documents sponsored by EPA, *The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits*[11] and *The Economic Benefits of Green Infrastructure: A Case Study of Lancaster, PA*.[12] Both highlight some of the quantitative and qualitative benefits of implementing stormwater management in a community.

Appendix C of this document includes a summary of various federal funding opportunities the city could pursue. Section 5 of this document includes deeper discussion of four federal funding programs that may be particularly relevant to the City of Santa Fe:

- EPA/State of New Mexico CWSRF Program
- USDOT BUILD Grant Program
- U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) Program
- EPA Section 319 Grant Program

Pick the Right Project

Not all projects will match well with government funding opportunities; however, communities that have proactively planned projects in advance of funding needs will be well-positioned to pursue outside funding as soon as an opportunity arises. Maintaining a pool of potential projects enables decision-makers to select the best for a particular funding program. Several considerations need to be made before applying for a government loan or grant program:

- ✓ Has enough planning been completed, and is there enough data available to support a successful application?
- ✓ How does the project fit the criteria for funding?
- ✓ Does the project timeline align with the funding cycle?

[11]The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits: https://www.cnt.org/sites/default/files/publications/CNT_Value-of-Green-Infrastructure.pdf
[12]The Economic Benefits of Green Infrastructure: A Case Study of Lancaster, PA: https://www.epa.gov/sites/production/files/2015-10/documents/cnt-lancaster-report-508_1.pdf

- ✓ Are the terms of the program appropriate for the project (e.g., loan payoff timeline, design requirements)?
- ✓ Is the community able to provide enough matching funds (if required)?
- ✓ Are there any partners (e.g., state or regionally) that can contribute to or help advocate for the project?

These are just some of the basic questions to consider when determining whether a project is a good fit for a certain program. Communities and agencies that are routinely successful at obtaining outside funding are well-versed in the application process (including how to meet key criteria) and communicate regularly with funding program administrators and application reviewers.

4. LEARN FROM PAST EXPERIENCE

Santa Fe has successfully pursued federal and state funding opportunities for various projects and programs across several city departments; however, incorporating stormwater management priorities has yielded mixed results.

Past Attempts

The city has pursued funding for several projects in the past highlighting green infrastructure, but been unsuccessful for various, and many times, unknown reasons. For example, in 2016, the city applied for $854,400 of Transportation Alternative Program (TAP) funding, to go with $145,600 of matching local funds, to construct a one-mile bike/pedestrian trail to extend the Acequia Trail and connect to the El Camino Real Trail. The project would improve the city's trail system connectivity and included measures to mitigate flooding by replacing the existing culvert and eliminating choke points where the roadway crosses the Santa Fe River. The project was ultimately not awarded TAP funding and it was not exactly clear why at the time. The city was similarly unsuccessful in pursuing TAP funds for the Arroyo de Los Chamisos Extension project in 2015 and the Canada Rincon Trail in 2016.

The city has also pursued various other funding opportunities with similar results for projects incorporating stormwater management, such as projects through FHWA's Recreational Trails Program (RTP), EPA's Urban Waters and Section 319 grants, as well as assistance form EPA's Greening America's Communities initiative.

Lessons Learned

In many cases, the city was not notified with clear reasons for unsuccessful applications. This underscores the need for Santa Fe to be proactive in following up with funding administrators after successful and unsuccessful applications. The city is often dedicating considerable resources to planning for and pursuing these opportunities, and it is important to ask for feedback and learn how the process can be improved to maximize results.

In a handful of cases, it was clear why funding was not awarded. For example, the city has historically lacked of a watershed-based plan, which is pre-requisite under EPA's Section 319 grant program. Further, Santa Fe's waterbodies have not always been formally classified with impairments (e.g., 303(d) and TMDLs), which is often given priority ranking for water quality-driven funding programs.

Making Improvements

The city has taken steps to improve stormwater planning and better position itself for success. Since 2017, Santa Fe has been engaging in an effort to internally evaluate its stormwater program as a whole and develop a *Stormwater Management Strategic Plan*. One of the many outcomes of this effort will provide, is to identify areas to improve the sustainability of the city's stormwater program funding. The city has also been working to generate hydraulic modeling reports in support of watershed-based planning. Further, the city has been working with EPA to develop *A Guide to Incorporating Green Infrastructure into Roadway Projects in Santa Fe*. These documents will help emphasize the value of managing stormwater and facilitate the integration of stormwater management into project planning.

Additionally, in 2017, EPA approved E. coli total maximum daily load (TMDL) requirements for the Santa Fe River from Cienega Creek to Nichols Reservoir. This new requirement to address a recognized impairment should give the city better leverage when pursuing funding options geared towards improving water quality.

Success Story: The Acequia Trail Underpass

Acequia Trail Underpass (completed 2017)[13]

FHWA – Congestion Mitigation and Air Quality (CMAQ) Improvement Program; Total Funding – $4,290,463 (including over $600,000 of local matching funds)

Santa Fe's Acequia Trail Underpass project involved constructing a path under St. Francis Drive, one of the busiest intersections in the city, providing cyclists and pedestrians a safer connection between southwest Santa Fe and the popular Santa Fe Railyard area. The Acequia Trail is one of four major trail corridors in the city of Santa Fe and has an average of 358 users a day. Prior to construction, trail users crossed the intersection at St. Francis Drive via a signalized crosswalk. However, the public often used unsafe and out of direction paths to reach the crosswalk, such as crossing at unmarked mid-block locations rather than the crosswalk, jumping the road median, and not observing crosswalk countdown signals. Vehicles also failed to yield to cyclists and pedestrians at the intersection, and vehicles stopped in the crosswalk prevented safe passage.

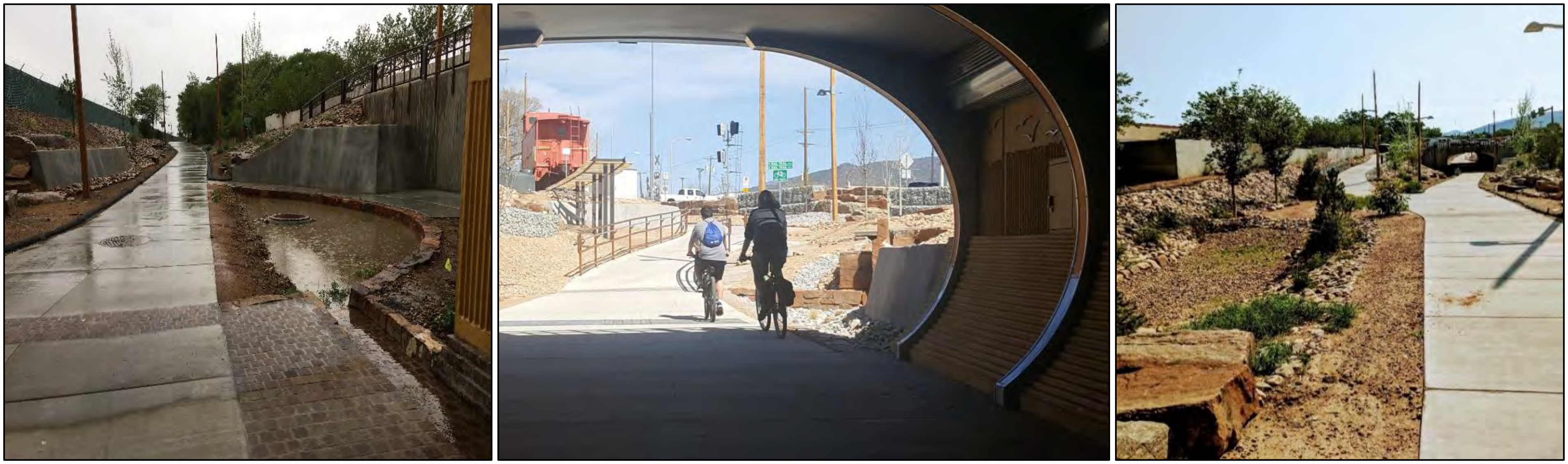
Photograph: Stormwater swale installed as a component of the Acequia Trail Underpass project (Source: City of Santa Fe)

The City initially applied for Highway Safety Improvement Program (HSIP) funding through FHWA, but was unsuccessful. This was likely due to the city's lack of robust crash data necessary to satisfy HSIP's data driven selection process. The city was eventually able to obtain project funding, in the form of a CMAQ Improvement Program funds (also FHWA)—a program focused on traffic-calming and air quality improvements.

While the funding mechanism for the underpass project did not specifically highlight stormwater components, the city integrated these elements in the construction plan. For example, a detailed hydrologic study and hydraulic analysis were

[13] The data and information referenced in this section were provided during communications with City of Santa Fe staff and from internal documents provided by the city related to the grant application and project development process.

conducted to ensure offsite flows did not enter the Acequia Madre. Additionally, the project's hardscape and landscape plan included LID drainage features for stormwater management. The project also included several geomorphic and LID features to reduce runoff and erosion, maximize infiltration, and slow down water flow. For example, berms, mounds, knolls, and swales route stormwater through the landscape into percolation trenches and infiltration ponds. Since the underpass creates a manmade depression, stormwater overflow from ponds is collected in a 15,000-gallon cistern and slowly discharged to the aquifer to prevent flooding. Onsite and offsite drainage systems were also designed to accommodate a 100-year storm event. Because these features were included in the design phase of the project, they were funded when the city received CMAQ funding. This project is a prime example of how stormwater components can be integrated in projects with funding vehicles not specifically set aside for stormwater/green infrastructure improvements.



Photographs: The completed Acequia Trail Underpass project (Source: City of Santa Fe).

5. POTENTIAL OPPORTUNITIES FOR SANTA FE

This section provides a more in-depth view of four federal funding programs that the City of Santa Fe may consider pursuing in the future

EPA Clean Water State Revolving Fund (CWSRF)

EPA's CWSRF program was established in 1987 to provide at or below-market interest rate loans,[14] refinancing assistance, and loan guarantees for water infrastructure projects. EPA provides capitalization grants to the 51 CWSRF programs across the country each year;[15] states are required to contribute a 20 percent match. Loan repayments "revolve" back into state funds to finance future projects. The CWSRF is "ideally suited to serve as sources of low or no cost financial assistance to a broad and diverse range of publicly and privately-owned green infrastructure projects" (Sawyers, 2016). The CWSRF Green Project Reserve (GPR), established in 2009, is specifically designed to support green infrastructure, water and energy efficiency improvements, and other innovative activities. (EPA, 2017). Since 2009, $1.1 billion was reported as going towards green infrastructure projects nationally through the CWSRF program

EPA encourages state CWSRF programs to offer financial incentives and priority ranking criteria/bonus points for green infrastructure projects (Sawyers, 2016). In New Mexico, CWSRF applications can receive a maximum of 475 points; up to 25 points are awarded to projects that incorporate stormwater BMPs, and 25 bonus points are awarded to projects that can be classified under the GPR (EPA, 2015). However, none of the 21 active CWSRF loans were for stormwater-focused projects as of the end of FY 2017 (NMED Construction Programs Bureau, 2017).

States have the flexibility to provide additional subsidies to municipal or intermunicipal funding recipients in the form of negative interest loans or principal forgiveness. The maximum percentage of a state's capitalization grant used for additional subsidization ranges from 0 to 30 percent, depending on the amount of the total appropriation.

NMED aims to provide the maximum allowable additional subsidy each year (NMED, 2018). Additional subsidization can be provided to address affordability issues (for municipalities that meet New Mexico's affordability criteria; New Mexico CWSRF Program, 2018), to benefit individual residential rate payers, or for projects/activities that address water or energy efficiency goals, mitigate stormwater runoff, or encourage sustainable project planning, design, and construction (Sawyers, 2015).

[14] CWSRF loans offer terms up to 30 years, though no longer than the useful life of the project.
[15] EPA provides CWSRF grants to all 50 states and Puerto Rico.

Eligibility

New Mexico's CWSRF program is managed by NMED's Construction Programs Bureau (CPB).[16] The application period opens once per year, typically in the spring.[17] There are several broad categories of projects eligible for the program.

Eligible Types of Projects	
• Constructing publicly owned treatment works (POTWs)	• Watershed pilot projects
• Nonpoint source	• Energy efficiency, water efficiency, or reuse
• Reducing the demand for POTW capacity through water conservation, efficiency, and reuse	• Reusing or recycling wastewater, stormwater, or subsurface drainage water
• Stormwater	• Security measures at POTWs
• Decentralized systems	• National Estuary Program projects
• Technical assistance/planning	

Most municipalities are eligible to pursue funding for publicly-owned **stormwater projects**[18], including:

- ✓ Stormwater BMP projects that utilize cost-effective controls and use innovative technologies.
- ✓ Development and implementation of a municipality-wide stormwater management plan.
- ✓ Projects designed to manage, reduce, treat, reuse, or recapture stormwater or subsurface drainage water.
- ✓ Development or implementation of watershed partnerships between municipalities and property owners to address nonpoint sources of pollution.
- ✓ Management of municipal wet weather discharges on an integrated watershed or subwatershed basis, demonstrating the effectiveness of a unified wet weather approach.

Further, projects that contribute to the implementation of a Section 319 Nonpoint Source Management Program or a Section 320 Comprehensive Conservation and Management Plan (CCMP) are also typically eligible for funding. Eligibility requirements vary to some extent for planning, energy and water conservation, and surface water protection and restoration projects. As of 2014, projects pursued to meet the requirements of a MS4 permit are eligible for CWSRF funding, regardless of ownership (public or private).

[16] Contact: NMENV-cpbinfo@state.nm.us or (505) 827-2806

[17] Application forms and supplemental materials are available at: https://www.env.nm.gov/construction-programs/cpb-forms-and-documents/#CWSRF-ApplicationandInformationtoApply

[18] NMED has petitioned the state's Water Quality Control Commission to expand the list of eligible CWSRF assistance recipient to include state agencies.

Throughout the long-term stormwater planning process, stakeholders in Santa Fe have communicated the importance of stormwater capture and infiltration, as well as prioritizing stormwater management starting in upland areas to mitigate erosion and prevent sediment and trash from flowing into lower areas. The following types of projects are eligible for CWSRF funding and may be particularly applicable to the city.

Specific Types of Stormwater Projects Applicable to Santa Fe	

• Traditional pipe, storage, and treatment systems
• Real-time control systems for CSO management
• Stormwater BMPs
• Watershed management of wet weather discharges
• Sediment controls including:
  o Filter fences
  o Storm drain inlet protection
  o Street sweepers
  o Vacuum trucks
• Green roofs, green streets, and green walls
• Rainwater harvesting, storage, management, and distribution systems
• Real-time control systems for harvested rainwater
• Infiltration basins
• Constructed wetlands, including surface flow and subsurface flow (e.g., gravel) wetlands
• Bioretention/bioswales (e.g., rain gardens, tree boxes)
• Permeable pavement
	• Wetland/riparian/shoreline creation, protection, and restoration
	• Establishment/restoration of urban tree canopy
	• Integrating green infrastructure into existing gray infrastructure including purchase and demolition costs
	• Municipality-wide stormwater planning
	• Water conservation education and incentive programs (e.g., installation of permeable surfaces or rain barrels)
	• Distribution lines to support water reuse and use of harvested precipitation
	• Energy efficient equipment and components (e.g., lighting, HVAC, electronic systems)
	• On-site and off-site renewable energy
	• Land acquisition*
	• Asset management/fiscal sustainability planning**
	• Integrated planning**
	• Cost and effectiveness analyses
	• Capital improvement plans**

* *Eligible if part of a broader eligible project*

** *Eligible if these activities are reasonably expected to result in a capital project*

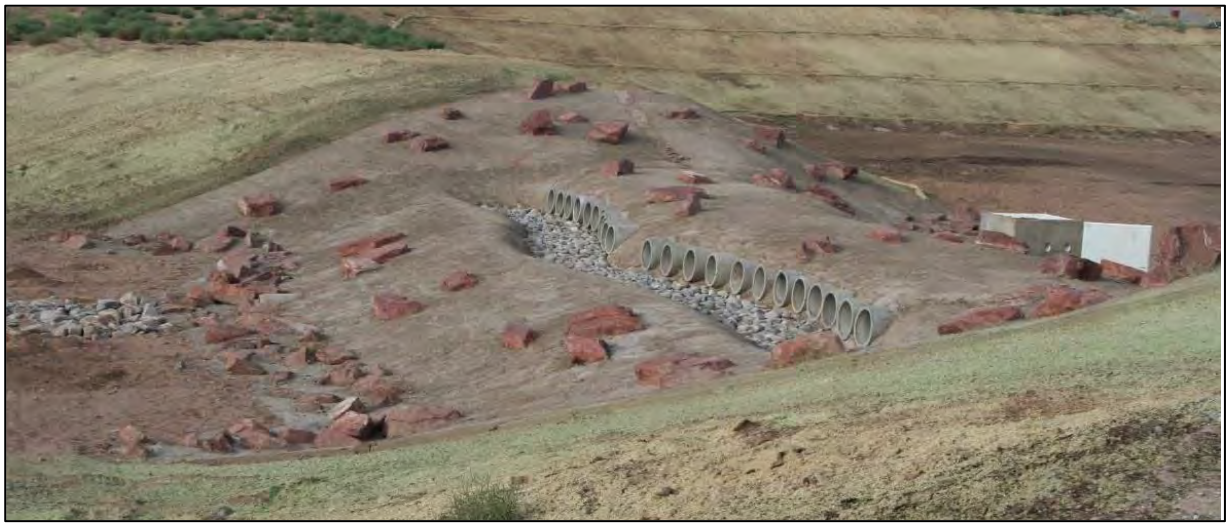
Additional Program Requirements

As of 2014, municipal or intermunicipal CWSRF assistance recipients are required to conduct a *cost and effectiveness analysis*. Specifically, the analysis must include study and evaluation of the cost and effectiveness of the processes, materials, techniques, and technologies for carrying out the proposed project or activity for which assistance is sought. Projects and activities must show they increase the potential for efficient water use, capture, reuse, and conservation, and energy conservation to the maximum extent practicable (taking into account construction costs, operations and maintenance costs over the lifetime of the project/activity, and replacement costs) (Sawyers, 2015).

Project Examples

In FY 2017, NMED issued eight construction loan agreements and one amendment to an existing agreement, totaling over $9.5 million. The new loan agreements ranged in value from $582,500 to $3 million. Since the program's inception, NMED has provided $405 million in cumulative assistance, $2.99 million of which was for gray or green stormwater infrastructure projects ($350,000 in green infrastructure via one assistance agreement, and the remainder in gray via three assistance agreements).

In 2015, the Southern Sandoval County Flood Control Authority (SSCAFCA) completed a CWSRF-funded green infrastructure project at the Lower Montoyas-area flood control facility. The project was included by EPA in the "Recognized Excellence" category of the 2017 Performance and Innovation in the SRF Creating Environmental Success (PISCES) awards, which acknowledge exceptional CWSRF-funded projects. This type of project can serve as a particularly good example for Santa Fe, as the city is responsible for managing and maintaining arroyos for its own community. **Appendix B** includes a more detailed case study of SSCAFCA and the Lower Montoyas project.



Photograph: Flooding and floatable controls installed as part of SSCAFCA's Lower Montoyas project (Source: SSCAFCA)

"After flooding plagued the Village of Corrales, NM, in 2006 and 2013, SSCAFCA developed a project utilizing innovative green design to enhance the absorption of stormwater to lower the risk of further floods. The core element of the project was a 'mechanical phytoremediation' facility designed to use the capacity of plants to capture and filter sediment, floatables, and debris from stormwater and to allow for the absorption of the remaining flow into a permeable surface. This low-impact project preserves the arroyo in its natural state and creates open space with trails for community use" (CWSRF, 2017).

USDOT Better Utilizing Investments to Leverage Development (BUILD) Grant Program

USDOT's BUILD Grant Program, which replaced the Transportation Investment Generating Economic Recovery (TIGER) program in 2018, provides funding to surface transportation projects that have a significant regional or local impact. The program also considers the extent to which the applicant has implemented "local activities to generate additional non-Federal revenue for transportation infrastructure" (DOT, 2018). In 2017, TIGER grants were awarded to 41 projects across the country ranging in value from $2 to the $25 million maximum.[19]

BUILD grants have been successfully applied to green and gray stormwater infrastructure and other stormwater management components, and are often used to fund Complete Streets and Green Streets-type projects. Environmental protection, quality of life, and innovation are three of the merit criteria considered for awarding BUILD grants that could be leveraged for implementing stormwater management into project designs.[20] USDOT specifically encourages applicants to provide data on a project's anticipated environmental benefits, including reduced energy consumption and stormwater runoff.[21]

Complete Streets

More than 1,400 cities and towns across the country (including the Santa Fe MPO) have pursued Complete Streets policies to make their roadways more accessible for all forms of transportation, minimize the environmental impacts of impervious surfaces, and improve safety. **Complete Streets** designs often incorporate green infrastructure elements (e.g., bioswales, planters) for sustainable stormwater management. These natural and engineered solutions reduce the risk of flooding while offering valuable co-benefits like and improvements in air quality and enhanced recreational spaces.

Eligibility

Eligible grant recipients include state, local, and tribal governments, including transit agencies, port authorities, MPOs, and other political subdivisions of state or local governments. States and jurisdictions can also coordinate to submit a joint application (as long as all participants are eligible) (BUILD, 2016). The following are general examples of projects eligible for BUILD grants (DOT, 2018):

- Highway, bridge, or other road projects eligible under Title 23 of the U.S. Code
- Public transportation projects eligible under Chapter 53 of Title 49 of the U.S. Code
- Passenger and freight rail transportation projects
- Intermodal projects

In 2018, Congress also authorized up to $15 million for planning grants (e.g., preliminary engineering and design, environmental and final design, feasibility studies). Projects are ultimately evaluated against their alignment with one or more of the program's merit criteria,[22] which includes, among others, environmental protection. Considerations that may be especially relevant to Santa Fe's long-term stormwater planning efforts are outlined in the following table. Santa Fe is able to pursue these opportunities on their own, or in conjunction with a local planning group, like the Santa Fe MPO (see **Appendix A**) or the New Mexico DOT.

---

[19] https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/tiger/306331/t9-fact-sheets_0.pdf
[20] https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/tiger/308656/build-vs-tiger-fact-sheet-042018-1049am.pdf
[21] https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/build/114796/fed-reg-build-nofo-2018_0.pdf
[22] Contact: BUILDgrants@dot.gov, or 202-366-0301; application forms and supplemental materials are available at: https://www.transportation.gov/BUILDgrants

Merit Criterion	Evaluation Considerations
Safety	• Ability to foster a safe transportation system
State of Good Repair	• Project aligns with existing plans to maintain transportation facilities or systems in a state of good repair and address current to projected vulnerabilities • If unaddressed, asset condition threatens accessibility, mobility of goods or people, economic growth, and transportation network efficiency • Project is appropriately capitalized up front and uses asset management to optimize long-term cost structure
Economic Competitiveness	• Improve long-term efficiency, reliability or costs of people or goods mobility • Increase economic productivity of land, capital, or labor • Long-term job creation or other economic opportunities
Environmental Protection	• Reduce water pollution through congestion mitigation strategies • Avoid adverse environmental impacts to water quality and wetlands • Provide environmental benefits, such as wetlands creation or improved habitat connectivity and stormwater mitigation
Innovation	• Innovations in transportation funding and finance, including by using private sector funding
Partnership	• Projects demonstrate strong collaboration among a broad range of stakeholders to achieve local or regional benefits • Project applications demonstrate collaboration among neighboring or regional jurisdictions, including neighboring rural areas, to achieve local or regional benefits • Projects include partnerships that bring together diverse transportation agencies and/or are supported, financially or otherwise, by other stakeholders that are pursuing similar objectives

The evaluation considerations under each merit criterion are detailed further in USDOT's 2018 presentation: *How to Compete for FY 2018 BUILD Transportation Discretionary Grants.*[23] USDOT identified the following characteristics of highly competitive BUILD grant project applications: [24]

- ✓ Demonstrated **strength in merit criteria**. USDOT recognizes that a project will not align with all selection criteria, and applicants are encouraged to focus on the criteria/criterion that best fits the project.
- ✓ Projects that will enter construction **within the period of obligation**. For 2018 funding, applicants were asked to target projects starting by June 30, 2020.
- ✓ A **clear story and project impact**. Applicants are encouraged to describe the problem and explain why the project is the solution to that problem, up front. The applicant should then address the selection criteria that are most appropriate to the project, and articulate the benefits that will be realized by the project.
- ✓ A **definitive timeline** and pathway for project success and completion.
- ✓ Incorporation of **innovative funding and finance approaches**.
- ✓ Inclusion of a **strong partnership component** (including public-private partnerships), particularly new partnerships, and multi-jurisdictional cooperation. The competitiveness of the application is not affected by whether or not the proposed partnerships are financial in nature.

[23] https://www.transportation.gov/sites/dot.gov/files/docs/subdoc/236/final-how-compete-build-52418.pdf

Project Examples

USDOT has made available information for all 462 projects funded in the previous nine rounds of BUILD/TIGER funding,[25] as well as information on all projects for which applications were submitted (whether they received funding or not) over those previous funding cycles, including four from the City of Santa Fe.[26] TIGER grants have been awarded both to stormwater-focused projects and transportation-focused projects that include stormwater elements. Examples of successfully funded projects include the following.

Location	Project Description	Stormwater Elements	Benefits
Carson City, NV	Complete Streets initiative to address roadway, parking lot, and building flooding	Gray and green stormwater components to improve drainage estimated at $3.2 million out of a total project cost of $19 million (Maloney, 2017)	Improve traffic flow, safety, access to local businesses and encourage private sector investments
Syracuse, NY	Supported green street design and construction in the first phase of a larger effort to connect the downtown business district and Syracuse University campus	Tree trenches, porous pavement, and landscape buffers designed to reduce stormwater runoff by an estimated 5.74 million gallons per year (Mahoney, 2011)	Enhanced safety, introduction of new multimodal facilities for bicycles and pedestrians, improved environmental and public health, and enhanced economic competitiveness[27]
Washington, D.C.	Part of project to interconnect a large network of bicycle and pedestrian paths	Innovative stormwater management techniques to reduce runoff into the Anacostia River	Enhanced safety and economic and health benefits for local communities, including low-income neighborhoods[28]

[25] https://www.transportation.gov/BUILDgrants/all-projects-map
[26] https://www.transportation.gov/policy-initiatives/tiger/tiger-application-list
[27] Presentation of the Tiger 2011 Awards from the U.S. Department of Transportation. Available at https://www.transportation.gov/sites/dot.gov/files/docs/TIGER_2011_AWARD.pdf
[28] Presentation of the Tiger 2012 Awards from the U.S. Department of Transportation. Available at https://www.transportation.gov/sites/dot.gov/files/docs/fy2012tiger_0.pdf

U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) Program

As a HUD-designated entitlement community, the City of Santa Fe already receives annual CDBG funding of approximately $500,000. The City's Community Development Commission is responsible for allocating the funds to local agencies and non-profits to carry out the goals and strategies related to housing and community needs as outlined in Santa Fe's *Draft Consolidated Plan 2018 – 2022.*[29] The draft plan articulates the following high-level program goals (Fitzpatrick, 2018):

- ✓ Increased opportunities for at-risk populations through reduction in the rate of households with cost burden.
- ✓ Increased affordable housing opportunity through increased inventory of very low-income rental units and vouchers.
- ✓ Increased opportunity for homeownership and increased support for current homeowners.
- ✓ Improving housing opportunities to reflect urban needs, and aligning redevelopment projects, economic development objectives, and sustainability goals to reflect changing demographics.

CDBG-funded programs, projects and activities are able to include sustainable building practices and initiatives, such as effective stormwater management and water quality improvements. As part of the final goal listed above, the city recognizes the need for housing that achieves "high standards of sustainability through green building, design, and alternative energy sources." The draft plan also highlights the importance of water resources and infrastructure for Santa Fe's business community. A 2013 update to the City's *Housing Needs Assessment* acknowledged progress in incorporating green/sustainable components into building upgrades and new housing developments, including water catchment, drip irrigation, and rainwater harvesting (BBC, 2013), as well as conversion from septic (using CDBG funding).

All CDBG projects must address needs of low- to moderate-income City residents. Eligible projects may include (CDC, 2017):

- Acquisition of real property
- Relocation and demolition
- Rehabilitation of residential and non-residential structures
- **Provision of public facilities and improvements (water and sewer services, flood and drainage improvements, aesthetic amenities including trees, parks, sidewalks, curbs and gutters, etc.)**[30]
- Down payment assistance toward the purchase of a home
- Payment for public services within certain limits

Since 2007, about 10 percent of Santa Fe's available CDBG funding has been provided for public facility improvements.[31]

---

[29] PDF of *Draft Consolidated Plan 2018 – 2022:* https://www.santafenm.gov/document_center/document/8434

[30] PDF Categorizing Eligible Activities through Community Development Block Grant Program. Available at https://www.hud.gov/sites/documents/DOC_17133.PDF

[31] Excel Sheet describing the Consolidated Plan Funding 2013-2018 Percentages (by category, to date.) Available at https://www.santafenm.gov/document_center/document/7635

Project Examples

Below are examples of successfully funded CDBG projects from other communities that have been able to incorporate stormwater elements.

Location	Project Description	Stormwater Elements	Benefits
Adams, MA	Address drainage, accessibility, and other issues	Stormwater retrofits and installation of rain gardens	Improve the town's visitor center parking lot (Erie Street CDBG, 2016)
Storm Lake, IA	Improve stormwater drainage in the town's Erie Street area	Design and construction of a stormwater conveyance system that includes permeable pavers, rain gardens, bio swales, and tree wells	Anticipate significant reduction in stormwater runoff and pollutant loading (Erie Street CDBG, 2016)
Pittsburgh, PA	Transform a blighted, vacant hotel it into part of a larger streetscape (also used Allegheny County funding and EPA Section 319 funds)	Incorporates trees, underground storage to promote infiltration, pervious pavers, bio-filtration systems, a rain park, and other green infrastructure components	Manage an estimated 500,000 gallons of stormwater runoff per year (Ramage, 2017)
Chicago, IL	Innovative green retrofit on a historic (1897) building, the Chicago Cultural Center	Green roof supplemented by solar panels	Reduces rooftop runoff and incorporates an irrigation system fed by recycled rainwater (Bartsch, 2015)

While not specifically stormwater-focused, cities including Bangor, ME and Ashland, KY, have used CDBG funding to revitalize neighborhoods in part through the development and installation of green space (which could have added stormwater management benefits, if desired). Cities including Austin, TX, Bellevue, NE, and Attleboro, MA invested CDBG funding in substantial infrastructure upgrades (including water services, surface transportation and sidewalks) to redevelop neighborhoods for low-income residential housing and retail and commercial space (Cornett, 2017).

CDBG – Disaster Recovery Assistance[32]

As an extension of CDBG program, HUD's Disaster Recovery Assistance program also has funding available for recovery after major disasters, as well as for implementing measures for resiliency against future disasters. In April 2018, HUD announced the award of approximately $28 billion to help disaster recovery in several states, as well as Puerto Rico and the U.S. Virgin Islands. These funds were targeted at helping areas that have experienced Presidentially-declared disasters occurring since 2015, and will help communities repair and restore residences, businesses and infrastructure, as well as protect against future events. Funding can be requested in response to events like extreme weather and wild fires. Santa Fe can keep this funding source in mind in case the need arises.

[32] HUD CDBG Disaster Recovery Assistance website: https://www.hud.gov/hudprograms/disaster-recovery

EPA Section 319 Grant Program

EPA's Clean Water Act Section 319 program allocates funding to states[33] to support nonpoint source pollution reduction efforts. EPA's Section 319 program guidance specifically recognizes the "importance of green infrastructure…in managing stormwater" and supports awarding funding to green infrastructure projects (Yoshikawa, 2013). Urban stormwater runoff activities are eligible for Section 319 funding if those activities are not required by or do not directly implement a draft or final NPDES permit. Eligible activities may include:

- Technical assistance
- Monitoring activities related to designing and evaluating urban runoff management strategies
- Outreach and education
- Regulatory, policy, or local ordinance development
- Best management practices
- Technology transfer and training

> *An important component of* [the Section 319 Grant Program] *process is the watershed-based plan (WBP) approach as outlined in the guidance provided in EPA's* Nonpoint Source Program and Grants Guidelines for States and Territories … *As WBP expands on the information provided in a TMDL by identifying causes and sources of impairment, recommending management measures, estimating expected load reductions from management measures, providing methods to measure implementation success, estimating funding needs, and outlining potential education and outreach efforts. NMED intends to support watershed-based planning through a competitive statewide request for grant applications (RFGA), conducted approximately annually, and through technical support provided to partner agencies and stakeholder groups interested in water quality. The first such RFGA was released in November 2017 and is similar to past requests for proposals (RFPs) for watershed-based planning projects. More information on watershed-based planning is available at www.env.nm.gov/surface-water-quality/wbp.*
>
> – NMED Nonpoint Source Management Program 2017 Annual Report

New Mexico's 319 funds are administered by the NMED's SWQB. Eligible projects "must be in watersheds of specified priority stream reaches," (i.e., stream reaches listed as impaired in New Mexico's current Section 303(d)/305(b) Integrated Report) (Martinez, 2018). Eligible funding recipients include citizen watershed groups; non-profit and for-profit organizations; citizens; and federal, state, and local agencies.

New Mexico had a total of $200,000 available in 319 grants in Federal Fiscal Year 2018; grantees were required to provide at least 40 percent of the project in cash or in-kind match (Martinez, 2018). SWQB first reviews grant applications to confirm application completeness and project and applicant eligibility, then evaluates and scores qualifying applications.

[33] Allocations based on an established formula.

Project Examples

In the early 2000s, Santa Fe partnered with NMED, the local water conservation district, Santa Fe County, and local advocacy groups in a Section 319-funded project to improve water quality by restoring riparian vegetation along the Santa Fe River, downstream of the city's wastewater treatment plant. The project helped improve water quality in the area, including reducing sediment and normalizing pH levels. The effort has been featured as one of EPA's program success stories.[34] Examples of successful projects in other communities that have incorporated stormwater elements are described below.

Location	Project Description	Stormwater Elements
Ciudad Soil and Water Conservation District, New Mexico	Evaluate opportunities to reduce fecal coliform and *E. coli* bacteria discharged from Bernalillo County's stormwater collection and systems in the Rio Grande-Albuquerque watershed	Evaluation and prioritization of applicable BMPs; public education on septage disposal practices and reporting; installation of sensors and data loggers at stormwater pump stations; incorporation of relevant stormwater management and control activities into watershed action strategy.[35]
Commonwealth of Massachusetts	Stormwater reduction modeling and BMP installation	Awarded $48k in funding to a for-profit entity to generate a quantitative characterization of the potential role of mature tree canopy in achieving significant stormwater runoff reduction, develop model municipal and state regulatory language to encourage use of tree canopy as a BMP, and compile guidelines for stormwater management through the use of tree canopy (Comprehensive Environmental Inc., 2017).
		Provided $218k in funding to a regional council of governments to design and install BMPs to reduce urban stormwater runoff into a Category 5 impaired river. This effort also involved community outreach, public awareness, and education for local officials on LID regulation (Harper, 2018).
City of Albuquerque	Urban GI-LID retrofitting demonstration project. *Project discontinued due to lack of matching funds*[36]	Design, permitting, and construction of a one-acre green infrastructure-low impact development retrofit project using an existing private urban shopping center parking lot with a history of stormwater drainage problems.

[34] https://www.epa.gov/sites/production/files/2015-10/documents/nm_santafe-2.pdf
[35] Grant reporting and tracking system produced by the EPA. Available at https://iaspub.epa.gov/apex/grts/f?p=grts:700:::NO:RP,700:P700_PRJ_SEQ:52621
[36] Grant reporting and tracking system produced by the EPA. New Mexico 2012 project. Available at https://iaspub.epa.gov/apex/grts/f?p=grts:700:::NO:RP,700:P700_PRJ_SEQ:84381

REFERENCES

Bartsch, Charlie. "Recycling History: The Value of 'Old' in Brownfield Reuse." *Recycling History: The Value of "Old" in Brownfield Reuse*, 4 Sept. 2015, pp. 1–33. *US Environmental Protection Agency*, Economic Development, doi:8/1/2018.

BBC, Research & Consulting. "Housing Needs Assessment Update." *EXECUTIVE SUMMARY Santa Fe 2012 Housing Needs Assessment*, City of Santa Fe, New Mexico, 19 Mar. 2013, www.santafenm.gov/document_center/document/5446.

BUILD, DOT. "2018 BUILD Applications FAQs." *US Department of Transportation*, United States Department of Transportation, 23 Feb. 2016, www.transportation.gov/BUILDgrants/2018-build-application-faqs.

Community Development Commission (CDC). "Eligible Activities." *Water Quality and Compliance | City of Santa Fe, New Mexico*, City of Santa Fe, 1 Jan. 2017, www.santafenm.gov/eligible_activities.

Comprehensive Environmental Inc., et al. *Tree Canopy Stormwater Implementation & Outreach Program: 14-07/319: 2014-2017*. Massachusetts Executive Office of Energy and Environmental Affairs, Department of Environmental Protection, Bureau of Water Resources, Division of Municipal Services, 2017.

Cornett, Mick, et al. "CDBG Works: How Mayors Put CDBG to Work." *CDBG WORKS: How Mayors Put CDBG to Work*, 1 June 2017, pp. 1–116. *The United States Conference of Mayors*, doi:8/1/2018.

CWSRF. "PISCES Recognition Program 2017 Compendium." *Epa.gov*, 2017, www.epa.gov/sites/production/files/2017-11/documents/pisces_compendium_final2.pdf.

DOT. "Federal Register." *DEPARTMENT OF TRANSPORTATION Office of the Secretary of Transportation Notice of Funding Opportunity for the Department of Transportation's National Infrastructure Investments Under the Consolidated Appropriations Act, 2018*, vol. 83, no. 82, 27 Apr. 2018, pp. 1–11. *Office of the Secretary of Transportation*, DOT, doi:8/2/2018.

EPA. "Financing Green Infrastructure: A Best Practices Guide for the Clean Water State Revolving Fund." Epa.gov, 2015, www.epa.gov/sites/production/files/2016-01/documents/final_gi_best_practices_guide_12-9-15.pdf.

EPA. "2017 Annual Report: CWSRF Programs." Epa.gov, 2017, www.epa.gov/sites/production/files/2018-03/documents/final_2017_cwsrf_annual_report_for_web2.pdf.

"Erie Street CDBG Storm Water Improvements | Storm Lake, IA - Official Website." *Solar Energy | Storm Lake, IA - Official Website*, Government Websites by CivicPlus, 6 June 2016, www.stormlake.org/631/Erie-Street-CDBG-Storm-Water-Improvement.

Fitzpatrick, Mollie. "City of Santa Fe CONSOLIDATED PLAN." *Santa Fe Community Development Commission and Open House*, 18 Apr. 2018, pp. 1–20. *BBC*, Consulting, doi:8/2/2018.

Harper, Malcolm M. "PROJECT SUMMARIES." *SECTION 319 NONPOINT SOURCE COMPETITIVE GRANTS PROGRAM*, pp. 1–64. *MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION*, doi:8/2/2018.

Martinez, Susana, et al. "Federal Clean Water Act Section 319 Grant Federal Fiscal Year 2018: Watershed-Based Planning." *Request for Grant Application (RFGA),* 1 Jan. 2018, pp. 1–4. *New Mexico Environment Department*, Surface Water Quality Bureau, doi:8/2/2018.

Mahoney, Joanne M. "Save The Rain Clean The Lake." *FACT SHEET: Connective Corridor Phase 1, Contract 1*, 22 Dec. 2011, pp. 1–1., doi:8/2/2018.

Maloney, Lucia. "Carson City Gateway." *TIGER 2017 Discretionary Grant Application*, 16 Oct. 2017, pp. 1–35. *TIGER 2017,* doi:8/2/2018. Grant Application

New Mexico CWSRF Program, and Northbridge Environmental. "CWSRF Affordability Criteria System." Www.env.nm.gov, Feb. 2018, www.env.nm.gov/wp-content/uploads/2017/04/CWSRF-Affordability-Criteria-System_FEB2018.pdf.

New Mexico Environment Department. "New Mexico Clean Water State Revolving Fund Intended Use Plan State Fiscal Year 2019." www.env.nm.gov, 30 June 2018, www.env.nm.gov/wp-content/uploads/2017/04/CWSRF-2019-Draft-Intended-Use-Plan.pdf.

New Mexico Environment Department Construction Programs Bureau. "Infrastructure Development Report." www.nmlegis.gov, July 2017, www.nmlegis.gov/handouts/NMFA 110117 Item 3 b - NMED Presentation.pdf.

Ramage, Mary Ellen. "Funding & Sustainability Initiatives in The Borough of Etna." *Funding & Sustainability Initiatives in The Borough of Etna*, 1 May 2017, pp. 1–27. *Bayer Center*, Non-Profit Management, doi:8/1/2018. Power Point slides

Sawyers, Andrew D. "Memorandum: Green Infrastructure Policy for the Clean Water State Revolving Fund Program." Epa.gov, 6 Jan. 2016, www.epa.gov/sites/production/files/2016-01/documents/cwsrf_green_infrastructure_policy_final.pdf.

Sawyers, Andrew D. "Memorandum: Interpretive Guidance for Certain Amendments in the Water Resources Reform and Development Act to Titles I, II, V, and VI of the Federal Water Pollution Control Act." Epa.gov, June 2015, www.epa.gov/sites/production/files/2015-04/documents/water_resources_reform_and_development_act_guidance.pdf

U.S. DOT. "BUILD vs. TIGER Fact Sheet." Www.transportation.gov, 2018, www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/tiger/308656/build-vs-tiger-fact-sheet-042018-1049am.pdf.

Yoshikawa, Nancy. "Nonpoint Source Program and Grants Guidelines for States and Territories." pp. 1–78.*EPA's Nonpoint Source Website*, EPA, 12 Apr. 2013, doi:8/2/2018.

Appendix A: Case Study – Santa Fe Metropolitan Planning Organization

Metropolitan Planning Organizations (MPOs) are regional organizations comprised of cities, counties, and towns. They are federally-designated planning agencies located in urbanized areas with populations greater than 50,000. Funded by the U.S. Department of Transportation (USDOT), they serve as centralized agencies for coordinating regional transportation projects and policies. They typically maintain a broad portfolio of projects for all modes of transportation, including roads, pedestrian/bicycling facilities, transit, rail, marine, freight, and air.

The **Santa Fe MPO** was established in 1982. A staff of three is overseen by the Transportation Policy Board, comprised of eight elected and appointed members, that serves as the final arbiter on all decisions. A twelve-person Technical Coordinating Committee (representing partner agencies (i.e., city and county government, regional transit service providers, New Mexico Department of Transportation (NMDOT), the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA) offers guidance and expertise.

Santa Fe MPO receives federal funds channeled through NMDOT for planning activities. Due to its small size, construction expenses are not supported in the standard operating budget; however, grant and loan opportunities are available.

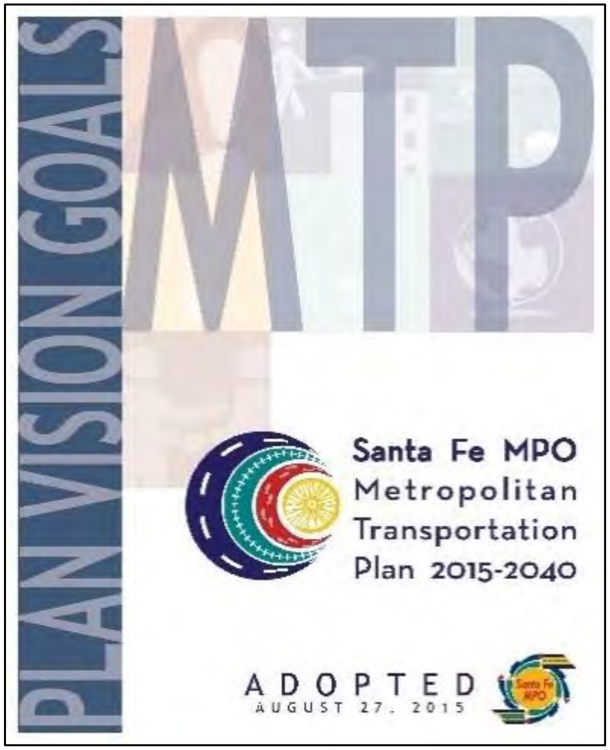


Figure 1. Santa Fe MPO's long-term transportation project planning guide.

Project Planning and Funding

The Santa Fe MPO maintains a **Metropolitan Transportation Plan** (MTP) that includes a prioritized list of regionally-significant transportation projects proposed by member entities over a 25-year horizon. The current version was published in 2015 and extends through 2040 (see Figure 1). The document is informed by extensive public input and updated every five years.

Although the Santa Fe MPO does not fund projects itself, the organization does help its partners identify and apply for project funding. Short-term projects – projects expected to commence and need funding within a four-year period – are included as part of the MPO's **Transportation Improvement Program** (TIP). All projects from all entities must be consistent and included in the MTP to be considered for funding. Further, proposed projects must demonstrate alignment with seven federal goals outlined in the Moving Ahead for Progress in the 21st Century Act (MAP-21):

1. Safety
2. Infrastructure condition
3. Congestion reduction
4. System reliability
5. Freight movement and economic vitality
6. Environmental sustainability
7. Reduce project delays

Funding programs available for TIP projects include:

- Metropolitan Planning (PL)
- National Highway Performance Program (NHPP)
- Surface Transportation Block Grant Program (STBG)
- Highway Safety Improvement Program (HSIP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Transportation Alternatives Program (TAP)

These programs typically favor state-level projects and local projects determined to be regionally significant. Santa Fe MPO representatives indicated bridge rehabilitation and paving projects tend to be given higher-priority at the local level. The TIP is updated every two years in coordination with NMDOT.

Santa Fe MPO indicated that NMDOT is often only able to disburse a portion of its available project funding each year (sometimes as little as 50 percent or less) due in part to procedural challenges, constraints of recipients and project timelines, and lack of available local matching funds. This shows there is likely room for improvement in the process and an opportunity for well-prepared entities to capitalize.

Integrating Stormwater into MPO Projects

Santa Fe MPO representatives acknowledge that infrastructure improvements have traditionally skewed towards “hard” elements like sidewalks and bike lanes, but, as an organization, they are willing and already active in promoting the use of more environmentally sustainable building practices. The MPO recognizes the value that stormwater management concepts can bring to transportation projects, and the MTP actively promotes the use of GI/LID practices. Santa Fe MPO promotes green streets design practices and has adopted *A Resolution Advancing Complete Streets for the Santa Fe Metropolitan Planning Area*,[37] which states “the Santa Fe Metropolitan Planning Organization promotes a multi-modal, regional transportation system that is safe, energy and fiscally efficient, maximizes community connectivity, serves the mobility needs of all citizens, and exists in harmony with the environment.” Design concepts like narrower street widths, bioretention curb extensions and sidewalk planters, permeable pavement, and sidewalk trees and tree boxes are just some of the LID techniques recommended specifically in Santa Fe’s MTP.

[37] Santa Fe MPO Complete Streets resolution (Resolution No. 2007-1): http://santafempo.org/wp-content/uploads/2009/07/Complete-Streets-Resolution.pdf

"There is a huge opportunity for projects to significantly reduce their carbon footprint and, in many cases, overall costs simply by using construction materials that are locally sourced, recycled, and sustainably produced. Known as Green Infrastructure (GI) and LID techniques, these sustainable design and construction methods are gaining in popularity because of their ability to reduce runoff, improve stormwater quality, preserve or create valuable habitat, contribute to more livable and walkable communities, and be eligible for LEED accreditation by the US Green Buildings Council."

-Santa Fe MTP (2015-2040)

MPO Projects in Santa Fe

The City of Santa Fe already has a successful working relationship with the MPO. Projects like the **Santa Fe Railyard** (pictured below), which included improvements to the New Mexico Rail Runner Express system, were planned with the help of the MPO and have helped stimulate economic growth in Santa Fe. Looking toward the future, the MPO has expressed interest in helping the city accomplish its environmental sustainability goals, including in relation to long-term stormwater planning.

Photograph: Santa Fe Railyard water tower. (Source: PG Environmental)

The city is currently leading or participating in several projects proposed in the 2015-2040 MTP, including multiple sites along the **Guadalupe Street corridor**. These proposed projects involve designs related to road diet and improving pedestrian safety and accessibility. The sites in this area that are still in planning and not yet at full-design offer opportunities for the city to be proactive in incorporating innovative stormwater management concepts and subsequently securing government funding. To this end, EPA has worked with the city to develop some concepts of what GI and LID designs would like for the corridor. These have been highlighted in a separate document called *A Guide to Incorporating Green Infrastructure into Roadway Projects in Santa Fe*.

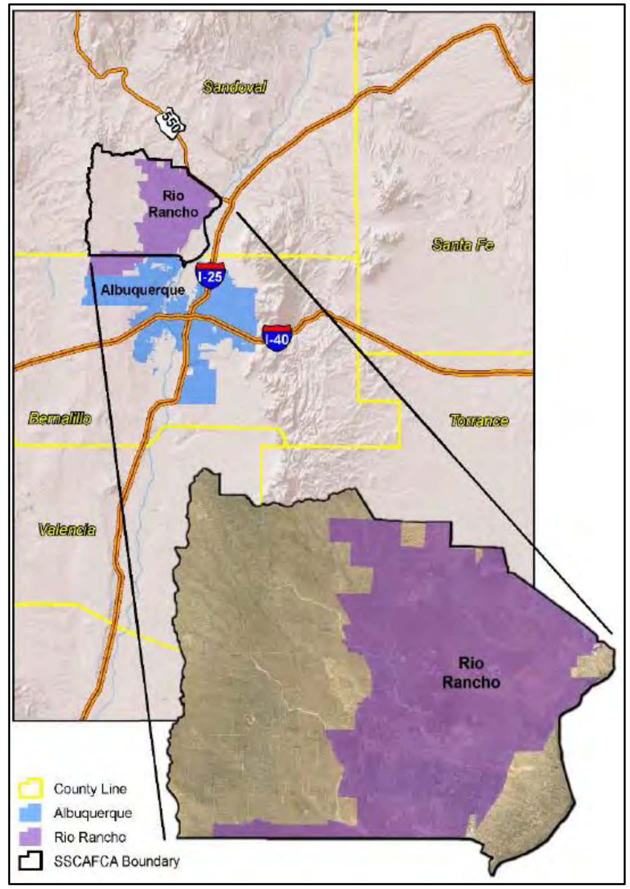
Appendix B: Case Study – Southern Sandoval County Arroyo Flood Control Authority

The **Southern Sandoval County Arroyo Flood Control Authority** (SSCAFCA) is located north of Albuquerque and southwest of Santa Fe, in the central part of New Mexico. SSCAFCA's service area encompasses approximately 225 square miles and serves a total population of 90,000 across Rio Rancho, Corrales, Bernalillo, and Sandoval County (see Figure 1).

SSCAFCA does not have a direct relationship with the City of Santa Fe; however, they are connected regionally, as both are part of the Rio Grande watershed. SSCAFCA serves as a good example of an organization that makes the most of its funding and can be looked to as a resource for best practices in leveraging government-sponsored opportunities. Additionally, one of SSCAFCA's main functions is to manage and maintain the arroyos in its jurisdiction, which is also a significant service provided by the City Santa Fe for its constituents.

SSCAFCA's mission is to protect citizens and property by implementing proven flood control solutions. Unlike a traditional utility with a fee structure, its operational budget is funded through property tax levies, while its capital budget is supported through bond sales, and in many cases, federal and state grants and loans.

SSCAFCA engages in a calculated, long-term funding approach for stormwater management and flood control projects. In an effort to maximize every public dollar it receives, the authority is heavily involved in pursuing government funding subsidies.



Source: SSCAFCA 2018 Annual Report

Figure 1. SSCAFCA location map.

Long-term Planning Approach

SSCAFCA has been particularly adept at securing federal funding for its stormwater mitigation projects thanks in part to a long-term planning approach. Staff credit a strong push to identify needed flood control facilities and improvements soon after the agency was established.

Engaging in a working relationship with their local service area communities was cited as another key element for success. SCCAFCA is regulated under a watershed-based National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit that encourages ongoing coordination. SSCAFCA's drainage projects are viewed as especially valuable by the surrounding municipalities, allowing them to conserve their limited water resource budgets and focus on other priorities.

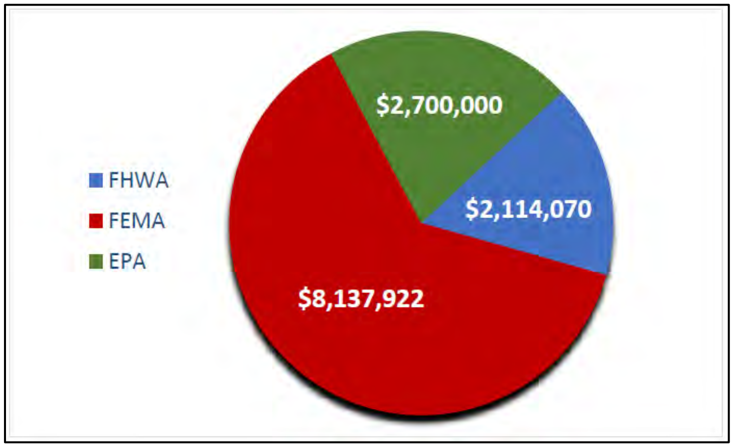
> "[SSCAFCA's] *second major focus is a continuation of the strategy to pursue external funding sources to match with our local bond funds. SSCAFCA is continuing to pursue state capital outlay funds, for the third consecutive year, and has successfully received funding from the State Water Trust Board, the NM Environment Department with a Clean Water Revolving Loan Fund grant/loan combination, as well as FHWA funding through the Mid-Region Council of Government for two separate projects … SSCAFCA has also received funding support from the US Army Corps of Engineers (USACE) in the form of sediment transport soil analysis and the Federal Emergency Management Agency (FEMA) in their Hazard Mitigation Grant Program … In addition to these sources, SSCAFCA continues to apply for other federal grants."*
>
> \- Excerpt from SSCAFCA's 2015 audit report

SSCAFCA's relationship with its service community helps inform the development of its 5-year plan, which strategically aligns projects with government funding cycles. The agency also maintains a broader 15-year funding needs analysis. This proactive measure allows SSCAFCA to be nimble in pursuing project funding—SSCAFCA has plans at-the-ready when opportunities arise.

SSCAFCA is solely responsible for managing flood controls (i.e., arroyos) within its service area, and it has no regulatory oversight responsibilities. This is different than most traditional municipal governments. As a result, staff can devote more resources to project planning and identifying funding opportunities. Often multiple staff will collaborate on an application. SSCAFCA representatives indicated that the level of effort for an application generally corresponds with the funding amount and some applications may take up to one month of staff time, collectively. Because the conceptual project plans have been developed in advance, it is easier to match them with a corresponding funding source, as they become available.

Federal Funding Portfolio

SSCAFCA's long-term planning approach has yielded nearly $13M in federal funding since 2012, with more than half from Federal Emergency Management Agency (FEMA) (see Figure 2). SSCAFCA has been successful in competing for FEMA's **Pre-Disaster Mitigation Grant Program**, which is designated for projects that reduce overall risk to the population and structures from future hazard events. In order to best position themselves for this opportunity, the authority highlights the safety aspects of arroyo improvement when applying. SSCAFCA has also been awarded funding through FEMA's **Hazard Mitigation Grant Program**, which supports post-disaster projects that aim to reduce or eliminate long-term risk to people and property from future disasters. To be eligible for FEMA funding, projects must meet a designated benefit-cost ratio for protection of property and life.[38]



Source: *SSCAFCA 2018 Annual Report*

Figure 2. SSCAFCA federal fund portfolio, 2012 to 2018.

[38] FEMA's Benefit-Cost Analysis Toolkit is available for download at https://www.fema.gov/benefit-cost-analysis.

By designing multifunctional projects, SSCAFCA has also been able to secure funds under the Federal Highway Administration's (FHWA's) **Transportation Alternative Program (TAP)**, which supports smaller-scale transportation projects such as pedestrian and bicycle facilities and recreational trails. Specifically, they have submitted trails/outdoor access projects that include drainage protection elements. For example, SSCAFCA was able to incorporate erosion and sediment control improvements a TAP-funded arroyo bridge crossing project.

Regardless of the source, SSCAFCA indicated that advance preparation is the biggest factor in successfully obtaining outside funds. Application windows are often limited, so long-term planning gives organizations a head start – and a significant advantage – when the right opportunity arises.

Project Example: Lower Montoyas Water Quality Feature

Photograph: Grade control structure in the Lower Montoyas arroyo incorporating planting strip. (Source: SSCAFCA)

One of SSCAFCA's primary functions is to manage local arroyos. Common to the southwestern U.S., arroyos are especially prone to flooding. With an arid climate, the area is vulnerable to flash flooding during monsoon season, which typically spans mid-June through the end of September. Storm events in 2006, 2010, and 2013 caused significant damage to SSCAFCA's service area and posed a hazard to the health and safety of local residents.

SSCAFCA identified the Lower Montoyas arroyo, located downstream of the largest watershed within its jurisdiction, as a priority for implementing stormwater controls. Staff initially considered installing a traditional dam structure for flood management; however, local residents expressed the desire to maintain the natural landscape. Instead, the agency identified a more cost-effective GI/LID approach to restore natural hydrology and enhance infiltration capacity.

SSCAFCA learned about the opportunity to use the EPA's Clean Water State Revolving Fund (CWSRF) to help finance the project by communicating directly with representatives from the NMED CPB. At that time, the CWSRF incorporated a ranking bonus for applicants pursuing green infrastructure approaches, increasing the likelihood of successfully acquiring funding this particular project. Favorable loan terms were another determining factor. For example, the authority would not be required to start repaying debt until after construction was complete. Further, the available 20-year loan term allows SSCAFCA more financial flexibility because the authority's bond cycle is typically only 13 years. The resulting smaller payments spread over a longer time period would allow SSCAFCA to allocate the difference to other projects. Staff indicated that the proposal was able to come together quickly because of advanced planning.

The Lower Montoyas Water Quality Feature Project was awarded a $20M CWSRF loan in 2013, covering most of the project cost. The in-channel water quality facility included the strategic placement of natural elements (e.g., vegetation, boulders) and re-grading in order to slow water flows and filter out pollutants (e.g., sediment, floatables). The project, completed in 2015, was designed to handle flows from a 100-year storm event.

Appendix C: Summary of Potential Federal Funding Opportunities

U.S. EPA

Federal Funding Programs - Stormwater and Green Infrastructure Projects

U.S. Environmental Protection Agency (EPA)

PROGRAM	PROGRAM DESCRIPTION	EXAMPLE OF FUNDED PROJECTS
Clean Water State Revolving Fund	Using a combination of federal and state funds, provides loans to construct municipal wastewater facilities, control nonpoint sources of pollution, build decentralized wastewater treatment systems, create green infrastructure projects, protect estuaries, and fund other water quality projects. The Best Practices Guide (2015) highlights successful case studies and examples of ways state CWSRF programs can prioritize green infrastructure projects for funding by implementing priority point systems, program set-asides, and marketing strategies for state programs. Green Infrastructure Approaches to Managing Wet Weather with Clean Water State Revolving Funds Factsheet (2008).	The Inland Empire Utilities Agency (IEUA) – a regional wastewater service provider and distributor of wholesale water and recycled water in San Bernardino County, CA – received more than $30 million in financing from the American Recovery and Reinvestment Act (ARRA). A portion of these funds will be used for stormwater capture in local groundwater aquifers and green infrastructure projects to improve the water quality of the Chino Creek Watershed and improve wildlife habitat by restoring the degraded riparian ecosystem. In 2004, the Nature Conservancy used a $9 million CWSRF loan to fund the interim financing and holding a critical portion of land, known as the Palo Corona Ranch, in Monterey County, CA. This project protected 9,898 acres of pristine Redwood and Monterey Pine forests from imminent development. Without the Nature Conservancy's purchase increased sedimentation and stormwater runoff would have cause severe impaired to coastal and aquatic resources. The property will be retained by the Department of Parks and the Monterey Peninsula Recreational Park District with dedicated funds over a seven-year period.
Water Infrastructure Finance and Innovation Act (WIFIA)	WIFIA is a federal credit program administered by EPA for eligible water and wastewater infrastructure projects, including stormwater and green infrastructure projects.	The WIFIA program is inviting 12 entities with projects in 9 states to apply for more than $2 billion in WIFIA loans. Several of the selected projects include stormwater: • The City of Baltimore, MD will repair, rehabilitate, replace, and upgrade its wastewater collection and treatment, water treatment and distribution, and stormwater management systems. • The City of Omaha, NE will construct a new retention treatment basin to address combined sewer overflows in the Saddle Creek Basin. • King Co., WA will construct a new wet weather treatment station, conveyance pipelines and outfall structure to treat combined sewer overflows to the Lower Duwamish Waterway.

PROGRAM	PROGRAM DESCRIPTION	EXAMPLE OF FUNDED PROJECTS
		• Saint Louis, MO will construct a new pump station, replace parts of the sanitary sewer to address combined and sanitary sewer overflows to Deer Creek.
Section 319 Nonpoint Source Grant Program	Funding goes to states to reduce nonpoint source pollution (pollution caused by rainfall running over the ground and carrying pollutants including trash, oil and grease, and fertilizers into nearby waterways). EPA's most recent program guidance recognized the "importance of green infrastructure … in managing stormwater" and supported awarding funding to green infrastructure projects.	The District of Columbia Department of Energy and Environment (DOEE) used Section 319 funding to partially fund remediation of the Watts Branch watershed in northeast D.C. Watts Branch suffered from severe erosion and sediment pollution due to frequent flooding. DDOE led a project to restore the stream bed and control flooding using tree and shrub plantings, regrading of the stream bed, and upstream low-impact development practices to manage impervious surface runoff.
Urban Waters Small Grants Program (UWSG)	Funding to communities to improve the quality of urban waters while simultaneously stimulating neighborhood revitalization. The Urban Waters Small Grants Program has a focus on underserved communities, defined as "communities with environmental justice concerns and/or susceptible populations." The Program can be used specifically for innovative or new green infrastructure practices that improve water quality; state, local, and tribal governments, as well as universities and nonprofit organizations, are eligible to apply.	The Constitutional Rights Foundation, in partnership with Los Angeles Waterkeeper and UCLA, award to work with four high schools in Los Angeles County. College-aspiring students will be taught how to collect data related to trash and industrial stormwater pollution. Up to five seniors from UCLA's Environmental Sciences bachelors program will serve as peer mentors and role models for participants (2015/6). Heal the Bay will monitor bacterial water pollution at two recreational zones in the Los Angeles River. Water quality data will be made available regularly to the public. Results of the study will be used to make recommendations to agencies and watershed stakeholders for improving water quality and protecting public health (2015/6).

U.S. Housing and Urban Development (HUD)

PROGRAM	PROGRAM DESCRIPTION	EXAMPLE OF FUNDED PROJECTS
Community Development Block Grant (CDBG)	Eligible to fund stormwater and green infrastructure because these projects can create jobs, increase economic activity, and increase property values. For example, urban tree planting can increase economic activity in a commercial district. Additionally, green infrastructure can increase property values by mitigating flooding, improving neighborhood aesthetics, and providing other co-benefits.	Detroit, MI, used $8.9 million in CDBG funds in 2014 to create a major flood prevention and economic development program. Detroit is using the funding to demolish blighted properties, landscape and install trees on 200 vacant lots to improve stormwater management and neighborhood aesthetics, and install infrastructure that will direct stormwater into new bio-retention basins. Chicago has used CDBG funding to put a new green roof on its historic Cultural Center.

<table>
<tr><th>PROGRAM</th><th>PROGRAM DESCRIPTION</th><th>EXAMPLE OF FUNDED PROJECTS</th></tr>
<tr><td>Sustainable Communities Regional Planning Grants</td><td>Supports metropolitan and multijurisdictional planning efforts to integrate housing, land use, economic and workforce development, transportation, and infrastructure investments in a manner that empowers jurisdictions to consider the interdependent challenges of economic competitiveness and revitalization, social equity, inclusion, and access to opportunity, energy use and climate change, and public health and environmental impact.</td><td rowspan="2">Green Infrastructure and the Sustainable Communities Initiative report provides case studies of 30 local governments who have used U.S. HUD Sustainable Communities Regional Planning Grants or Community Challenge Planning Grants to fund green infrastructure programs. Generally, HUD SCI grantees have planned for climate resilience by identifying strategic areas to implement stormwater best management practices with a dual approach to stormwater management that uses both traditional gray infrastructure and green infrastructure.

Although the HUD Sustainable Communities Initiative grant programs have not received appropriations since 2011, the case studies provide excellent examples of how local governments can combine various funding streams to pay for green infrastructure programs.

For example, the City of Pittsburgh combined funding from a HUD Community Challenge Planning Grants with funding from a U.S. DOT TIGER II grant to fund the planning of the Allegheny Riverfront Green boulevard project.</td></tr>
<tr><td>Community Challenge Planning Grants</td><td>Fosters reform and reduces barriers to achieving affordable, economically vital, and sustainable communities. Such efforts may include amending or replacing local master plans, zoning codes, and building codes, either on a jurisdiction-wide basis or in a specific neighborhood to promote mixed-use development, affordable housing, the reuse of older buildings for new purposes, and similar activities with the goal of promoting sustainability at the local or neighborhood level.</td></tr>
<tr><td>Section 108 Loan Guarantee Program</td><td>Allows future CDBG allocations to be used to guarantee loans for neighborhood revitalization projects, including construction and installation of public facilities and infrastructure. Section 108-guaranteed projects can incorporate green infrastructure into their design and construction.</td><td></td></tr>
<tr><td>Community Development Block Grant – Disaster Recovery (CDBG-DR)</td><td>Provides federal aid to states post-disaster, and funds can be used for a variety of community development activities that benefit low- and moderate-income individuals, reduce blight, or address an urgent community need. In rehabilitating housing and constructing public amenities, cities may be able to incorporate green infrastructure techniques (like street trees and permeable pavements) in street design.</td><td>Louisiana used CDBG funds to acquire properties in floodplains after Hurricane Katrina.</td></tr>
</table>

Department of Homeland Security - Federal Emergency Management Administration (FEMA)

PROGRAM	PROGRAM DESCRIPTION	EXAMPLE OF FUNDED PROJECTS
Hazard Mitigation Grant Program (HMGP)	Provides post-disaster federal aid to states to mitigate the risks of future disasters and can fund flood mitigation projects, including acquisition and relocation of flood-prone properties and soil stabilization projects like the installation of vegetative buffer strips	New Orleans used HMGP funding for its post-Katrina rebuilding process, including the reconstruction of the city's stormwater infrastructure. Although the New Orleans Stormwater plan calls for a significant expansion of green infrastructure to manage the city's chronic flooding, the city initially had difficulty demonstrating the benefits of green infrastructure under FEMA's required benefit-cost analysis because the city 1) lacked the data to demonstrate potential flood losses avoided and 2) could not count many of green infrastructure's environmental benefits. Demonstrating the cost-benefit of green infrastructure under HMGP has been much easier since FEMA amended its policy to allow counting of some "ecosystem services" (including aesthetic value, air quality, recreation space, and water filtration) as benefits.
Pre-Disaster Mitigation Grant Program	Funds to implement a sustained pre-disaster natural hazard mitigation program. The goal is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters. This program awards planning and project grants and provides opportunities for raising public awareness about reducing future losses before disaster strikes. Mitigation planning is a key process used to break the cycle of disaster damage, reconstruction, and repeated damage. PDM grants are funded annually by Congressional appropriations and are awarded on a nationally competitive basis.	
Flood Mitigation Assistance (FMA) Grant Program	The FMA program aims to reduce or eliminate claims under the National Flood Insurance Program (NFIP). FMA provides funding to States, Territories, federally-recognized tribes and local communities for projects and planning that reduces or eliminates long-term risk of flood damage to structures insured under the NFIP. FMA funding is also available for management costs. Funding is appropriated by Congress annually. FEMA requires state, tribal, and local governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance, including	In Fiscal Year 2017, $160,000,000 in Flood Mitigation Assistance (FMA), is available to assist States, Tribal, Territorial and local governments in reducing or eliminating claims under the National Flood Insurance Program (NFIP). Eligible project activities include: o Infrastructure protective measures o Floodwater storage and diversion o Utility protective measures o Stormwater management o Localized flood control to protect critical facility o Floodplain and stream restoration o Water and sanitary sewer system protective measures

PROGRAM	PROGRAM DESCRIPTION	EXAMPLE OF FUNDED PROJECTS
	funding for HMA mitigation projects. For more information on mitigation plan requirement or refer to the current HMA. Generally, local communities will sponsor applications on behalf of homeowners and then submit the applications to their State. All FMA grant applications must be submitted to FEMA by a State, U.S. Territory, or federally-recognized tribe. Please refer to the current HMA guidance for detail information on the Flood Mitigation Assistance Program.	o Wetland restoration/creation o Aquifer storage and recovery

Department of Defense – Army Corps of Engineering

PROGRAM	PROGRAM DESCRIPTION	EXAMPLE OF FUNDED PROJECTS
Planning Assistance to States (PAS)	The Corps of Engineers can provide states, local governments, other non-Federal entities, and eligible Native American Indian tribes assistance in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources. Typical studies are only planning level of detail; they do not include detailed design for project construction. The program can encompass many types of studies dealing with water resources issues. Types of studies conducted in recent years under the program include the following: water supply/demand, water conservation, water quality, environmental/conservation, wetlands evaluation/restoration, dam safety/failure, flood damage reduction, coastal zone protection, and harbor planning. Cost Sharing Requirements. Efforts under this program are cost shared on a 50 percent Federal – 50 percent non-Federal basis. The study sponsor has the option of providing in-kind services for its share of the study cost.	

U.S. Department of Transportation

PROGRAM	PROGRAM DESCRIPTION	EXAMPLE OF FUNDED PROJECTS
Transportation Investment Generating Economic Recovery (TIGER) program	Funds investments in road, rail, transit and port projects. TIGER grants have been awarded to projects that included green infrastructure components	Syracuse Connective Corridor project The Connective Corridor project in Syracuse created more bikeable and walkable streets to encourage active transportation and reduce greenhouse gas emissions, and incorporated green infrastructure elements such as tree trenches and porous pavements.
Federal Highway Administration (FHWA) Surface Transportation Block Grant – Transportation Alternatives Set-Aside	Provides funding for "transportation alternatives," including "off-road trail facilities for pedestrians, bicyclists, and other non-motorized forms of transportation." TAP funding could be used to pay for green infrastructure components of trails and sidewalks such as permeable pavements.	The Southeast Michigan Council of Governments (SEMCOG) used TAP funding in 2015 from the state of Michigan to fund the Detroit – Inner Circle Greenway Railroad Acquisition, which included 1) installation of green infrastructure such as green streets and bioretention and 2) repurposing of 8.3 miles of abandoned railway near Detroit
Federal Highway Administration (FHWA) Congestion Mitigation and Air Quality (CMAQ) program	Allocates federal funding for infrastructure projects that reduce congestion and improve air quality. Bicycle transportation and pedestrian walkways are eligible uses of the money, and can be designed to include green infrastructure features, such as permeable surfaces for trails, and bioswales and bioretention for areas adjacent to trail surfaces.	The City of Santa Fe's Acequia Trail Underpass project used CMAQ funding in 2017/18 via the New Mexico DOT to construct a bicycle underpass under federal highway US 284/85 to improve safety of pedestrians and bicyclists crossing one of the city's busiest and most congested intersections along the alignment of an abandoned rail line. The work installed low-impact development drainage basins which capture and infiltrate 100-percent of the on-site stormwater up the 100-year storm, and other green infrastructure elements such as soil-enhanced swales and landscaping to improve site-permeability.

U.S. Department of Agriculture

PROGRAM	PROGRAM DESCRIPTION
Rural Development Water and Environmental Programs (WEP)	WEP is exclusively focused on the water and waste infrastructure needs of rural communities with populations of 10,000 or less. The programs provide technical assistance and financing for development of drinking water, waste disposal, and stormwater systems in rural areas.
Rural Development Water and Waste Disposal Loan and Grant Program	Provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and storm water drainage to households and businesses in eligible rural areas.
U.S. Forest Service Urban and Community Forestry Program	Urban and Community Forestry (UCF) is a cooperative program of the US Forest Service that focuses on the stewardship of urban natural resources – provides grants for urban forestry projects

U.S. Department of the Treasury

PROGRAM	PROGRAM DESCRIPTION
New Markets Tax Credit program	Encourages private investment in a range of project types in distressed areas (e.g., real estate or business development projects). Awards are allocated to nonprofit and private entities based on their proposals for distributing the tax benefits.

U.S. Department of Energy

PROGRAM	PROGRAM DESCRIPTION
Energy Efficiency Savings – Tax Incentives and Rebates	Green infrastructure can be integrated into project design to claim tax incentives and rebates. For example, Eugene, Oregon, a new biofuel station built on an abandoned gas station site included a green roof, bioswales and rain gardens. Nearly $250,000 worth of tax credits reduced income and sales tax for the private company that built and operated the project.
Weatherization and Intergovernmental Program	Provides grants, technical assistance, and information tools to states, local governments, community action agencies, utilities, Indian tribes, and U.S. territories for their energy programs. The funding can be used to encourage installation of green infrastructure—such as green roofs—as part of the weatherization process.

Department of the Interior – National Park Service

PROGRAM	PROGRAM DESCRIPTION
Rivers, Trails and Conservation Assistance Program	Assists community-led natural resource conservation and outdoor recreation initiatives. RTCA staff provide guidance to communities on conserving waterways, preserving open space, and developing trails and greenways.

U.S. Department of Commerce

PROGRAM	PROGRAM DESCRIPTION
Economic Development Administration: Public Works and Economic Adjustment Assistance programs (EDAP)	Support a range of business and industrial development activities—including infrastructure development—that create or retain jobs. EDA-capitalized revolving loan funds encourage new business development in economically distressed communities.
National Oceanic and Atmospheric Administration: Community-Based Restoration Program	Program began in 1996 to inspire and sustain local efforts to restore coastal habitat. It has funded more than 1,500 projects in the United States, Canada, the Caribbean, and the Pacific Islands that have restored more than 41,000 acres of habitat and opened more than 1,700 stream miles for fish passage.
National Oceanic and Atmospheric Administration: Coastal Resilience Grants Program	This competitive grant program funds projects that are helping coastal communities and ecosystems prepare for and recover from extreme weather events, climate hazards, and changing ocean conditions. All project proposals undergo a rigorous merit review and selection process by a panel of subject matter experts from across the United States that include representatives of government, academia, and private industry.

Sources: http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/federal-funding.html
https://www.epa.gov/green-infrastructure/green-infrastructure-funding-opportunities