FINAL REPORT

WASTEWATER MASTER PLAN

MAY 2015

Timothy Francis

Registered Professional Engineer (Civil)
CERTIFICATE NO.
22684
TIMOTHY
FRANCIS
Date Signed 5/12/15
ARIZONA, U.S.A.

Expires 12/31/17

00776004.0001

ARCADIS
Infrastructure · Water · Environment · Buildings

ARCADIS U.S., Inc.
410 N. 44th Street
Suite 1000
Phoenix
Arizona 85008
Tel 602 438 0883
Fax 602 438 0102
www.arcadis-us.com

WATER PLANNING

James P. Shano, P.E.
Public Works Director / Town Engineer
Town of Paradise Valley
6401 E. Lincoln Drive
Paradise Valley, AZ 85253

Subject: *Wastewater Master Plan*

Date:
May 12, 2015

Contact:
Timothy Francis

Phone:
(602) 797-4618

Email:
tim.francis@arcadis-us.com

Our ref:
00776004.0001

Dear Mr. Shano:

ARCADIS-US, Inc. is pleased to submit the *Wastewater Master Plan* Final Report. The *Master Plan* presents near-term and long-term recommendations to improve monitoring of the Town's wastewater flows, acquire additional capacity ownership in Scottsdale's wastewater system, provide infrastructure for new connections to the system, and to begin implementing a wastewater system rehabilitation and replacement program. A new wastewater system hydraulic model was also developed which will be useful in future planning updates and in assuring adequate capacity for all Town residents and businesses as new connections are made to the Town's collection system.

We sincerely appreciate the assistance and guidance provided by Town staff during preparation of the *Master Plan* and we look forward to continuing our working relationship in the future.

Sincerely,

ARCADIS U.S., Inc.

Timothy Francis, P.E., BCEE
Principal Environmental Engineer, Project Manager

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Imagine the result

Wastewater Master Plan

May, 2015

ARCADIS

Timothy Francis, P.E.
Principal Environmental Engineer

Venkat Radhakrishnan, P.E.
Project Engineer

Wastewater Master Plan

Wastewater Planning Services

Prepared for:
Town of Paradise Valley

Prepared by:
ARCADIS U.S., Inc.
410 N. 44th Street
Suite 1000
Phoenix
Arizona 85008
Tel 602 438 0883
Fax 602 438 0102

Our Ref.:
00776004.0001

Date:
May, 2015

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Timothy Francis

Registered Professional Engineer (Civil)
CERTIFICATE NO. 22684
TIMOTHY FRANCIS
Date Signed 5/12/15
ARIZONA, U.S.A.

Expires 12/31/17

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Acronyms and Abbreviations

AWT	Advanced Water Treatment
BOD	Biological Oxygen Demand
CCTV	Closed Circuit Television
CIP	Capital Improvement Plan
CMOM	Capacity, Management, Operations, and Maintenance
COD	Chemical Oxygen Demand
DEM	Digital Elevation Model
DIP	Ductile Iron Pipe
EPS	Extended Period Simulation
GIS	Geographic Information Systems
gpd	Gallons per Day
IGA	Intergovernmental Agreement
I&I	Inflow and Infiltration
LF	Linear Feet
MAG	Maricopa Association of Governments
MIS	Management Information System
MF	Microfiltration
mgd	Million Gallons per Day
NASSCO	National Association of Sewer Services Companies
O&M	Operations and Maintenance
PACP	Pipeline Assessment Certification Program
PVC	Polyvinyl Chloride
RO	Reverse Osmosis
RWDS	Reclaimed Water Delivery System
SRO	Salt River Outfall
SROG	Sub-Regional Operating Group
SSO	Sanitary Sewer Overflow
TSA	Time Series Analyzer
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VCP	Vitrified Clay Pipe
WRF	Water Reclamation Facility
WRP	Water Reclamation Plant
WWTP	Wastewater Treatment Plant

Executive Summary

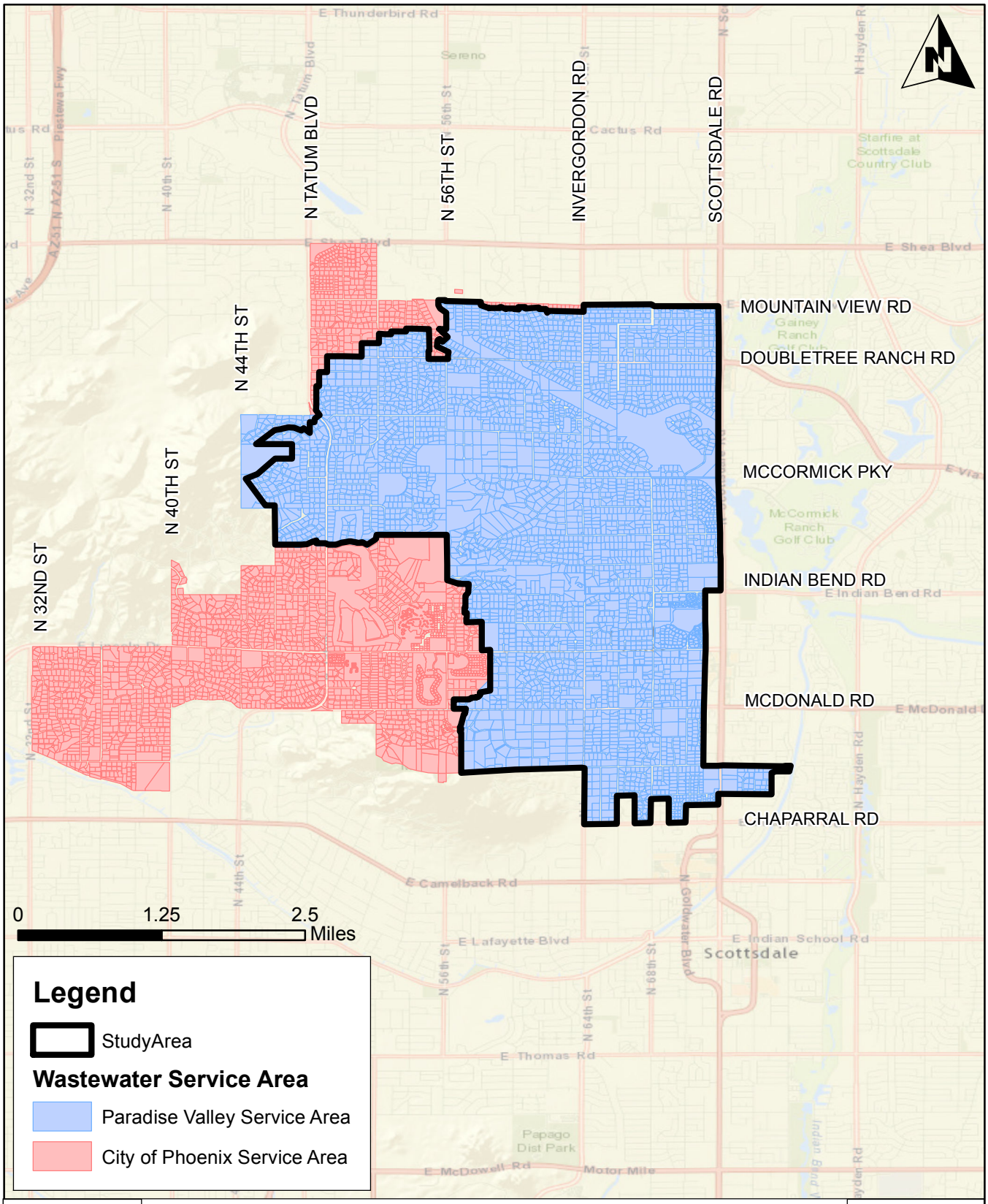
Introduction

The Town of Paradise Valley (Town) has two wastewater service providers. Portions of the southwest and northwest are served by the City of Phoenix which owns, operates and maintains the wastewater facilities in these areas (**Figure ES-1**). The remaining areas are served by the Town which owns, operates and maintains the collection system within these areas. This Wastewater Master Plan has been developed for the Town's service area.

The Town's wastewater service area is provided wastewater treatment and disposal services through an Intergovernmental Agreement (IGA) with the City of Scottsdale (Scottsdale). The Town's wastewater is either pumped to Scottsdale's Water Campus or flows by gravity through Scottsdale's system to the Sub-Regional Operating Group (SROG) interceptor system, which conveys flows to the 91st Avenue Wastewater Treatment Plant (WWTP). Scottsdale is a member of the SROG. The Town's capacity ownership in the Scottsdale wastewater system is monitored by flow metering at 13 locations in the Town's service area (**Figure ES-2**) for 13 wastewater drainage basins. Flows from 6 drainage basins are not metered; these flows are estimated using information from the metered areas.

Wastewater Flow Database

Data loggers at the 13 flow metering stations calculate flows at 5-minute intervals and transmit the data to Scottsdale, and Scottsdale provides the data to the Town on a daily basis. The Town has a new Wastewater Flow Management Tool that assists in graphical display and visualization of flow information for any time period and drainage basin (or collection of basins). The Tool calculates flow for the unmetered basins based on the metered flow data and contains data from January 1, 2005 to the present. The Tool was used to develop wastewater flow characteristics, including average and peak flows, diurnal flow curves, and per dwelling unit flow factors.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Study Area

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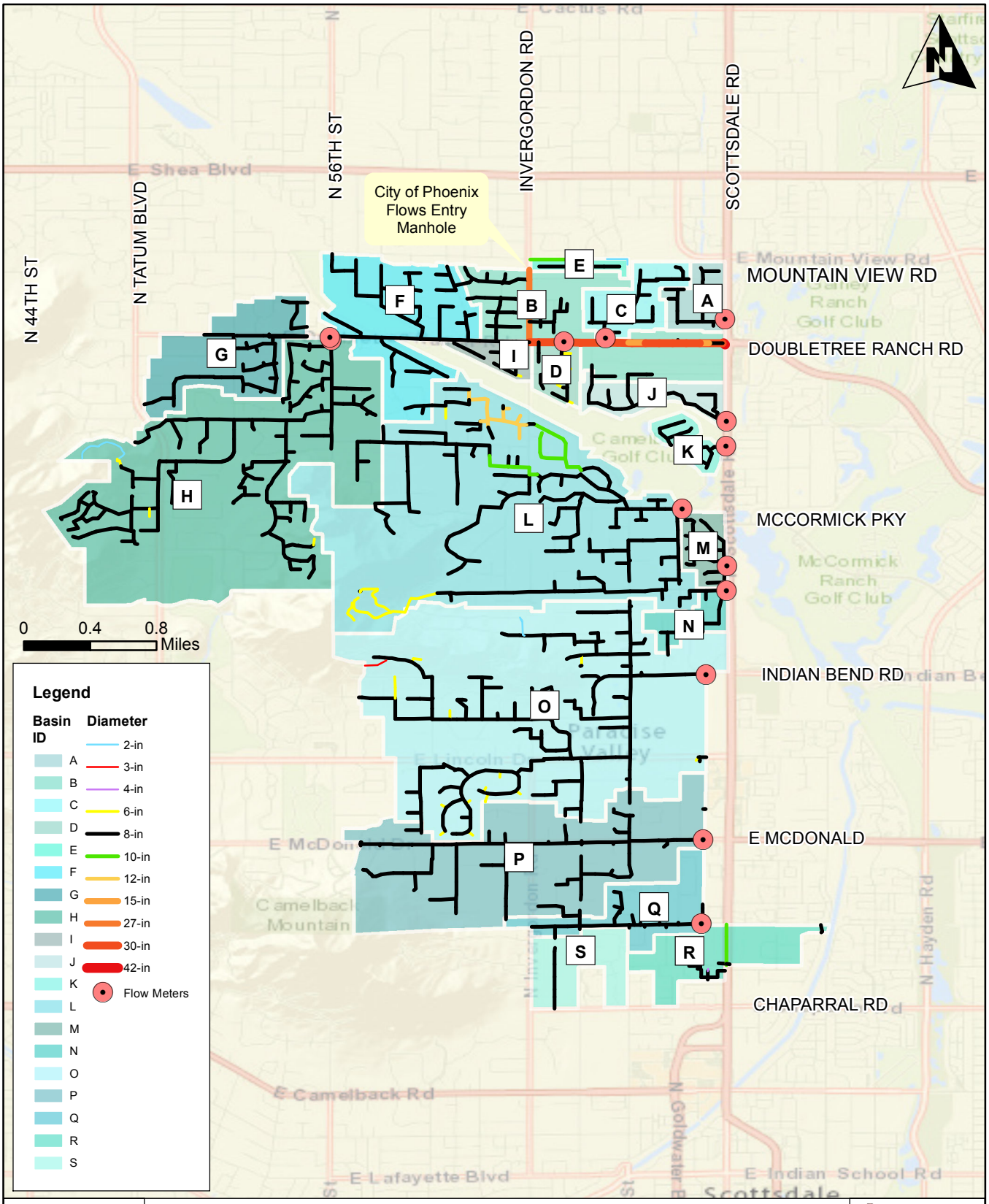
FIGURE ES-1



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Collection System

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FIGURE ES-2

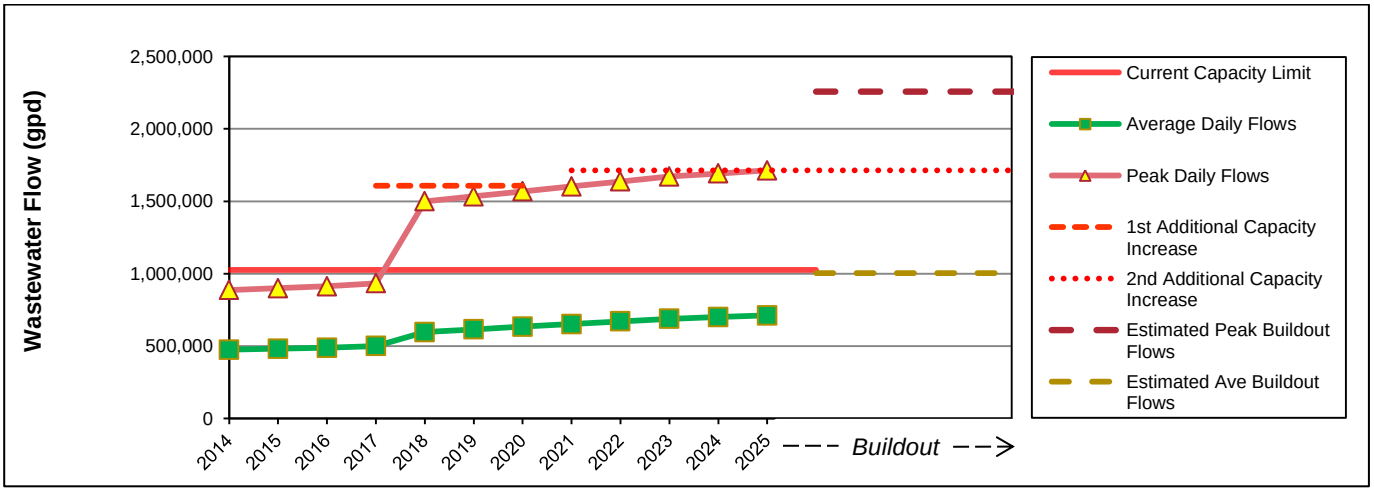
Wastewater Flow Projections

Wastewater flow projections were developed based on per dwelling unit flow factors and projected connections of existing dwelling units on septic systems and vacant parcels to the wastewater system through 2025, and at buildout (**Figure ES-3**).

On an average day basis, the flows are projected to increase from approximately 480,000 gpd in 2015 to 710,000 gpd in 2025, and to further increase to 1 mgd at buildout. On a peak day basis, the flows are projected to increase from approximately 890,000 gpd in 2015 to 1.7 mgd in 2025, and to further increase to 2.3 mgd at buildout.

The Town's current purchased capacity in the Scottsdale system is 1.026 mgd. The first capacity exceedance is projected to occur in 2018, primarily as a result of the proposed 5-Star Development. The Town would need an additional 580,000 gpd of capacity in 2017 (total capacity to increase to 1.6 mgd). As the wastewater customer base increases from new connections, the Town would require an additional 110,000 gpd of treatment capacity in 2021 (total capacity to increase to 1.7 mgd). This final capacity increase will be sufficient through 2025.

Figure ES-3 Wastewater Flow Projections



Wastewater Drainage Basin Modifications

An important objective of the Town was to improve monitoring of its capacity ownership in the Scottsdale system by assessing options for modifying drainage basins and meter locations to achieve 100 percent metering of its wastewater flows. Multiple options were explored, including connecting unmetered basins, combining basins, and

identifying suitable locations for new meters. The Town selected the option that provided the best tradeoff between costs and meter reductions (**Figure ES-4**). The selected option reduces the number of flow meters from 13 to 6, but provides 100 percent metering of the Town's flows.

Wastewater System Hydraulic Model

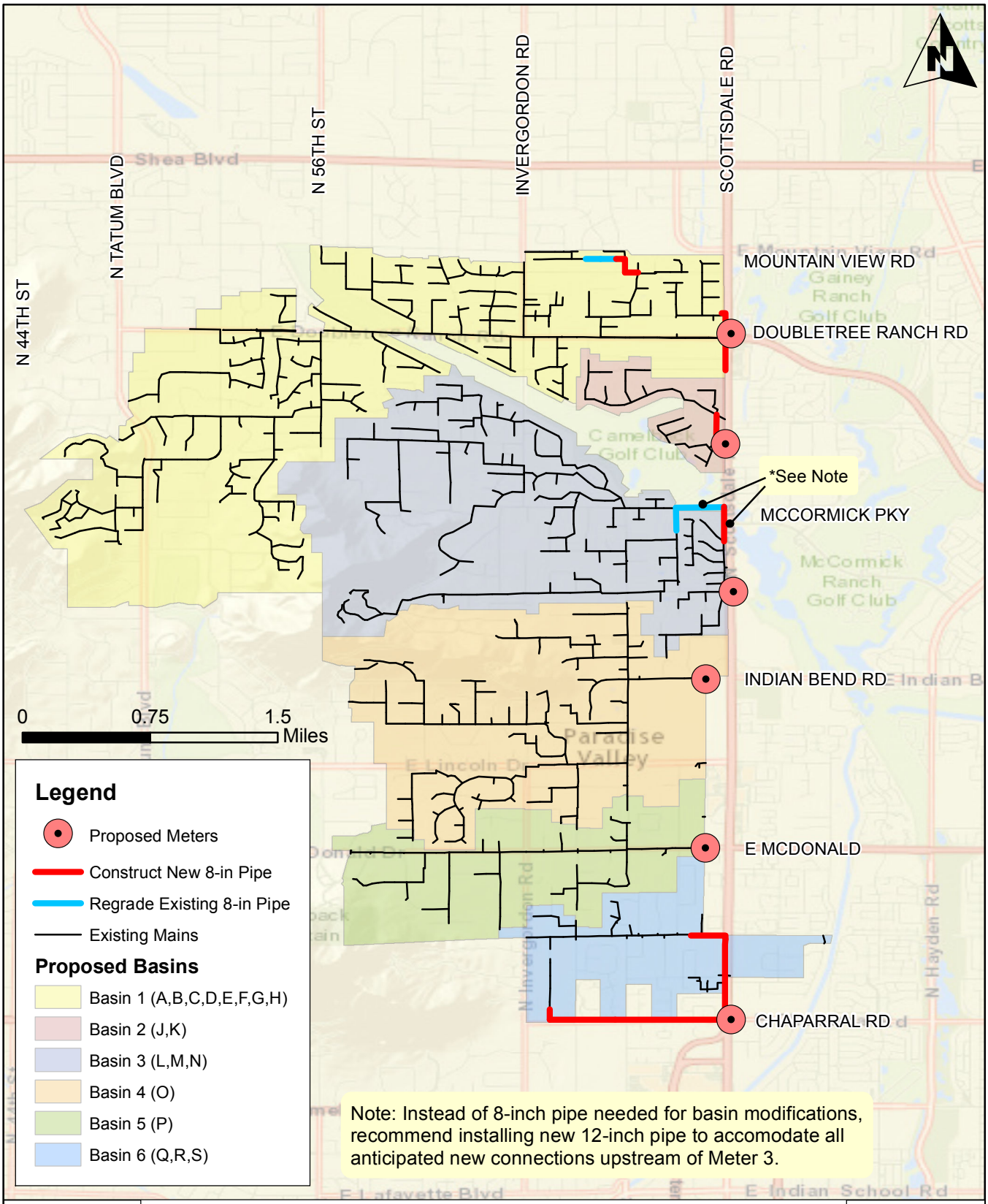
An Extended Period Simulation (EPS) computer model of the Town's collection system was built using Bentley SewerGEMS V8i software. Bentley SewerGEMS uses the U.S. Environmental Protection Agency's SWMM (Storm Water Management Model) engine, which is an industry standard for dynamic hydraulic modeling and computation, particularly in urban areas. The hydraulic model was used to evaluate the existing wastewater system under existing and projected future flow conditions. The modeling evaluations found no system deficiencies under existing conditions. The model was also used to evaluate future flow conditions to identify recommended system improvements over time.

Potential for Water Reuse

The opportunity for water reuse within the Town appears challenging as the Town does not generate enough wastewater to serve even the most preferable demands within the Town, and constructing and operating a Town water reuse system would be costly. There is, however, demonstrated value for the Town's wastewater effluent as a water resource. Since the current wastewater IGA with Scottsdale stipulates that ownership of the Town's wastewater reverts to Scottsdale once it enters their system, the stipulation would have to be negotiated out of the agreement before the Town would realize any benefit or value from its wastewater resource. In addition, any option for obtaining value for the wastewater resource would have to be negotiated into the IGA or other agreement with Scottsdale. The options that the Town has for obtaining value from its wastewater resource would include the following:

- Receive an offset or credit in the wastewater rate paid to Scottsdale for the value that the wastewater resource represents as a new water supply to Scottsdale (based on costs for new water supplies paid by other communities in Arizona).

- Receive reclaimed water back from Scottsdale and sell to Town customers. The revenues from the sales could offset a portion of the wastewater treatment and disposal rate paid to Scottsdale.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Selected Drainage Basin and Meter Configuration Modifications

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FIGURE ES-4

- Receive the storage credits for reclaimed water recharged by Scottsdale at the Water Campus, and sell the credits to local water suppliers (such as EPCOR, Berneil Water Company, Phoenix, and/or Scottsdale) or the Central Arizona Groundwater Replenishment District (CAGRD). The revenues from sale of the recharge credits could also offset a portion of the wastewater fees paid to Scottsdale.

Recommended System Improvements that can be Scheduled

The recommended wastewater system improvements include 1) projects that can be scheduled in a Wastewater CIP, and 2) projects that will allow service to future customer connections, but cannot be scheduled.

The recommended system improvements that can be scheduled include the following (**Table ES-1 and Figure ES-5**):

- Drainage basin modifications – includes re-grading of existing pipes and new pipes to reconfigure drainage basins from a 13-meter to a 6-meter program. The Town will proceed with design and construction of these improvements in 2016.

- Additional capacity in the Scottsdale system. The Town anticipates that construction of the proposed 5-Star Development will begin in 2018 and maximum occupancy can be expected shortly thereafter. Therefore, the Town will be required to purchase 580,000 gpd of additional Scottsdale system capacity in 2017. The wastewater flow projections also indicate that the Town will require an additional 110,000 gpd of Scottsdale capacity in 2021.

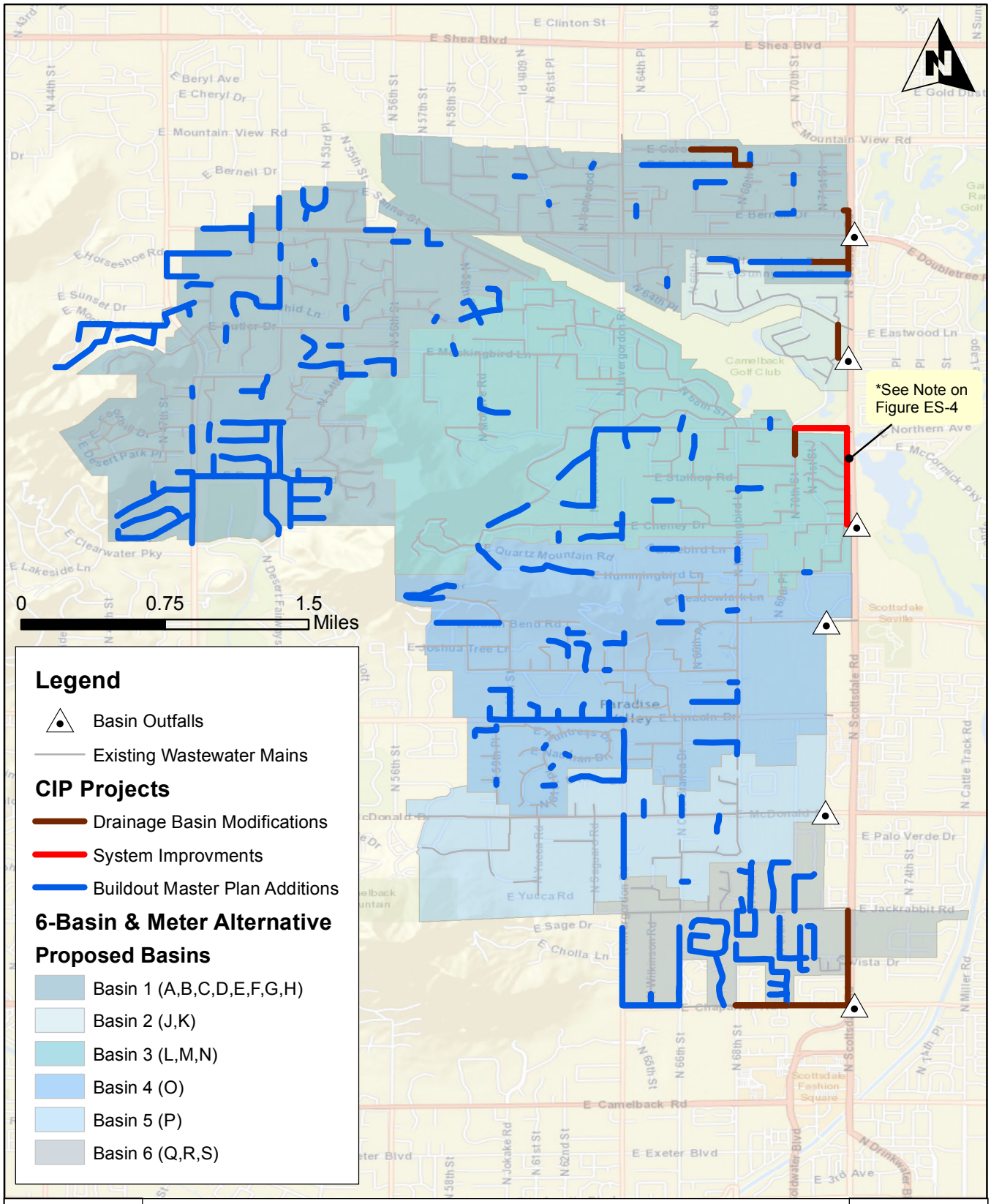
- Rehabilitation of existing pipes that were found to have defects based on previous pipe inspections. The recommended rehabilitation and replacement program is described in the following section.

Table ES-1 Recommended Scheduling of Wastewater System Improvements

Type of Project	Opinion of Probable Construction Costs ($ million)										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Projected System Improvements											
Drainage Basin Modifications[1]	-	$2.77	-	-	-	-	-	-	-	-	$2.77
Additional Scottsdale Capacity	-	-	$6.71	-	-	$1.24	-	-	-	-	$7.95
Rehabilitation and Replacement Program											
Rehabilitation Based on Pipe Inspection Records	$0.099	$0.099	$0.099	$0.099	$0.099	-	-	-	-	-	$0.49
Evaluation and Repair of Balance of System	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$1.82
Grand Total	**$0.28**	**$3.05**	**$6.99**	**$0.28**	**$0.28**	**$1.52**	**$0.18**	**$0.18**	**$0.18**	**$0.18**	**$13.03**

Note:

1. Includes new 12-inch pipe upstream of new Meter 3, instead of regarding of 8-inch pipe and new 8-inch pipe required for basin modifications. New 12-inch pipe will accommodate all anticipated new connections upstream of new Meter 3.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Recommended Capital Improvements

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FIGURE ES-5

Recommended Rehabilitation and Replacement Program

Available wastewater system inspection records were reviewed to identify rehabilitation and/or replacement projects. Approximately 19.5 miles of pipe were included in the available inspection reports, out of estimated 69 miles in the entire system. Of the 441 pipes inspected, just 54 pipes (12 percent) of the pipes were found to have structural defects and 202 pipes (46 percent) had operational and maintenance (O&M) defects. No collapsed or partially collapsed pipes were found.

Of the 54 pipes identified with structural defects, 21 are recommended for repairs, 19 are candidates for repair following another inspection, and the remaining 14 require no further action. Of the 202 pipes identified with O&M defects, 75 are recommended for inspection to determine further action, 11 also had structural defects and are recommended for repairs, and the remaining 116 require no further action.

The above inspections and recommendations account for 28 percent of the Town's system. The remainder of the system should be inspected over 5 years to identify repairs to be made within 10 years of the start of the program. The inspection program will cover 20 percent of the system annually. The entire system will be inspected within the first 5 years and all pipes requiring repair will be identified. This annual inspection rate is aggressive but not uncommon and will avoid letting the system fall into further disrepair. The repair program will repair 3 percent of system annually, or 30 percent over 10 years. The inspection and repair rates and budgets can be reconsidered after the first inspection cycle (5 years).

System Improvements that cannot be Scheduled

The recommended system improvements that will allow service to future customer connections, but cannot be scheduled ("Master Plan Additions") are only needed if and when existing septic and vacant parcels are connected to the system (**Table ES-2**). **Appendix H** provides a detailed list, cost estimates, and map of the Master Plan Additions projects. The Master Plan Additions are grouped according to the modified wastewater drainage basins (for reference, the existing drainage basins comprising the modified basins are also provided). The Town can implement these projects based on customer demand and/or the success of a public information program encouraging connection to the system.

Table ES-2 Summary of Master Plan Additions

Item	Amount	Total Cost
Basin 1 New 8-in Pipe for System Expansion *(Original Basins A, C, B, D, E, F, G, H, I)*	56,039 LF	$10,200,000
Basin 2 New 8-in Pipe for System Expansion *(Original Basins J & K)*	875 LF	$160,000
Basin 3 New 8-in Pipe for System Expansion *(Original Basins L, M, N)*	15,718 LF	$2,860,000
Basin 4 New 8-in Pipe for System Expansion *(Original Basin O)*	23,408 LF	$4,260,000
Basin 5 New 8-in Pipe for System Expansion *(Original Basin P)*	3,211 LF	$590,000
Basin 6 New 8-in Pipe for System Expansion *(Original Basins Q, R, S)*	25,979 LF	$4,730,000
TOTAL		**$22,780,000**

1. Introduction

1.1 Background

The Town of Paradise Valley (Town) currently has two wastewater service providers. Portions of the southwest and northwest are served by the City of Phoenix which owns, operates and maintains the wastewater facilities in these areas (**Figure 1-1**). The remaining areas are served by the Town which owns, operates and maintains the collection system within these areas. This *Wastewater Master Plan* has been developed only for the portion of the service area served by the Town. The Town does not have an existing Wastewater Master Plan.

The Town's wastewater service area is provided wastewater treatment and disposal services through an Intergovernmental Agreement (IGA) with the City of Scottsdale (Scottsdale). The northern third of the service area drains to a pump station that pumps wastewater to Scottsdale's Water Campus, and the southern two-thirds drains (through Scottsdale's system) to the Sub-Regional Operating Group (SROG) interceptor system which conveys flows to the 91st Avenue Wastewater Treatment Plan (WWTP). Scottsdale is a member of the SROG. The Town's capacity ownership in the Scottsdale wastewater system is monitored by flow metering at 13 locations in the Town's service area. Flows from some parts of the Town's collection system are not metered; these flows are estimated using the information from the metered areas.

1.2 Purpose and Scope

The Town retained ARCADIS-US, Inc. (ARCADIS) in June, 2014 to provide Wastewater Planning Services. The purposes of the Planning Services are to provide Technical Assistance to the Town and Scottsdale during renegotiation of their IGA (Task 1), identify wastewater system rehabilitation and replacement projects and provide recommendations for wastewater operations and maintenance (O&M) best practices (Task 3), and to develop a *Wastewater Master Plan* (Task 4). Certain results and deliverables from Tasks 1 and 3 are included in this *Wastewater Master Plan*.

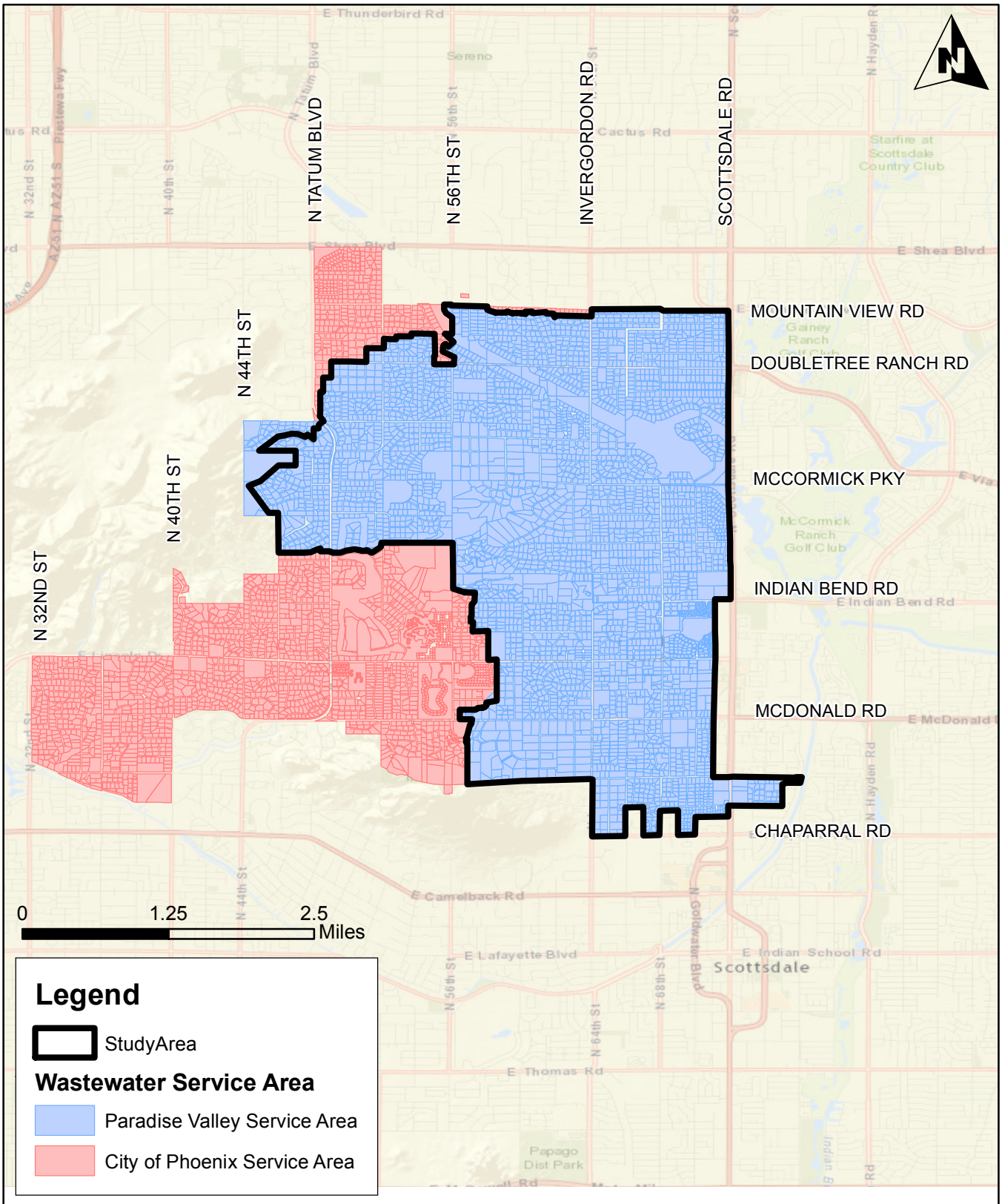
In addition to project management and meeting tasks, the *Wastewater Master Plan* included the following scope of work tasks:

- Review of background information and base data,
- Preparation of wastewater flow monitoring data for hydraulic model calibration,
- Development of wastewater flow projections for input to the hydraulic model,

- Development and calibration of a new wastewater system hydraulic model,
- Modeling and evaluation of the existing and future collection systems,
- Review of potential for water reuse, and
- Development of recommended system improvements and opinions of capital costs of construction.

1.3 Study Area

The study area for the *Wastewater Master Plan* is the Town's wastewater collection service area as shown on **Figure 1-1**. As indicated previously, wastewater from within the study area drains to the City of Scottsdale wastewater system for treatment and ultimate disposal.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Study Area

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MAY 2015

FIGURE 1-1

2. Institutional Background

This section provides a summary of the institutional constraints and requirements that govern design, construction and operation of the Town's wastewater collection system. The constraints and requirements are dictated by regional wastewater planning agencies; an IGA between the Town and the City of Scottsdale; the Town's General Plan, ordinances and design guidelines; and, the long-range wastewater master plans of the Cities of Phoenix and Scottsdale

2.1 Regional Wastewater Planning

The Federal Water Pollution Control Act Amendments of 1972, 1977, and 1987 (Clean Water Act) require, under Section 208, that states develop and implement area-wide water quality management plans for pollution control. Plans prepared to meet the requirements of Section 208 must: a) identify the treatment works needed to meet anticipated municipal and industrial waste treatment needs of the area over a 20-year period, including construction priorities and schedules; b) establish a regulatory program to implement the plan; c) identify an implementation plan; d) identify non-point sources of pollution; e) identify mine-related and construction activity-related sources of pollution; f) identify a process to control residual waste disposal; and g) identify a process to control disposal of pollutants on land or in subsurface excavations.

The "208 planning process" provides an opportunity for a designated area to identify its specific area-wide waste treatment and water quality management problems and set forth a management program to alleviate those problems. The Maricopa Association of Governments (MAG) has been designated as the area-wide water quality management planning agency for the Maricopa County area.

MAG's most recent update of its 208 Water Quality Management Plan is dated October 2002. The Plan recognizes the areas within Paradise Valley that are served by the Phoenix and Scottsdale systems. The Plan also recognizes the contractual arrangement between the Town and Scottsdale providing for existing and future wastewater services to the Town's collection system that drains to the Scottsdale system. As such, the Plan does not foresee any future Town-owned wastewater treatment facilities, but that future wastewater treatment will be provided under the terms of contract between Paradise Valley and Scottsdale.

2.2 Paradise Valley/Scottsdale Intergovernmental Agreement

The Town entered into an IGA with Scottsdale on November 30, 1998 (IGA No. 980154) for wastewater treatment services. The IGA indicates that the Town's "North Area Flows" would be treated at Scottsdale's Water Campus, while the "South Area Flows" would be treated at the SROG 91st Avenue WWTP. The Town's total capacity limit was established at 880,000 gallons per day (gpd). An additional capacity limit was set for the South Area flows at 460,000 gpd. If the Town's usage exceeds 90 percent of the total capacity limit (or 85 percent of any future capacity limitation established by the City), the Town would have to purchase additional capacity, the additional capacity purchase would be based on a four-year projection of Town peak wastewater flows. In addition, if the South capacity limit is exceeded before January 1, 2007, the Town would have to construct a new lift station to pump excess flows to the North. Capacity usage is to be determined for each calendar year based on the average of the two highest consecutive days of discharge.

The IGA also had, among others, the following general provisions:

- Established monthly total user charges to be paid by the Town.
- Required installation of 13 permanent metering stations (for Drainage Basins A, C, D, G, H, J, K, L, M, N, O, P, and Q as described in Section 3).
- Identified 6 additional drainage basins that would not be metered, but for which flows will be estimated (Drainage Basins B, E, F, I, R, and S). The flows would be estimated by multiplying the number of residences connected in each basin by the per dwelling unit flow factor determined for Basin H. The non-residential flows identified by the City in these basins would be added to the estimated residential flows.
- Requires the Town to videotape all existing and new sewer lines connected to the system.
- The City is to provide all operation and maintenance (O&M) on the collection facilities within Town's service area, while the Town is responsible for all repair, rehabilitation and replacements.

- Town flows may not exceed 305 mg/L biological oxygen demand (BOD) and 290 mg/L total suspended solids (TSS), if these limits are exceeded Town must implement an industrial pretreatment program.

- All wastewater accepted by the City becomes the property of the City.

- Terms of agreement are perpetual and are applicable until another written agreement is executed.

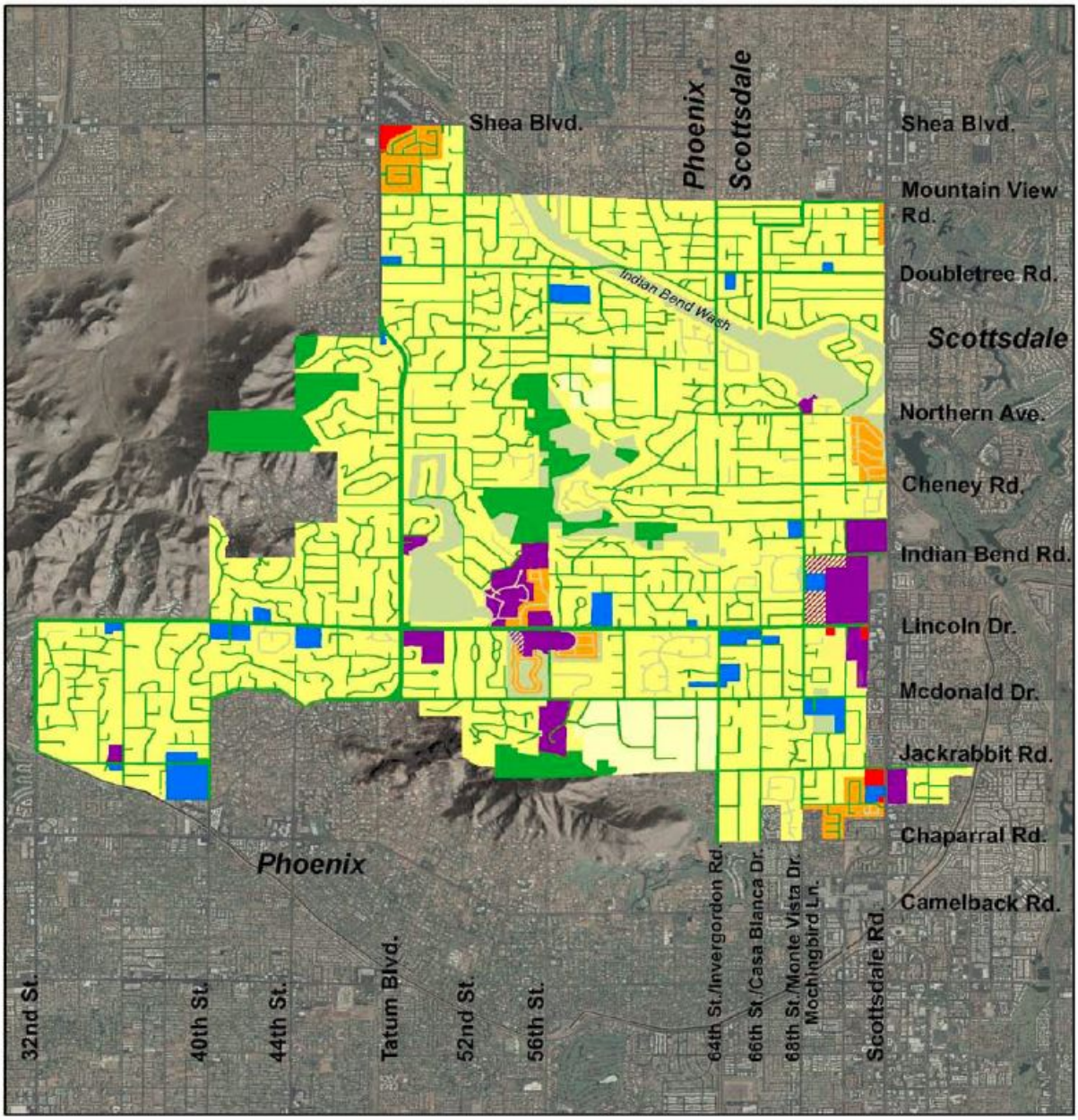
In 2006, the Town exceeded the total capacity limit trigger level (90 percent of the total capacity limit). At that time, and pursuant to the terms of the IGA, the Town purchased an additional 146,479 gpd of total capacity, for a current total capacity limit of 1,026,479 gpd. The South capacity limit was not exceeded by the specified date.

The Town and Scottsdale have been conducting ongoing discussions about revising and renewing the IGA. In 2008, the discussions identified a number of points for revision of the IGA. Key among these points was that references to South vs. North capacity would be eliminated, including the separate limitation on South capacity. The IGA should just refer to total capacity.

Proposed revisions to IGA have also been ongoing. The most recent proposed revision is dated May 14, 2014. This revision defines the Town's total capacity limit as 1,026,479 gpd, and provides that the Town may purchase additional system capacity by payment of the sewer development fee rate that is in effect at the time in Scottsdale. The Town is to issue an updated future capacity usage report every five years. If capacity usage exceeds the total system capacity over a continuous 5-day period, or if future capacity usage projections indicate exceedance of the total system capacity, the Town must purchase additional system capacity. Also, the Town's flows may not exceed 850 mg/L COD and 470 mg/L TSS; if these limits are exceeded, the Town must implement an industrial pretreatment program.

2.3 Paradise Valley General Plan

The Town of Paradise Valley 2012 General Plan provides the "vision" for how the Town expects to grow and develop over time. The General Plan provides guidance on the land use and development that is the basis for this *Wastewater Master Plan*. Specifically, the Land Use Map depicts the proposed general uses of land through build-out of the Town. The Land Use Map is depicted in **Figure 2-1**.



Legend

- Low Density Residential OR Resort/Country Club
- Private Open Space OR Resort/Country Club
- Very Low Density Residential
- Low Density Residential
- Medium Density Residential
- Private Open Space
- Public Open Space
- Medical Office
- Public/Quasi Public
- Resort/Country Club

0 0.25 0.5 1 Miles

N

Planning Commission – Revised September 20, 2011

Source: Town of Paradise Valley General Plan 2012 (Figure 2-2)

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Land Use Map

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FIGURE 2-1

The General Plan also identifies future development areas that should garner special attention in the *Wastewater Master Plan*. **Figure 2-2** depicts the Development Areas Map. The three development areas envisioned are:

- The 56th Street and Lincoln Drive Development Area is comprised of approximately 35 acres to include the former Mountain Shadows Resort. This development area drains to the Phoenix collection system and is, therefore, not considered herein.

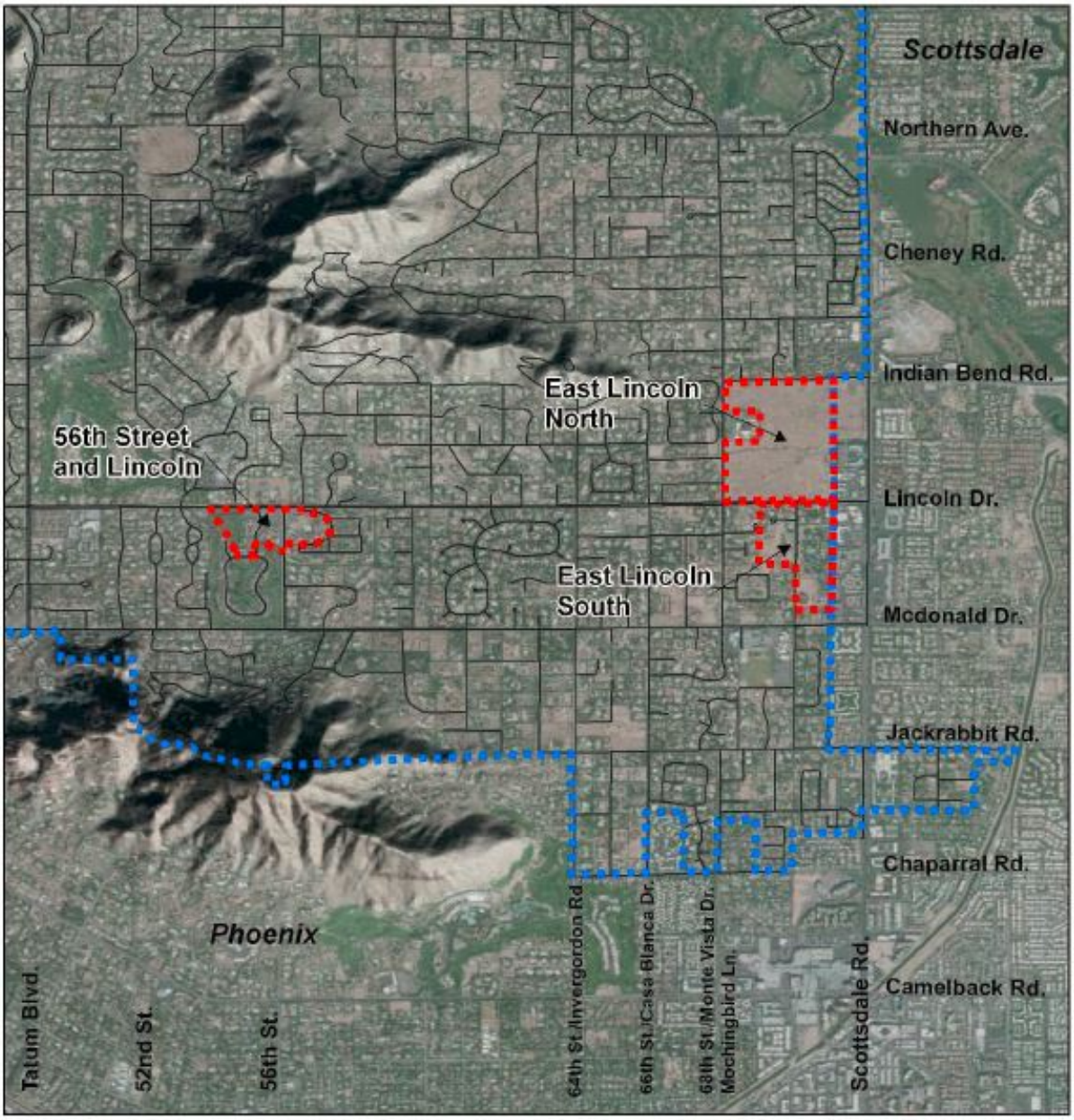
- The East Lincoln Drive North Development Area is comprised of approximately 110 acres of undeveloped land approved and platted as the Paradise Valley Ritz Carlton (now 5-Star Development) Special Use Permit property, but has not yet been constructed.

- The East Lincoln Drive South Development Area is comprised of approximately 55 acres including Smoke Tree Resort and Bungalows, Cottonwoods Resort, Lincoln Medical Complex, and the Applewood Pet Resort. This development area's close proximity to Scottsdale is anticipated to promote reinvestment.

2.4 Paradise Valley Ordinances and Guidelines

The Town's wastewater ordinances are contained in the Paradise Valley Municipal Code, Chapter 15, Sanitary Sewers. The Code provides general guidance on the design and construction process, including permits required, references to design standards and guidelines to be used, plan submittals and reviews, and construction inspections, among others. Town staff indicated that the Town's policy with regards to connections to the wastewater system are that a connection is generally required if new construction is within 300 feet of an existing sewer line. In addition, review of connection requirements are triggered for home remodeling projects greater than $500,000.

The Town does not have wastewater design guidelines. The Town currently requires developers, consultants and contractors to design and construct wastewater facilities according to the MAG Specifications and Standard Details, the Arizona State Health Services Bulletin No. 11, and the City of Scottsdale Sanitary Sewer Design Standards and Policy Manual (Chapter 7).



Legend

- Streets
- Development Areas
- Paradise Valley Boundary

0 0.25 0.5 Miles

N

Rev: 19 May, 2011

Source: Town of Paradise Valley General Plan 2012 (Figure 2-3)

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Development Areas Map

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FIGURE 2-2

2.5 Scottsdale Wastewater Master Plan

The City of Scottsdale 2012 Water Reuse Master Plan Update is the most recent long-term wastewater system planning document for the City. Scottsdale treats the portion of Paradise Valley that it serves as a part of the overall City wastewater system. Wastewater flow projections for the Paradise Valley areas are completed with the rest of the Scottsdale service area, the flow projections are generally based on land use types coupled with per-acre wastewater flow factors. Scottsdale distinguishes between portions of Paradise Valley which are influent to the City's Water Campus and which areas are influent to the SROG 91st Avenue WWTP. Scottsdale does not identify any existing or future wastewater system improvements within the Paradise Valley collection system.

2.6 Phoenix Wastewater Master Plan

As indicated in Section 1, the City of Phoenix serves portions of the northwest and southwest areas of Paradise Valley. Phoenix does not release its infrastructure master plans because they contain secured information regarding their systems and facilities. Phoenix staff did, however, provide information on their intent regarding wastewater service to the portions of Paradise Valley that it currently serves.

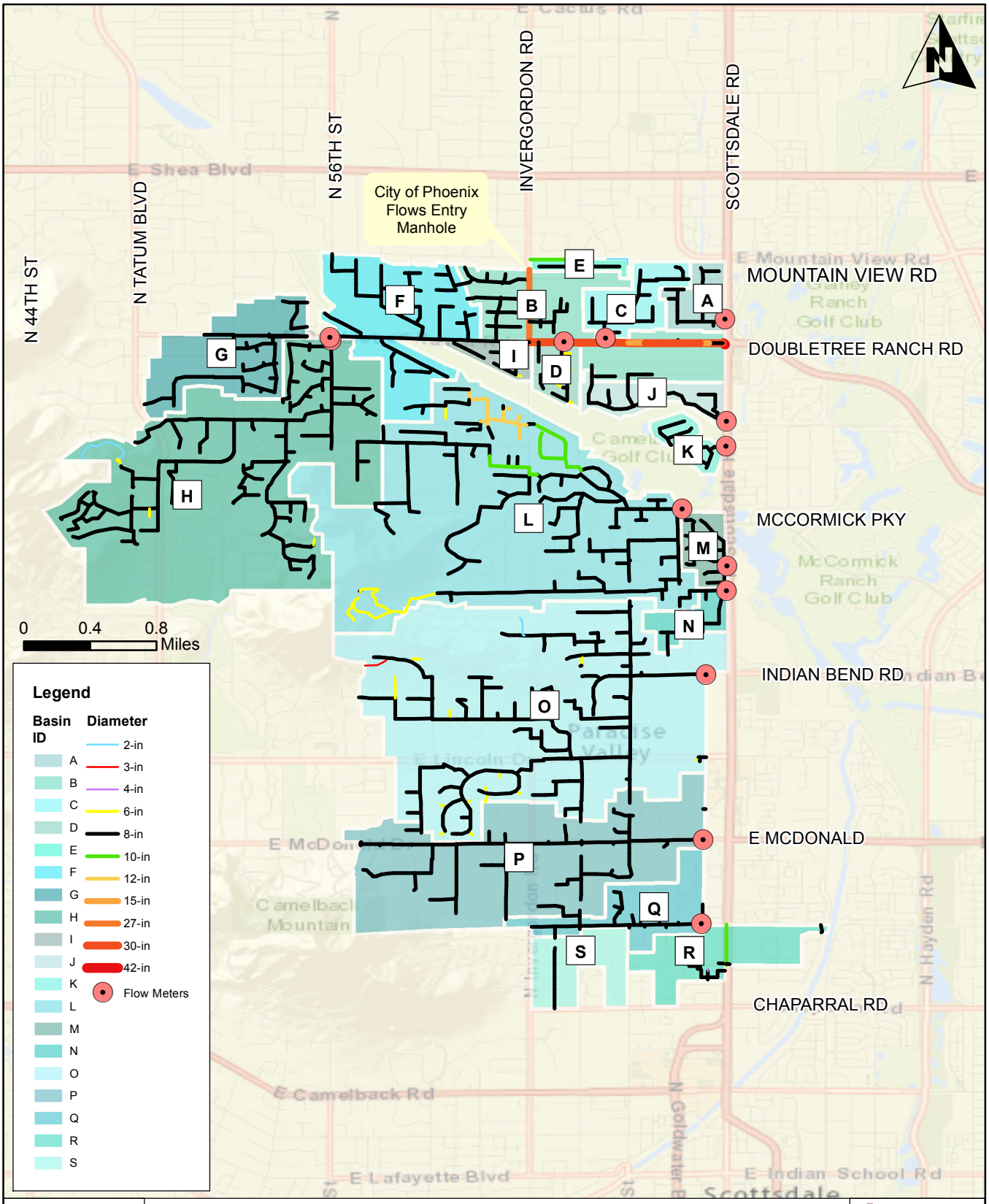
Phoenix plans to continue providing wastewater services to the portions of Paradise Valley that it currently serves. The Paradise Valley areas are included in the City's current long-term wastewater master plan. Currently, the only rehabilitation projects in the vicinity of Paradise Valley are the PV02 Metering Station and its upstream sewer main. This rehabilitation project will not affect the flow capacity of the sewer main or the PV02 Metering Station. With regards to long-term plans, the City's Lift Station 54 (0.22 mgd firm capacity) at Lincoln Drive and 38th Street servicing the Estate Antigua Community will be demolished in the future, and the wastewater generated by the Community will be conveyed by gravity sewers to the south and enter the City's sewer system. This planned adjustment will not have any impact on the Town's wastewater system.

Phoenix projects the maximum flow capacity for the sewer main immediately upstream of the PV02 Metering Station as 9 mgd, including flows from Paradise Valley. Phoenix projects flows from Paradise Valley based on 360 gallons/day/dwelling unit (gpd/du). Phoenix offers that Paradise Valley is a municipality that is characterized by predominantly large lot, single-family residential development. As a relatively affluent community, the Town has a high level of discretionary water use, which results in

average water use per household that is substantially higher - approximately six to eight times - the City's service area average. While most of the additional water use is likely due to outdoor water uses such as landscape watering that do not generate wastewater, some of the additional water uses are assumed to result in higher wastewater generation than found in other areas of the City's service area. The standard City of Phoenix sewer design flow for single-family residential is 240 gallons/day/dwelling unit.

3. Existing Wastewater System

The Town's service area is subdivided into 19 drainage basins (**Figure 3-1**). Basins A-H discharge into a 30-inch main running West to East along East Doubletree Ranch Road. This main also conveys some flows from Phoenix. Phoenix flows enter the line around 56th Street and combine with Paradise Valley flows. The Doubletree Ranch Road main conveys these combined flows to a lift station, where Paradise Valley, Phoenix, and Scottsdale flows are combined and pumped north to the Scottsdale Water Campus. Basins I-S discharge into a Scottsdale wastewater main running North to south along Scottsdale Road to Indian Bend Road, at which point flows are conveyed east to a main running south along North Hayden Road. The Hayden Road line conveys all incoming flows to the SROG Salt River Outfall (SRO) interceptor.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Collection System

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FIGURE 3-1

The Town's collection system has 68.5 miles of pipe and 1,411 manholes within its wastewater service area, serving 2,098 parcels. The collection system is explained in detail in Section 3.3 and Section 3.4.

3.1 Wastewater Drainage Basins

Figure 3-2 provides a schematic of the wastewater drainage basins to illustrate the relationships between drainage basins, flow metering locations, and ultimate conveyance of flows entering the Scottsdale system.

The Town's service area is divided into 19 drainage basins (**Figure 3-3**). Of the 19 basin, flows from 13 basins (Basins A, C, D, G, H, J, K, L, M, N, O, P, and Q) are metered. The flows from the remaining unmetered basins (Basins B, E, F, I, R, and S) are estimated based on a per dwelling unit flow factor determined for Basin H using metered flows and dwelling unit counts for Basin H.

Existing meter locations and basin configurations were analyzed to evaluate whether the meters are capturing all flows from their designated drainage basins. The delineation of each of the 13 metered basins was analyzed to determine whether it conformed to the meter location, layout of the wastewater mains, and available invert elevation data. The analysis revealed that some existing basin delineations did not align with the existing system layout, ground terrain and known flow direction. These basin layouts were modified to better align with the existing system layout and known flow direction. **Figure 3-4** shows the corrected delineations superimposed on the original, and the location of existing meters. Hatched areas represent corrections made to the original drainage basin boundaries. Refer to **Appendix A** for a full description of the process and a basin-by-basin assessment of the drainage basins.

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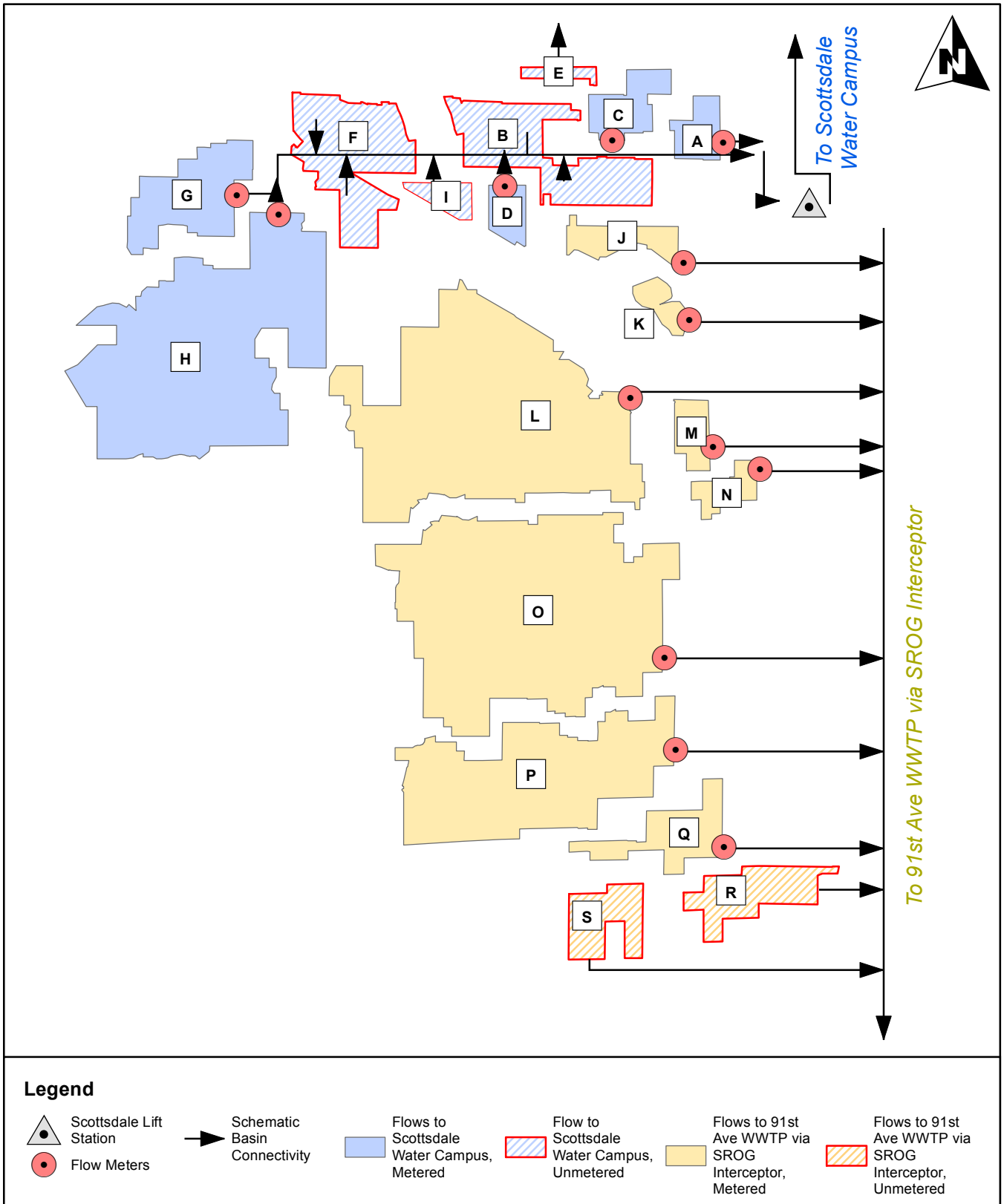

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Schematic of Existing Basin Connectivity

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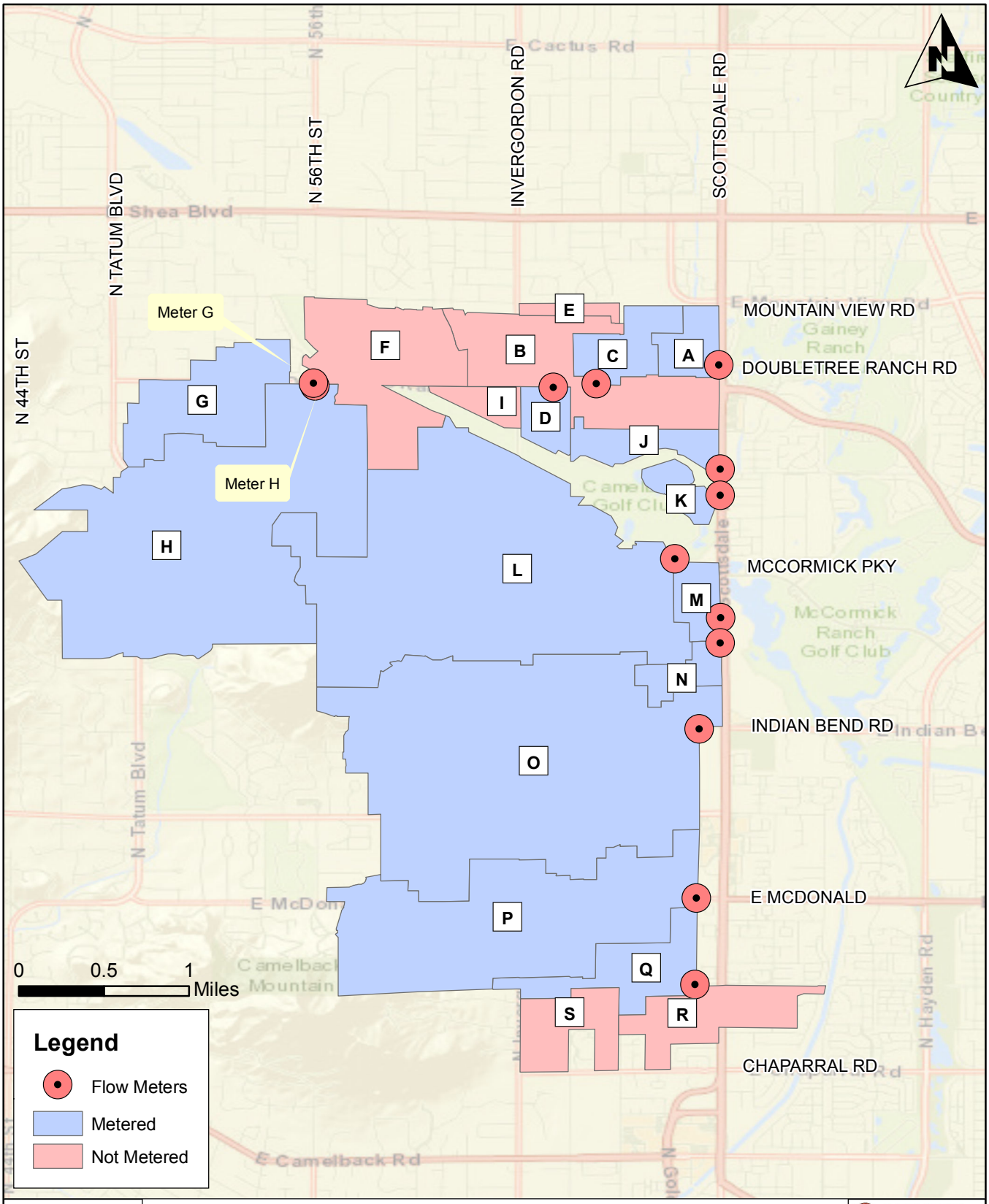
FIGURE 3-2



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Meters and Basin Configuration (As Provided)

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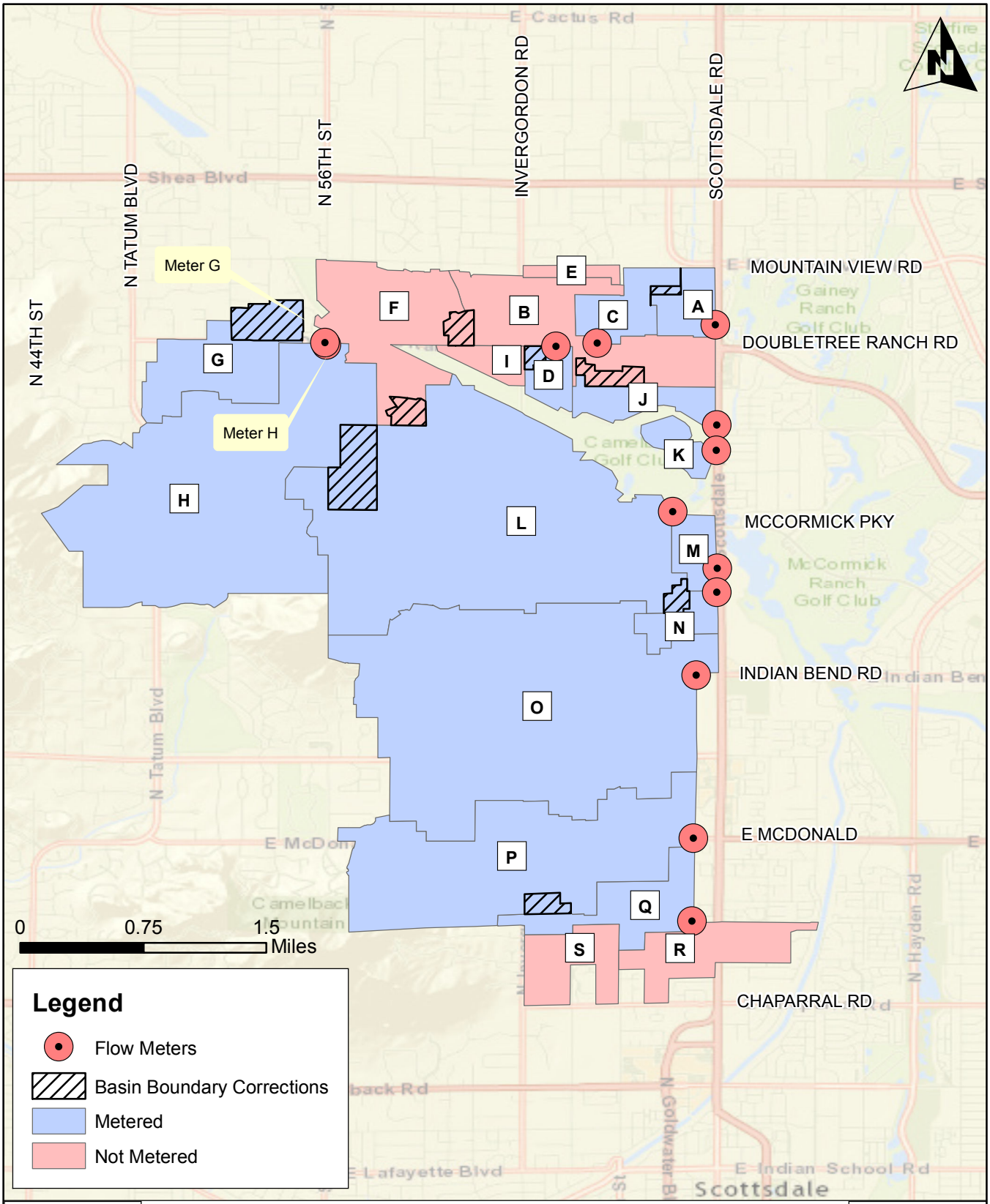
FIGURE 3-3



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Meters and Basin Configuration (Corrected)

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FIGURE 3-4

3.2 Assessment of Existing Wastewater Meters

As part of Task 1 of the Wastewater Planning Services project, the accuracy of the existing wastewater flow meters was assessed. In addition, alternative metering technologies were evaluated to determine if superior meters were available to better measure flows form the Town's service area. Refer to **Appendix B** for detailed discussion of the meter accuracy analysis and to **Appendix C** for the metering technology assessment.

The current metering program uses Palmer-Bowlus flumes and Magnetrol 341 or Magnetrol 345 depth meters to record depth, and then calculate flow, at the 13 metering stations. With respect to meter accuracy, the existing meters were found to be installed and functioning correctly, and are adequately maintained. Meters are checked each month and calibrated annually. Flumes are cleaned as necessary. There have been, however, physical metering issues in the past, such as shovels being left in downstream manholes and backing up flows into the flume, and data logging meter issues, including blocked line-of-site radio transmissions, which have caused inaccurate data. Inaccurate data was flagged during data analysis. All of the physical metering issues have been corrected and all meters are currently considered to be providing accurate data.

With respect to meter technology, any program of metering the Town's wastewater flows must consider the low flow characteristics of the flows. After evaluation of two alternative metering technologies, the flume/ultrasonic depth combination sensors were found to be superior in the low flow, non-surcharged conditions experienced in the Town's system. The existing Magnetrol 341/345 provides sufficient accuracy and is able to measure low flow depths. The existing Palmer-Bowlus flumes are not as likely to clog and are, therefore, practical for low flows in a sanitary sewer system. Based on the meter technology assessment, the existing Palmer-Bowlus flumes coupled with the Magnetrol 341/345 flow meters should be retained.

3.3 Collection System Pipes

The Town's service area has a total of 68.5 miles of pipe and 1,411 manholes. The Town's existing GIS database did not provide information on main sizes and materials of construction. GIS data obtained from Scottsdale helped to develop some of the pipe size and materials data. Although the GIS data was updated to allow master planning and hydraulic modeling, the Town should further update the wastewater system GIS to obtain maximum benefit.

Based on the Scottsdale GIS data, 66 percent of the Town's system is composed of 8-inch pipe. However, the diameters for 23.5 percent of the system were unknown. Similarly, 38 percent of the pipe materials of construction in the collection system were unknown. Tables 3-1 and 3-2 summarize the pipe inventories by material and diameter, respectively.

Table 3-1 Wastewater Collection System Pipe Inventory – by Material

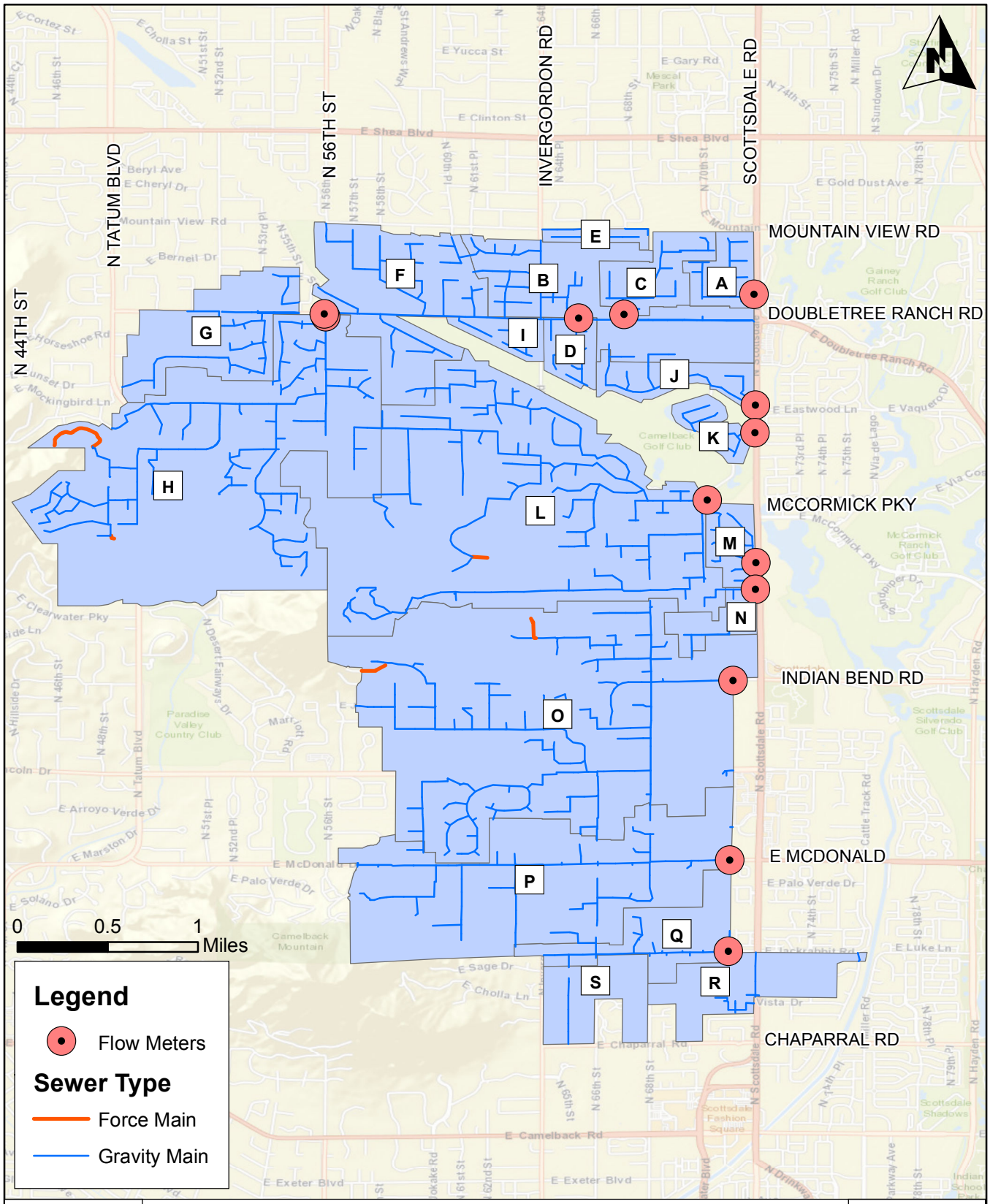
Material	Total Miles	Total Linear Feet	% of Total
Unknown	26.0	137,289	38.0%
DIP	1.7	9,235	2.6%
PVC	15.0	79,141	21.9%
VCP	25.7	135,829	37.6%
TOTAL	**68.5**	**361,494**	**100.0%**

Table 3-2 Wastewater Collection System Pipe Inventory – by Diameter

Pipe Diameter	Total Miles	Total Linear Feet	% of Total
No Data	16.1	85,086	23.5%
2-in	0.6	3,204	0.9%
3-in	0.1	622	0.2%
4-in	0.0	72	0.0%
6-in	2.0	10,449	2.9%
8-in	45.4	239,451	66.2%
10-in	1.5	8,090	2.2%
12-in	0.8	4,213	1.2%
15-in	0.5	2,795	0.8%
27-in	0.4	2,305	0.6%
30-in	1.0	5,153	1.4%
42-in	0.0	55	0.0%
TOTAL	**68.5**	**361,494**	**100.0%**

3.4 Force Mains and Lift Stations

There are several private lift stations and force mains within the Town's wastewater service area for homes that cannot be connected to the collection system by gravity (**Figure 3-5**).



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Force Mains

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FIGURE 3-5

3.5 Wastewater Treatment Facilities

The Town does not own or operate any wastewater treatment facilities. The Town's wastewater is either pumped to Scottsdale's Water Campus or conveyed to the SROG 91st Avenue WWTP for treatment and disposal.

The Water Campus, located at Union Hills Drive and the Pima Road alignment, treats wastewater generated in north and central Scottsdale and includes a 20 mgd Water Reclamation Plant (WRP) which uses a conventional activated sludge process to produce reclaimed water for irrigation. The Water Campus also includes a 20 mgd Advanced Water Treatment (AWT) plant that uses state-of-the-art technology to further treat the WRP effluent and produce water for 1) groundwater recharge and 2) as a blend source to meet reuse customer sodium concentration obligations.

Scottsdale owns 20.2 mgd of capacity in the SROG 91st Avenue WWTP which is located at 91st Avenue, north of the Salt River in southwest Phoenix. This facility provides wastewater treatment for Glendale, Mesa, Phoenix, Scottsdale and Tempe. Flow is conveyed to the 91st Avenue WWTP via Scottsdale's capacity ownership in the SROG Salt River Outfall (SRO) interceptor.

3.6 Assessment of Rehabilitation and Replacement Priorities

Pursuant to the Town/Scottsdale IGA, the Town has been inspecting its wastewater collection system since 1998 using a closed circuit television (CCTV) contractor. It was thought that the entire system had been inspected; however, the Town was only able to provide hard copy inspection reports for approximately 28 percent of the system, it is unknown if the CCTV videos contain footage for the entire system (the CCTV videos were not reviewed). The available inspection reports were reviewed to identify any rehabilitation and/or replacement projects that should be targeted in the Town's wastewater capital improvement plan (CIP). **Appendix D** contains the details of the review and analysis that was conducted to assess the structural condition of the inspected pipes, to estimate the remaining useful life of the pipes, and to develop a recommended rehabilitation and replacement program.

The pipe inspection reports were reviewed in accordance with the standard procedures of the National Association of Sewer Services Companies (NASSCO) Pipeline Assessment Certification Program (PACP). Pipe inspection results were extracted from the reports and tabularized for analysis. The number and type of pipe defects and other inspection observations were recorded. The PACP process establishes scores for

each type of pipe defect found, as well as a system for rating and comparing pipes according to these defects. The number and type of defects in each pipe are used to calculate ratings for structural and operational and maintenance (O&M) conditions for each pipe. The ratings are then evaluated to determine an appropriate corrective action for each pipe.

The evaluations were performed for the 19.5 miles of pipe that were included in the inspection reports (out of estimated 69 miles in the entire system, or 28 percent). Of the 441 pipes inspected, just 54 pipes (12 percent) of the pipes were found to have structural defects and 202 pipes (46 percent) had O&M defects. No collapsed or partially collapsed pipes were found. Section 9 (Section 9.4) provides a summary of the recommended repairs and improvements to the collection system and the associated costs for the inspected pipes, as well as a recommended system inspection and rehabilitation and repair program for the next 10 years.

4. Existing Wastewater Flows

This section presents an analysis of the existing wastewater flows to determine the Town's seasonal and daily flow characteristics (peak flows and diurnal flow patterns). A brief discussion of the Town's wastewater flow quality is also presented.

4.1 Wastewater Flow Database

Data loggers at each of the 13 flow metering stations calculate the flow values and transmit the flow data to Scottsdale via radio telemetry. In 2013, ARCADIS developed a Wastewater Flow Management Tool that takes updated flow data on a daily basis, and assists in graphical display and visualization of flow information for any time period and drainage basin (or collection of basins) desired. The Tool is loaded with flow data from January 1, 2005 to the present. The Tool accepts wastewater flow metering data from Scottsdale on a daily basis, calculates flows for the unmetered drainage basins, automatically updates the historical flow database, and generates flow data reports. Raw flow data in the Flow Management Tool is in 5-minute intervals and is stored in a SQL database. The Tool allows the user to convert the raw data to other time bases (hourly, daily, etc.)

4.2 Historical Wastewater Flows

All existing and available wastewater flow data (2005 to present, converted to hourly flow records) were reviewed. **Table 4-1** provides a summary of the Town wastewater flows, averaged monthly for each year of record.

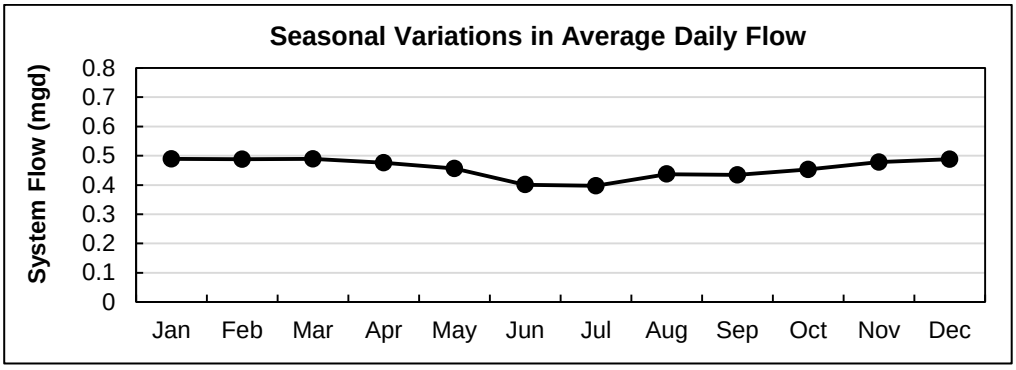
Table 4-1 Historical Wastewater Flows

Year	Average Daily Flow (mgd)												Annual Ave. Flow (mgd)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2005	0.66	0.70	0.69	0.69	0.70	0.50	0.49	0.60	0.51	0.62	0.56	0.54	0.61
2006	0.49	0.47	0.47	0.46	0.45	0.38	0.35	0.42	0.45	0.41	0.43	0.42	0.43
2007	0.42	0.41	0.38	0.38	0.36	0.37	0.25	0.32	0.31	0.34	0.38	0.40	0.36
2008	0.39	0.36	0.35	0.37	0.36	0.33	0.31	0.33	0.36	0.35	0.41	0.41	0.36
2009	0.40	0.39	0.39	0.40	0.38	0.47	0.42	0.47	0.49	0.52	0.56	0.61	0.46
2010	0.58	0.57	0.58	0.56	0.50	0.40	0.67	0.48	0.47	0.51	0.53	0.56	0.54
2011	0.47	0.56	0.58	0.52	0.50	0.42	0.42	0.45	0.46	0.48	0.53	0.52	0.49
2012	0.51	0.50	0.50	0.49	0.45	0.39	0.35	0.46	0.44	0.44	0.45	0.47	0.45
2013	0.51	0.49	0.48	0.45	0.43	0.37	0.38	0.42	0.42	0.42	0.45	0.46	0.44
2014	0.46	0.45	0.46	0.44	0.42	0.38	0.34	0.36	0.37	0.33	0.41	0.40	0.40
Ave	0.49	0.49	0.49	0.48	0.46	0.40	0.40	0.44	0.43	0.45	0.48	0.49	0.46

4.3 Seasonal and Daily Flow Patterns

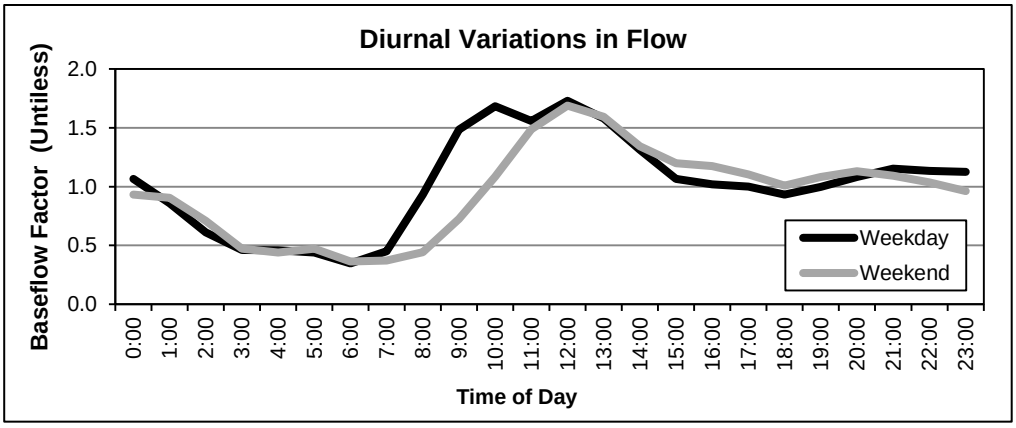
Seasonal variations in flow are attributed to the Town's significant percentage of residents who do not reside in the Town during the summer months. Flows are highest in the months of November through April, and lowest in the months of June through September. **Figure 4-1** illustrates the seasonal flow variations based on average monthly flows for the entire period of record.

Figure 4-1 Average Flows per Month



Daily flow patterns were derived using a Time Series Analyzer (TSA) to develop baseflow patterns for typical weekdays and weekends. In **Figure 4-2**, both the weekday and the weekend baseflow patterns are plotted for Drainage Basin A, for a typical winter season, averaged over the period of record. **Appendix E** contains the baseflow patterns developed for all drainage basins.

Figure 4-2 Diurnal Baseflow Pattern for Drainage Basin A



4.4 Wastewater Quality

The quality of the Town's wastewater is not currently monitored. However, the City of Scottsdale recently collected wastewater samples at several of the metering stations and analyzed the samples for chemical oxygen demand (COD) and total suspended solids (TSS). COD is an indirect measure of organic pollutants found in wastewater, while TSS is a measure of solid organic and inorganic materials that are suspended in the wastewater. These two wastewater parameters define the strength of wastewater and provide an important basis to determine processes, facilities and costs required to treat the wastewater.

Table 4-2 provides a summary of the wastewater quality results for samples collected in June and November 2014. The table also provides average COD and TSS values on a flow-weighted basis. Flow weighted averages of TSS and COD concentrations are considered the fairest method of determining concentrations that would be representative of the entire Paradise Valley collection system, as opposed to using just straight averages for the quality data. Flow weighting removes undue influences of low flows at some monitoring locations so that it has an equal influence on the average TSS and COD concentrations as do the higher flow basins. **Table 4-2** indicates significant variability in the wastewater quality results. Much of this variability is likely due to the low flows, particularly during the summer months. It is important to note, however, that the data is very limited.

Table 4-2 Paradise Valley Wastewater Quality

Date of Sampling Event	Basin A		Basin C		Basin H		Basin L		Basin O		Flow Weighted Average	
	COD (mg/L)	TSS (mg/L)	COD (mg/L)	TSS (mg/L)	COD (mg/L)	TSS (mg/L)	COD (mg/L)	TSS (mg/L)	COD (mg/L)	TSS (mg/L)	COD (mg/L)	TSS (mg/L)
6/20/2014	1,387	2,580	709	135							652	224
6/21/2014	311	80	1,307	180			1,377	370				
6/22/2014	429	153	472	570			459	290				
6/23/2014	593	180	368	173			388	420				
6/24/2014	560	280	385	160			633	970				
6/25/2014	620	360	721	180			394	400				
6/26/2014	955	330	1,461	130			197	100				
6/27/2014							647	270				
11/18/2014					859	1,013	433	205	613	253	518	499
11/19/2014					610	413	293	80	450	120		
11/20/2014					543	1,233	429	267	586	1,160		
11/21/2014					754	187	341	87	820	633		
11/22/2014					405	180	461	367	852	253		
11/23/2014					587	440	452	193	477	920		
11/24/2014					358	67	534	233	1,060	680		

5. Wastewater Flow Projections

This section presents the wastewater flow projections used for master planning of required future wastewater infrastructure. The discussion includes an overview of the projection methodology, descriptions of the existing property parcels on septic systems that could be connected in the future, descriptions of existing vacant parcels that could also be connected, and wastewater flow factors that were used to develop the flow projections.

5.1 Wastewater Flow Projection Methodology

The wastewater flow projections were developed using the following general methodology. The remaining sections provide further details and assumptions used for the projections:

- The number of property parcels connected to the existing collection system were confirmed and, combined with historic wastewater flows discussed in Section 4, used to determine per dwelling unit wastewater flow factors.

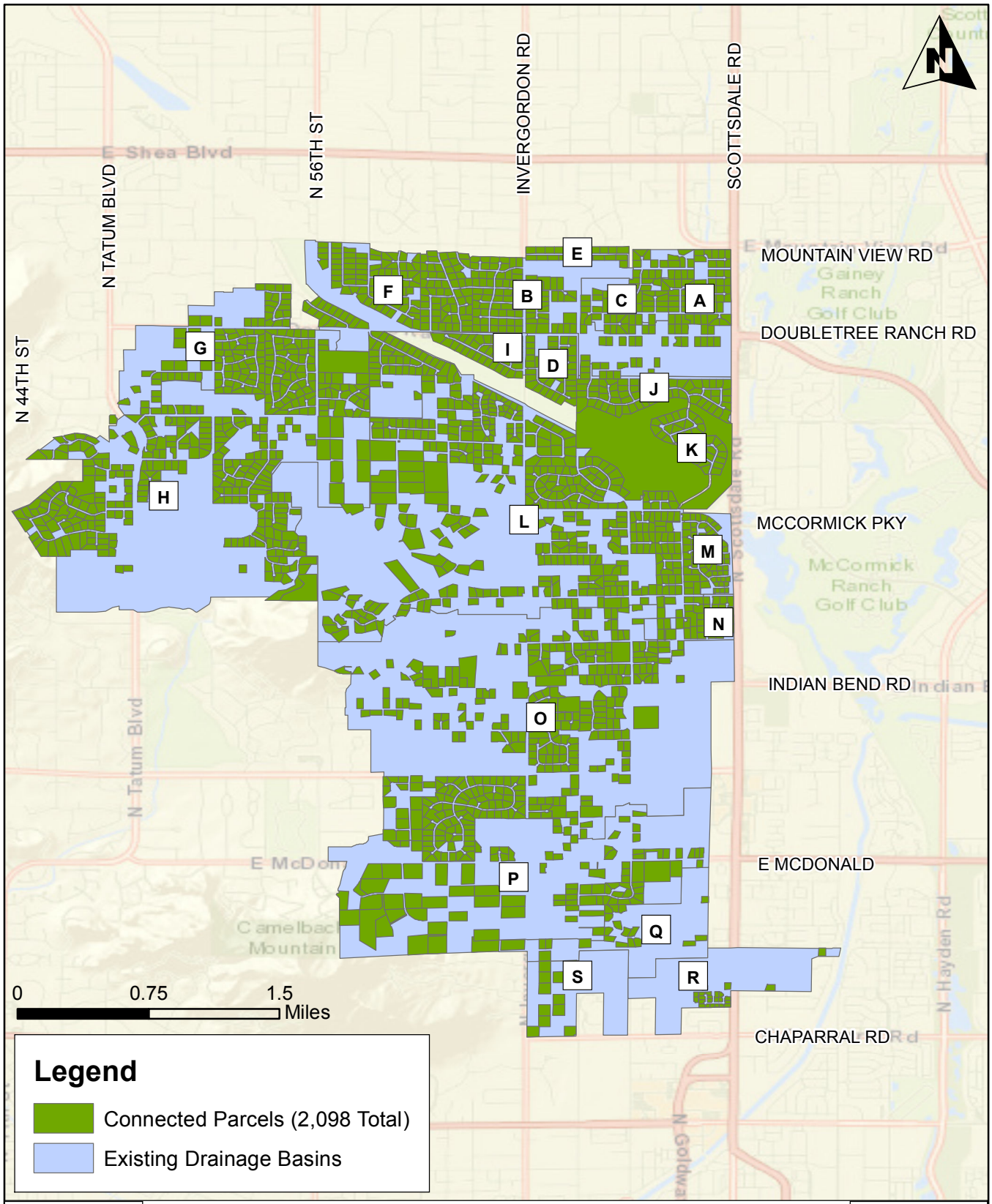
- Existing vacant parcels and parcels on septic systems were categorized into parcels that could be connected directly to the existing collection system, and parcels that would require additional infrastructure to connect to the system.

- In collaboration with the Town Planning and Public Works Departments, the number of septic parcels and vacant parcels that have historically been directly connected to the system were determined – this history of direct connections are assumed to remain the same for the projections. Also, the planned connections related to the proposed 5-Star Development were confirmed, including the timing of connections.

- A timeline of new connections (dwelling units) was established based on the previous steps and was applied to the wastewater flow factors to develop the wastewater flow projections.

5.2 Existing Connected Parcels

Currently, the Town's wastewater system collects flows from 2,098 connected parcels (**Figure 5-1**). **Figure 5-1** was developed based on current GIS information provided by the Town.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Parcels Connected to Collection System

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FIGURE 5-1

5.3 Existing Septic and Vacant Parcels

Within the Town's wastewater service area, another 1,876 parcels are not connected to the sewer systems, with 1,531 developed parcels currently served by septic systems and 345 vacant parcels. All of these parcels are presumed to be connected to the collection system in the future and will generate additional flows.

In determining which parcels will be ultimately connected, the Town provided guidance that all future connections will be by gravity flow, no new lift stations and force main pipes will be constructed. With this guidance, the existing septic and vacant parcels were categorized into four groups:

- Direct Connections: parcels that will be connected similar to past history. These are parcels that are generally within 300 feet of an existing pipe.
- Master Plan Additions: parcels that can only be added if new pipelines were constructed to collect their flows and convey them, by gravity, to existing pipes.
- Significant Improvements Required: parcels that would require significant pipe construction to connect to the system (parcels further than 300 feet from an existing pipe).
- Permanent Septic: parcels that would require a lift station and force main to connect to the system.

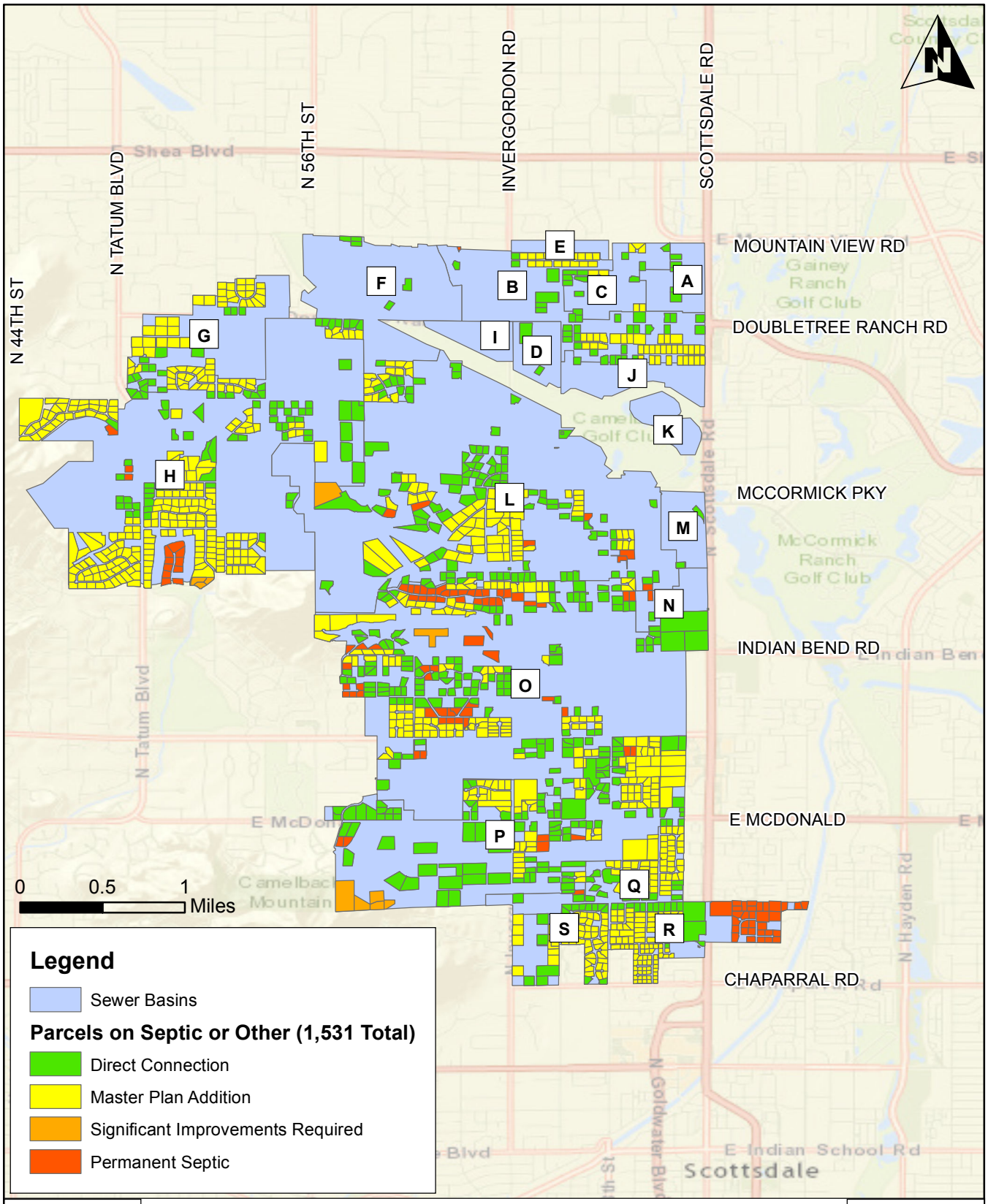
The existing septic and vacant parcels were determined based on current GIS information provided by the Town. The ability to connect to the existing collection system was determined based on the Town's GIS database for the wastewater collection system, upgraded as described in Section 3, overlaid on elevation contour maps obtained from standard U.S. Geographical Society elevation data in GIS.

Figure 5-2 illustrates the existing septic parcels and how they were categorized into the four groups above. **Figure 5-3** illustrates the existing vacant parcels and how they were categorized into the four groups above.

Table 5-1 summarizes the number of parcels in each of the Town's existing drainage basins that are either connected to the sewer, served by septic systems, or are vacant.

Table 5-1 Existing Parcels by Drainage Basin

Drainage Basin	Connected to Sewer	Existing Septic	Existing Vacant
A	54	7	1
B	182	87	13
C	66	22	2
D	46	2	0
E	21	0	0
F	203	56	2
G	88	56	4
H	388	282	30
I	46	0	0
J	77	28	4
K	38	0	0
L	437	205	47
M	73	3	0
N	49	10	3
O	367	306	36
P	119	176	21
Q	29	121	12
R	24	111	2
S	11	70	2
Totals	2,098	1,531	345



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Parcels Served by Septic Systems

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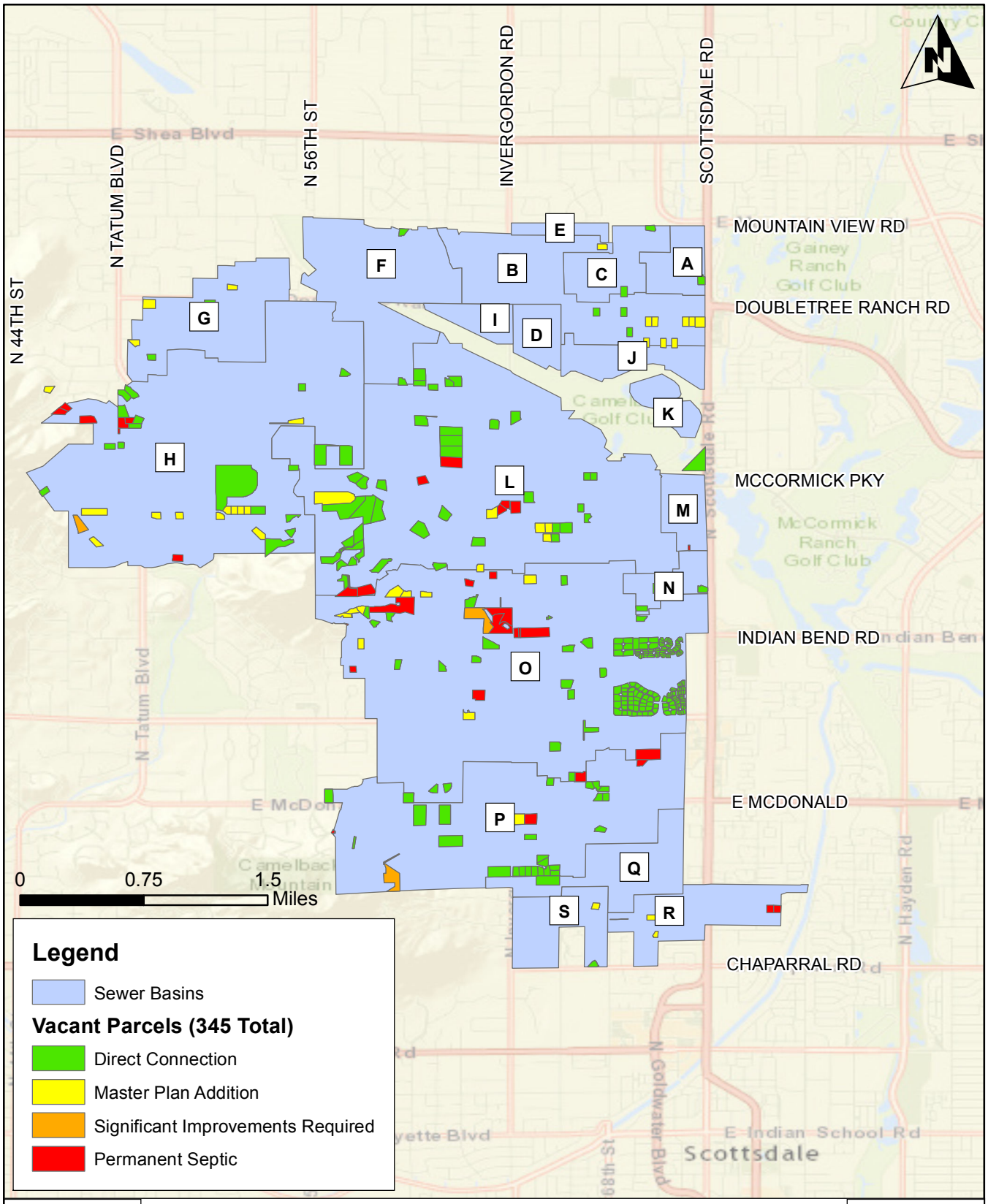
FIGURE 5-2



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Vacant Parcels

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FIGURE 5-3

5.4 Assumptions for Future Connections and Flows

Other than the wastewater flow factors utilized, the additional assumptions that went into the wastewater flow projections are as follows:

- The vacant lots were evaluated to see if any lots could be split into two or more lots. Based on the existing connected parcels, it was determined that the average lot size within the Town service area is approximately 1.2 acres. Thus, any vacant parcel that was larger than this was split into additional parcels that are similar in size to the average lot size. In this manner, 26 of the vacant parcels which were greater than the 1.2 acre-average were split to result in 71 total additional vacant parcels.

- Based on historical connections, 18 vacant lots that are within 300 feet of an existing pipe (Direct Connection) will be added to the system every year.

- Based on historical connections, 10 septic lots that are within 300 feet of an existing pipe (Direct Connection) will be added to the system every year.

- Based on the Town's judgment, 20 septic lots that are further than 300 feet of an existing pipe (Master Plan Addition) will be added to the system every year.

- The existing vacant and septic parcels that were categorized as Significant Improvements Required and Permanent Septic will not be connected; they will not be included in the master plan evaluations.

- Based on discussions with the Town Planning Department and engineering reports for the 5-Star Development, assumptions for the development include:

    - Hotel will be finished in 2018.

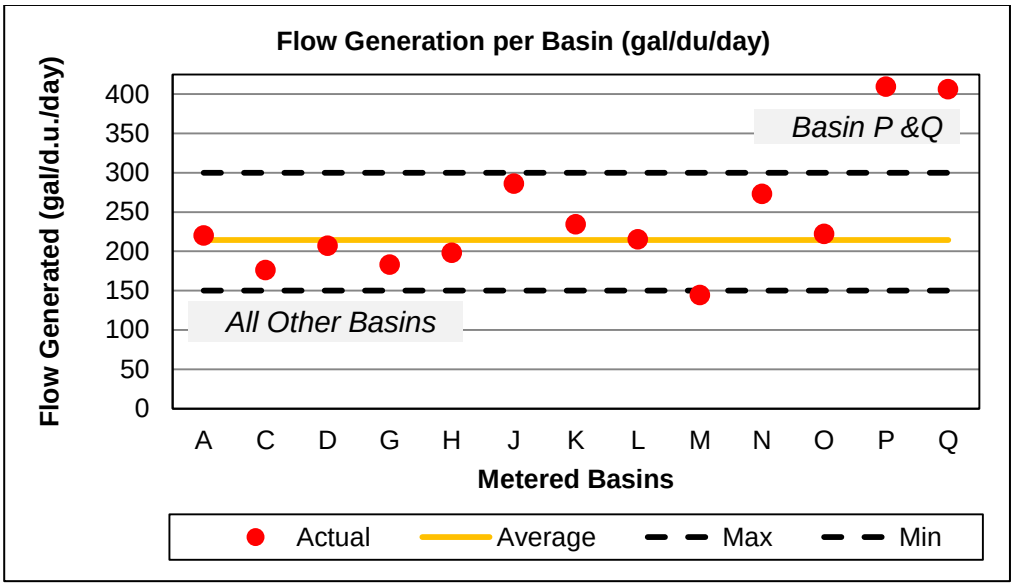
    - Hotel wastewater flows will be 85,500 gpd average and 384,800 gpd peak day.

    - The development will have 161 total residential units, and 32 units will be connected per year starting in 2019.

5.5 Wastewater Flow Factors

Wastewater generation factors were calculated based on dwelling unit estimates for each basin and the historical flows from the Wastewater Flow Management Tool. The flows for each metered basin were averaged over each year of record and divided by the dwelling unit counts for each year. The resulting flow generation factors are shown on **Figure 5-4**. Flow generation factors were considerably higher in Basins P and Q, compared with flow generation elsewhere in the Town's service area. A synagogue, a church, and a school are located in Basin P. The school used to serve as the main kitchen and provided the lunches for other area schools. The synagogue and church also have kitchen facilities. Thus, higher unit flows in Basin P may be attributed to the higher discharges of these users. Much of Basin Q is in Very Low Density Residential areas which typically exhibit higher than average per dwelling unit wastewater discharges. Town field staff also suspect that excessive discharge of swimming pool backwash into the sewers may be occurring Basin Q. Finally, both Basins P and Q had records for number of connections for only the last two years of data, which could also be skewing the results. As a result, and for purposes of projecting future flows the average flow factor of 214 gpd/du was used for all drainage basins, except Basins P and Q which used 408 gpd/du.

Figure 5-4 Wastewater Flow Factors



5.6 Future Flow Projections

Based on the preceding assumptions, a timeline of new connections to the collection system was developed and the assumed wastewater flow factors were applied to the assumed connections to develop the flow projections. **Appendix F** provides the flow projections in spreadsheet format.

Figure 5-5 illustrates the projected wastewater flows. The projected average daily flows and the peak day are shown on the figure. Currently, the Town has purchased capacity in the Scottsdale system for up to 1.026 mgd.

The projections indicate that on an average day basis, the flows will increase from approximately 480,000 gpd in 2015 to 710,000 gpd in 2025, and will further increase to approximately 1 mgd at buildout. On a peak day basis, the flows will increase from approximately 890,000 gpd in 2015 to 1.7 mpd in 2025, and will further increase to approximately 2.3 mgd at Buildout.

The Town should plan for the first capacity exceedance to occur in 2018, primarily as a result of the proposed 5-Star Development. To account for this increase in flows, the Town should purchase an additional 580,000 gpd of capacity in 2017 (total capacity to increase to approximately 1.6 mgd). Then, as the wastewater customer base increases as the result of new connections, the Town would require an additional 110,000 gpd of treatment capacity in 2021 (total capacity to increase to 1.7 mgd). This final capacity increase will be sufficient for all new connections through 2025.

Figure 5-5 Flow Projections with Planned Treatment Capacity Increases

6. Wastewater System Hydraulic Model

This section summarizes the development and calibration of the Town's wastewater collection system hydraulic model. The model is used to simulate the behavior of the wastewater system under existing and future conditions and to evaluate needed system improvements. The model was developed based on existing GIS data provided by the Town and Scottsdale. Additional data was added by reviewing the Town's as-built drawings and elevation data from the United States Geological Survey (USGS).

6.1 Model Software

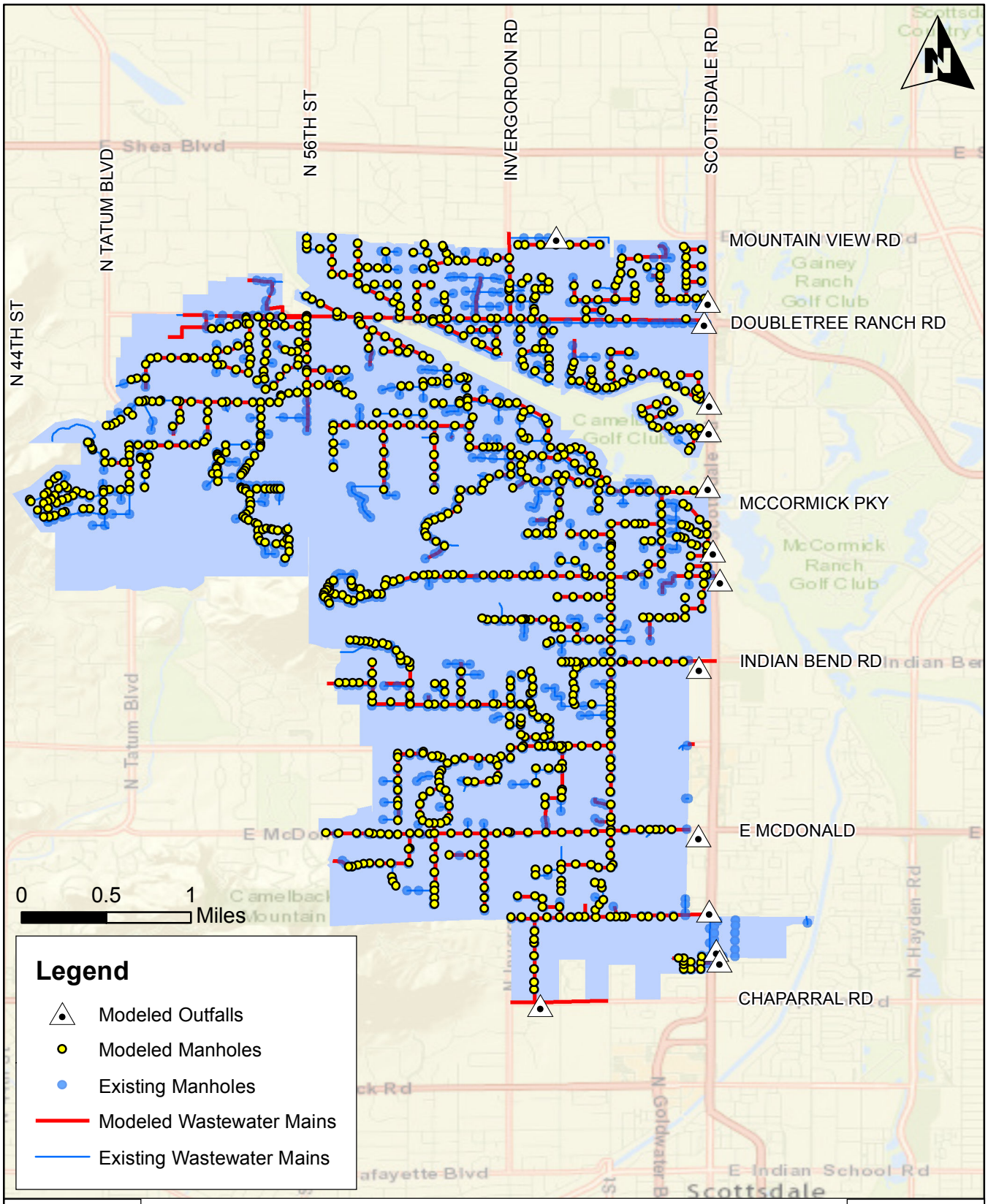
An Extended Period Simulation (EPS) model of the Town's collection system was built using Bentley SewerGEMS V8i software. Bentley SewerGEMS uses the U.S. Environmental Protection Agency's SWMM (Storm Water Management Model) engine, which is an industry standard for dynamic hydraulic modeling and computation, particularly in urban areas.

6.2 Modeled System

Physical information such as pipe diameter and manhole inverts for the entire collection system was not available. The system model, however, contained a majority of the Town's existing system (**Table 6-1**). The model includes a greater level of detail than is typical for skeletonized systems (e.g., interceptors and major trunk lines) used for long range master planning and capital improvement planning purposes. To address the data gaps in the original GIS, especially pertaining to manhole rim and invert elevations, the model was updated using the Town's scanned as-built data, ground elevations derived from 1-ft and 5-ft contours based on USGS National Elevation Database Digital Elevation Model (DEM) for the study area, and interpolated using SewerGEMS tools.

Table 6-1 Existing vs Modeled System

System Component	Existing System	Skeletonized System	Percentage of System Modeled
Sewer Mains	365,617 LF	243,394 LF	66.6%
Manholes	1,414	1,063	75.2%



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing vs. Modeled System

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FIGURE 6-1

6.3 Model Calibration

Calibration is necessary to ensure that the hydraulic model results accurately represent the actual system behavior. The model was calibrated for weekday and weekend flow conditions using the flow monitoring data for dry weather. No actual flow depth data was available in the flow metering data; hence the model was not calibrated for depth. The model was not calibrated to wet weather conditions either, as review of the available data and Town staff knowledge indicated little impact on the system resulting from rainfall-induced flows.

6.3.1 Calibration Criteria

The primary arbiter of model calibration was graphical comparison of the metered and modeled flow hydrographs. In addition, percent differences of modeled average flows and observed average flows is calculated and used as part of the overall assessment of model calibration. For this master planning effort, a meter is considered calibrated if the average modeled flow is ± 10 percent of the metered average flow. For basins with relatively low flows (e.g., less than 0.1 mgd average), the calibration was considered acceptable if modeled and metered flows are within 10 to 15 percent, or the absolute difference in modeled and metered average flows was less than 0.05 mgd. In the event that these ranges could not be achieved, possible explanations for the variance were explored.

6.3.2 Calibration Methodology

The hydraulic model was calibrated for a weekday and a weekend scenario. Model parameters listed below were adjusted to meet calibration guidelines, as well as the Town's understanding of the system:

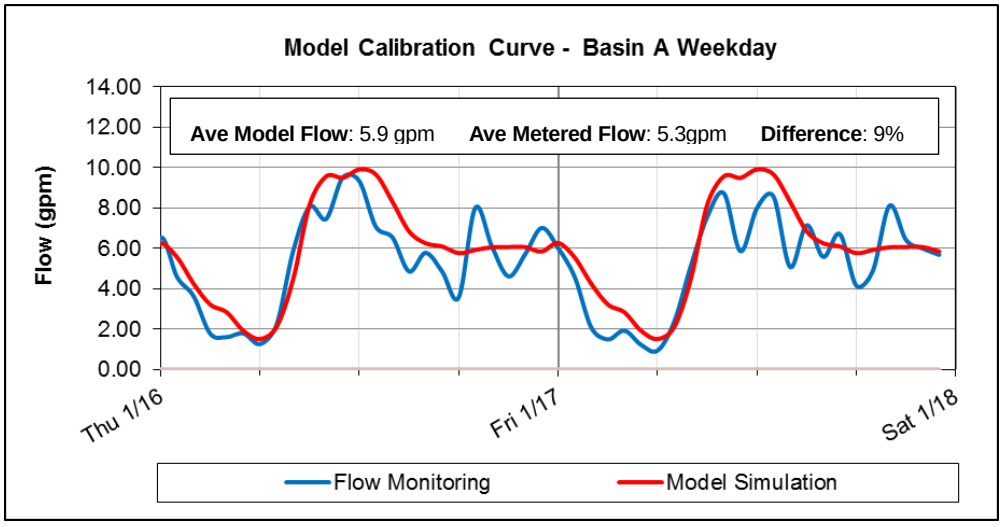
- Spatial location of wastewater loads
- Basin diurnal curves
- Pipe roughness
- Collection system connectivity
- Pipe constrictions/obstructions

The weekday and the weekend scenarios were run iteratively until the calibration guidelines were achieved.

6.3.3 Calibration Results

Overall, the Town's hydraulic model calibrated satisfactorily and is considered sufficient for long-term master planning purposes. **Figure 6-2** shows a sample calibration curve for Basin A. A full set of calibration results are provided in **Appendix G**.

Figure 6-2 Sample Calibration Curve for Drainage Basin A



For weekday calibration (**Table 6-2**), 10 of the Town's 13 metered basins met their calibration goals. Three (3) of the 13 basins (Basin H, Basin M, and Basin Q) had acceptable calibration results, falling within the 10-15 percent difference range. With respect to Basin M and Basin Q, these differences could also be attributed to the smaller size, where small differences in flow will present large percent differences.

The results from the weekend calibration scenario were also good (**Table 6-3**). Of the Town's 13 metered basins, 10 met their calibration goals. Basin A calibration was acceptable, falling within the 10-15 percent difference range. Calibration guidelines were not met for Basin N and Q. These basin are particularly small, low-flow basins and characterized with very few and large lots. In general, peak modeled flows matched fairly well with peak metered flows

Table 6-2 Calibration Summary – Weekday

Basin	Model Flow (gpm)	Meter Flow (gpm)	Percent Difference	Calibration Goal Met
A	5.9	5.3	9%	Yes
C	6.6	7.3	-9%	Yes
D	4.7	4.5	5%	Yes
G	9.6	9.4	2%	Yes
H	49.7	58.5	14%	Acceptable
J	11.7	11.0	5%	Yes
K	5.7	5.9	-3%	Yes
L	57.5	55.6	3%	Yes
M	5.8	6.6	11%	Acceptable
N	2.7	2.5	9%	Yes
O	51.4	57.3	10%	Yes
P	24.9	28.0	10%	Yes
Q	4.9	4.4	11%	Acceptable

Table 6-3 Calibration Summary - Weekend

Basin	Model Flow (gpm)	Meter Flow (gpm)	Percent Difference	Calibration Goal Met
A	5.6	4.8	15%	Acceptable
C	6.3	6.5	-3%	Yes
D	4.6	4.2	10%	Yes
G	8.9	9.0	-1%	Yes
H	45.6	48.1	-5%	Yes
J	11.2	10.9	3%	Yes
K	5.7	5.9	-3%	Yes
L	55.9	59.3	-6%	Yes
M	5.5	5.7	-4%	Yes
N	2.8	2.1	28%	No
O	47.4	49.9	-5%	Yes
P	21.6	21.6	0%	Yes
Q	5.5	4.1	25%	No

The hydraulic model of the Town's collection system represents a planning-level model that was developed using the best available information as of 2014, and calibrated to long-term metering data representing recent (2012 – 2014) flows and development

conditions within the Town. To address the overall project objectives, the model included all the major conduits and manholes in the Town's system. The purpose of this model is to establish a solid, consistent analysis tool to support the Town in planning level capacity analyses and to provide a tool capable of predicting the impact of new development or connections on local capacity and total flows delivered to the Scottsdale system. While the model meets the project objectives, there are the following limitations that the Town should be aware of as it applies the model results:

- The model was developed to meet master planning level goals and objectives, which provides a system-wide overview of performance, not a design-level analysis.

- The model calibration parameters, and therefore any projected flows, have greater uncertainty in drainage areas that were not monitored explicitly (unmetered basins).

The model was not calibrated to wet weather flows; therefore, the model cannot be used to predict the response from a specific storm event (real or synthetic).

7. Collection System Analysis

This section summarizes the evaluation of the Town's wastewater collection system under existing and projected future wastewater flow conditions using the calibrated hydraulic model. The evaluation results are used to:

- Identify existing system deficiencies,
- Develop recommendations to correct the deficiencies,
- Determine system improvements to accommodate future growth, and
- Develop opinions of estimated system improvement construction costs.

7.1 Existing System Analysis

The performance of the existing wastewater collection system was evaluated to identify any deficiencies. The existing connected parcels were assigned to individual manholes using available GIS data to develop manhole loadings, and the system was evaluated using the peak factor methodology. The existing system loading and peaking factors were used to develop peak loading conditions and to evaluate the system under dry and wet weather conditions. In addition, the impacts on shared infrastructure such as the common-use interceptor on Doubletree Ranch Road line conveying Phoenix flows, was also investigated.

7.1.1 Peaking Factors

To evaluate the existing system under realistic worst-case conditions, peaking factors were calculated. Based on the Town's historic wastewater flow data, these peaking factors represent realistic peak flows during dry and wet weather conditions. For both dry and wet weather analysis, data from the three most recent years of wastewater flow data (2012-2014) was used to develop the peaking factors. This period provides sufficient data to determine historical peaks, but also represents the most stable period during which data would be least effected by rapid population changes and most accurate due to improved meter maintenance.

7.1.1.1 Dry Weather

Dry weather peaking factors represent peak flows occurring during normal daily flow variations. Dry weather peaking factors for 2012-2014 were calculated for each of the Town's existing 13 metered basins. Rainfall events during the period were determined from the Flood Control District of Maricopa County's precipitation gauge located at Paradise Valley Country Club. Flow data from the wet weather days was excluded from the dry weather analysis. Dry weather peaking factors were estimated by calculating the ratio of the peak hourly dry weather flow to the annual average dry weather flow (**Table 7-1**). High peaking factors were generally observed in the smaller basins (Basin A, Basin C, Basin D, Basin M, and Basin N). This can be attributed to the overall higher variability in flow for smaller basins with fewer connections. The average dry weather peaking factor for the Town's entire system ranged from 2.0 in 2013 to 2.3 in 2014, which is consistent with similar sized utilities in the region. The average factor recorded in 2014 (2.3) was used during the system analysis.

Table 7-1 Dry Weather Peaking Factors

Basin	2012			2013			2014		
	Dry Weather Peak Flow (mgd)	Annual Average Dry Weather Flow (mgd)	Dry Weather Peaking Factor	Dry Weather Peak Flow (mgd)	Annual Average Dry Weather Flow (mgd)	Dry Weather Peaking Factor	Dry Weather Peak Flow (mgd)	Annual Average Dry Weather Flow (mgd)	Dry Weather Peaking Factor
A	0.02	0.01	2.5	0.03	0.01	3.5	0.02	0.01	2.6
C	0.03	0.01	2.4	0.03	0.01	2.6	0.02	0.01	2.5
D	0.02	0.01	2.4	0.03	0.01	3.4	0.02	0.01	2.4
G	0.03	0.01	2.1	0.04	0.02	2.0	0.04	0.02	2.2
H	0.15	0.08	2.0	0.15	0.07	2.1	0.14	0.07	2.1
J	0.03	0.01	2.1	0.03	0.01	2.1	0.03	0.02	2.0
K	0.02	0.01	2.4	0.02	0.01	2.3	0.02	0.01	2.2
L	0.19	0.09	2.0	0.15	0.09	1.6	0.18	0.09	2.1
M	0.02	0.01	2.4	0.02	0.01	2.3	0.02	0.01	2.6
N	0.03	0.01	4.4	0.01	0.00	3.0	0.01	0.00	3.3
O	0.14	0.08	1.8	0.14	0.08	1.8	0.14	0.08	1.8
P	0.07	0.04	1.9	0.07	0.04	1.9	0.07	0.03	2.0
Q	0.02	0.01	2.8	0.02	0.01	2.3	0.02	0.01	2.1
Yearly	**0.77**	**0.37**	**2.1**	**0.73**	**0.36**	**2.0**	**0.73**	**0.35**	**2.3**

7.1.1.2 Wet Weather

Wet weather peaking factors are used to account for the effect of any potential rainfall inflow and infiltration (I&I) into the wastewater collection system. The wet weather analysis was conducted for the same time period, 2012 through 2014. Rainfall events during the period were determined from the Flood Control District of Maricopa County's precipitation gauge located at the Paradise Valley Country Club. To calculate wet weather peaking factors, flow data from only the wet weather days were used. Peaking factors were estimated by calculating the ratio of the peak hourly wet weather flow to the annual average dry weather flow. Individual wet-weather peaking factors per basin varied greatly from 1.7 to 7.1 (**Table 7-2**). In particular, Basin A and Basin K demonstrated much higher peak wet weather flows. The system in these basins will require future investigation to identify cause of these increased flows. The average wet weather peaking factor for the entire system ranged from 2.3 in 2013 to 3.0 in 2014, which is lower than other utilities in the region. This could be attributed to the fact that the Town has recently slip-lined most of its manholes resulting in lower I&I. To be conservative and consistent, the peak system-wide average wet weather peak factor of 3.0 was used for the system analysis.

7.1.2 System Performance and Design Criteria

System performance and design criteria were developed to evaluate the Town's collection system and to identify and size system improvements. The criteria also included design flow conditions for the peak flow scenarios that were evaluated. The recommended system performance criteria for the Town's wastewater collection system (**Table 7-3**) were based on MAG standards and the existing criteria utilized by Scottsdale. The Town's recommended peaking factors are based on analysis of the Town's flow data as described above.

Table 7-2 Wet Weather Peaking Factors

Basin	2012			2013			2014		
	Wet Weather Peak Flow (mgd)	Annual Average Dry Weather Flow (mgd)	Wet Weather Peaking Factor	Wet Weather Peak Flow (mgd)	Annual Average Dry Weather Flow (mgd)	Wet Weather Peaking Factor	Wet Weather Peak Flow (mgd)	Annual Average Dry Weather Flow (mgd)	Wet Weather Peaking Factor
A	0.02	0.01	2.4	0.03	0.01	3.5	0.06	0.01	7.1
C	0.07	0.01	6.0	0.03	0.01	2.4	0.03	0.01	3.0
D	0.02	0.01	3.1	0.02	0.01	1.7	0.01	0.01	2.2
G	0.02	0.01	1.7	0.03	0.02	1.8	0.05	0.02	3.0
H	0.17	0.08	2.3	0.16	0.07	2.3	0.11	0.07	1.7
J	0.03	0.01	2.5	0.02	0.01	1.8	0.03	0.02	1.7
K	0.02	0.01	2.0	0.05	0.01	4.8	0.04	0.01	5.0
L	0.29	0.09	3.1	0.18	0.09	2.0	0.27	0.09	3.0
M	0.04	0.01	5.2	0.03	0.01	4.0	0.02	0.01	3.3
N	0.03	0.01	4.6	0.01	0.00	3.3	0.01	0.00	3.3
O	0.16	0.08	2.1	0.16	0.08	2.1	0.18	0.08	2.4
P	0.09	0.04	2.4	0.08	0.04	2.1	0.12	0.03	3.4
Q	0.01	0.01	1.7	0.02	0.01	3.1	0.03	0.01	3.6
Yearly	0.98	0.37	2.6	0.82	0.36	2.3	0.97	0.35	3.0

Table 7-3 System Performance and Design Criteria

Parameter			MAG	City of Scottsdale	Paradise Valley (Recommended)
Peaking Factor	**Peak Flow**	Dry Weather	-	≤ 12 inch Residential = 4 > 12 inch Residential = Q_{avg} [1+14 / (4+$P^{1/2}$)] Commercial & Industrial = Refer to Figure 7.1-2	2.3
		Wet Weather	-		3
Collection System Pipes	**Gravity**	Design Criteria	-	-	Peak Flow
		Manning's *n*	0.013	0.013	0.013
		Min Velocity	2.0 ft/s	2.5 ft/s	2.5 ft/s
		Max Velocity	10 ft/s	10 ft/s	10 ft/s
		Min Pipe Size	6 inch	8 inch	8 Inch
	Force Main	Design Criteria	Allowed: 3.5 to 6.0 ft/s Recommended: 4 ft/s	Max Velocity - 6 ft/s Min Velocity - 4 ft/s	Max Velocity - 6 ft/s Min Velocity - 4 ft/s
Depth Ratio	**Peak Flow**	Future pipes	-	0.65 for peak flow for ≤ 12 inch 0.70 for peak flow for > 12 inch	0.65
Lift Stations	**Firm Capacity**		-	-	Largest pump out of service
	Design Criteria		-	-	Firm Capacity Exceeds Peak Flow
Note: P = Population/1000					

Trigger criteria (**Table 7-4**) were also used during the evaluations to further identify the need for infrastructure improvements.

Table 7-4 Trigger Criteria

Conditions	Trigger Level for Gravity Sewer
Wet Weather	≤ 2-foot surcharge above crown of pipe during wet weather, or minimum distance of 7 feet from the manhole rim to water level - whatever is more conservative
Dry Weather	No surcharge at peak dry weather flow

7.1.3 Dry Weather Analysis

The calibrated collection system model was used to evaluate the system using the peaking factor method. The model results for a 48-hour period representing weekday and weekend conditions were used for the analysis.

To analyze the existing system, loadings from all connected parcels were assigned and imported into the hydraulic model. Using the evaluation criteria and an average dry-weather peaking factor of 2.3, the existing collection system was assessed to determine capacity deficiencies during the peak dry weather loading conditions.

The existing system performed very well under the dry weather conditions with no surcharging in the system.

7.1.4 Wet Weather Analysis

Similar to dry weather analysis, the wet weather simulation results representing a 48-hour weekday/weekend period were used.

Using an average wet-weather peaking factor of 3.0, the existing collection system was evaluated to determine capacity deficiencies during peak wet weather loading conditions.

The system performed well under peak loading conditions. No manholes were flooded, and the surcharge criteria were met adequately.

7.1.5 Conclusions for Existing Conditions

The Town's existing wastewater collection system, under existing (2015) flow conditions and assumed peaking factors, does not display any deficiencies based on the recommended system performance criteria. According to Town staff, this is consistent with the observed behavior of the system in the field.

7.2 Future System Analysis

Using the system performance and design criteria and the hydraulic model, the performance of the wastewater collection system was evaluated under future flow conditions to identify potential future system improvements. Other than the assumed connection of Direct Connection parcels (refer to Section 5), the schedule for connection of Master Plan Additions parcels could not be estimated. In addition, the spatial distribution of all future connections could not be estimated over time. Hence the future system analysis was evaluated for projected Build-Out conditions only.

7.2.1 Drainage Basin Modifications

Another Wastewater Planning Services task was to assess the current drainage basin configurations and to identify alternatives for modifying drainage basins and meter locations to achieve 100 percent metering of the Town's entire service area. All existing meter locations were reviewed to confirm that they capture all flows from their designated drainage basins. Using the Town's GIS data, supplemented with GIS data provided by Scottsdale, and as-built data made available via the Town's EMS Viewer, general sewer flow paths were established with the goal of determining flow directions and basin connectivity. Using the GIS and as-built data, the Town's 6 unmetered basins were evaluated to determine how they could be included in the metering program to achieve 100 percent coverage. Multiple options were explored, including combining unmetered basins, connecting metered basins, and identifying suitable locations for installation of new meters. Three alternatives were presented to the Town:

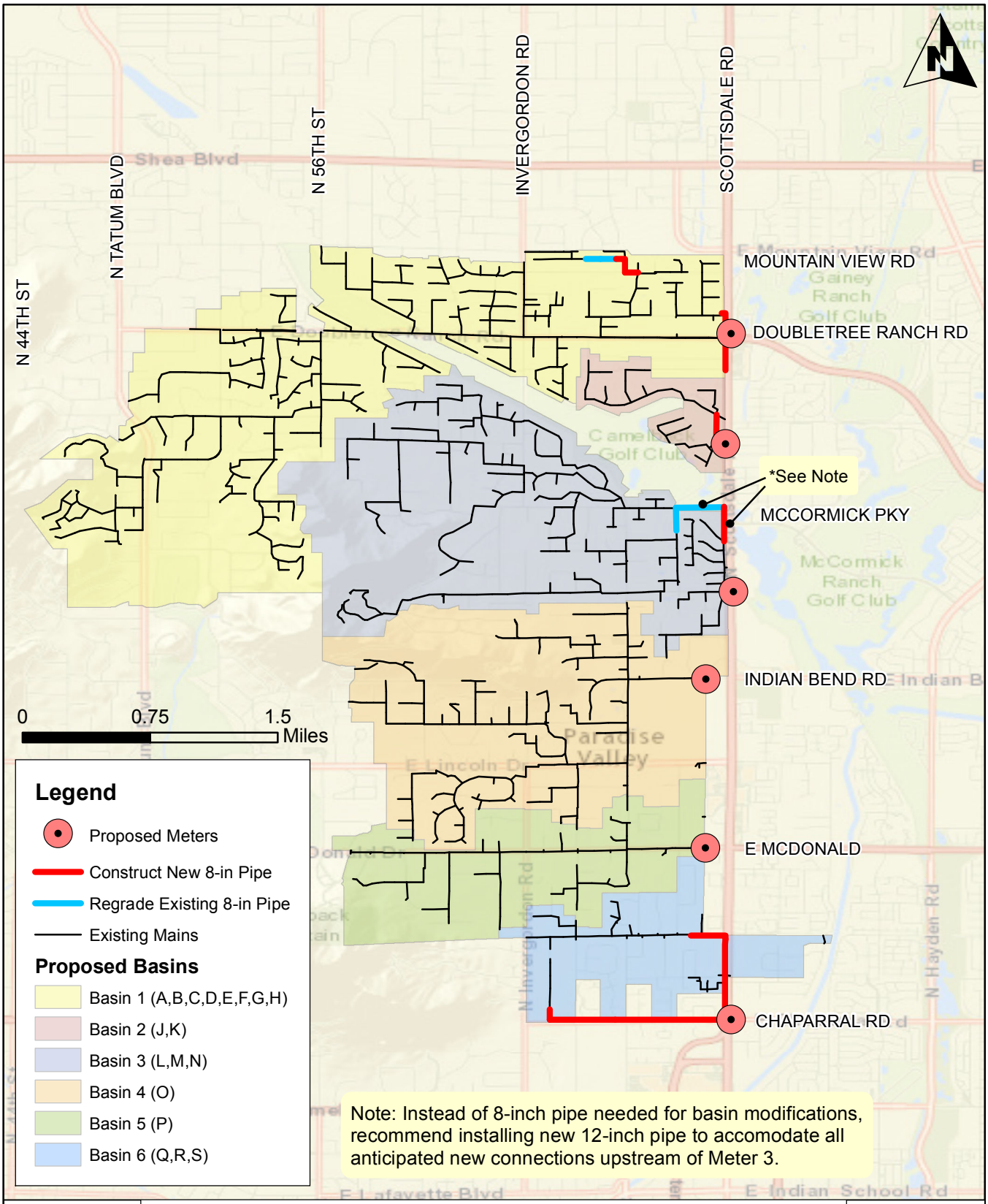
- Alternative A, requiring minimal infrastructure changes, achieves 100 percent metering of the Town's wastewater service area using the existing number of meters.

- Alternative B, involving a greater amount of infrastructure changes, achieves 100 percent metering with 6 meters.

- Alternative C, requiring the greatest amount of construction but achieving 100 percent metering with 2 flow meters.

The Town selected Alternative B (**Figure 7-1**), as it provided the best tradeoff on costs and meter reductions. For more details on the procedure for drainage basin modifications, refer to **Appendix A**.

It should be noted that some of the improvements needed to create new Drainage Basin 3 (existing Basins L, M and N) are also subject to improvements required to accommodate future connections (refer to Section 7.2.4). The improvements noted on Figure 7-1 including the new 8-inch pipe on Scottsdale Road and regrading of the existing 8-inch pipe on McCormick Parkway, both upstream of new Meter 3, would also have to upgraded to a new 12-inch pipe when new connections (new flows) reached a certain level. In order to prevent making improvements twice, the City should make the 12-inch upgrade when it is modifying the drainage basins.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Selected Drainage Basin and Meter Configuration Modifications

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FIGURE 7-1

7.2.2 Future System Analysis Assumptions

The following assumptions were made during the analysis of the future system conditions:

- Future system evaluations considered the system only at Build-Out. At Build-Out, all septic and vacant parcels that can be connected by gravity flow would be contributing flow.
- The future flows included the projected wastewater flows from areas currently connected to the system and service to new areas and customers (septic and undeveloped parcels).
- The construction of the 5-Star Development is complete and all flows from the resort are conveyed through the Town's system.
- A maximum flow of 9 mgd from Phoenix will be conveyed through the shared system.
- The 6-basin configuration will be implemented by the Town, and all appropriate modifications to the collection system and redirection of flows to accommodate the 6-basin configuration are completed.
- All other model simulations parameters were similar to those used during existing system evaluation.

7.2.3 Dry Weather Analysis

The dry weather analysis did not reveal any deficiencies in the Build-Out system under peak dry weather flows. No surcharging was seen throughout the system.

7.2.4 Wet Weather Analysis

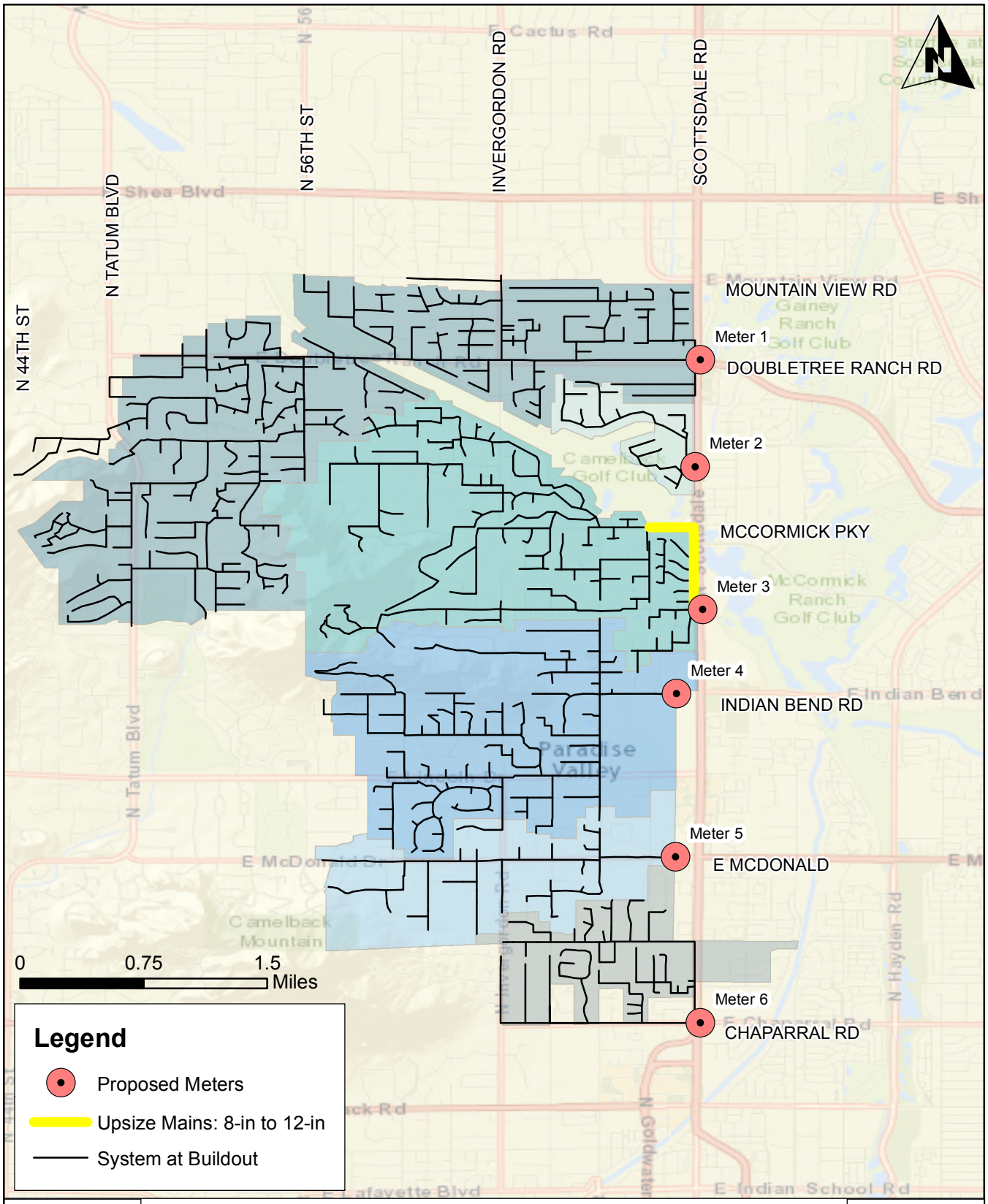
Overall, the system performed well under the peak wet weather loading conditions. There were a few manholes and pipes where the trigger criteria were violated. At peak wet weather flow, the system is predicted to experience no manhole flooding, but some surcharging upstream of Meter 3 is possible (**Table 7-5**).

Table 7-5 Build-Out Wet Weather Analysis Results – Surcharged Manholes

Manhole	Time When Surcharging Occurs (hours from start of simulation)	Min. Depth Below Rim (ft)
48249	46.02	0.655
45130	45.29	1.650
45119	45.2	2.015
45106	44.9	2.409
48245	46.31	3.026
48246	46.38	3.072
45138	46.24	3.633
45153	43.06	3.721
45144	46.36	3.741
48247	46.39	3.751
48244	46.4	3.916
45105	40.07	4.308
MH-3672	46.2	4.706
45090	25.31	5.317
MH-3673	46.15	5.970
MH-3273	45.49	5.975
48266	38.18	6.332
48248	46.1	6.345
45024	34.83	6.676
MH-2709	46.37	6.710

The surcharging was confined to one area just upstream of Meter 3, as a result of the drainage basin modifications and increased connections upstream. To correct the deficiency, the existing 8-inch sewer main should be upsized to a 12-inch main which would accommodate increased flows and eliminate the surcharging (**Figure 7-2**). As noted previously, this same main was also identified for an upgrade under the selected basin modification alternative to achieve 100 percent monitoring (Section 7.2.1). Thus, to avoid upgrading this main twice, the 12-inch upgrade should be used for both the drainage basin modifications and elimination of surcharging during peak wet weather flows.

At build-out, wet weather flows from the City of Phoenix are adequately conveyed by the existing interceptor line in Doubletree Ranch Road. Based on the wet weather analysis, the interceptor will require no improvements; either as a result of increased Phoenix flows, or as a result of increased connections with the Town's service area.



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Buildout Wet Weather Analysis - Improvements Required

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FIGURE 7-2

8. Assessment of Potential for Water Reuse

A Water Reclamation and Reuse Alternatives Study was prepared for the Town in early 1991 (Malcolm Pirnie, Inc., January 1991). The study generally included the following tasks, among others:

- Identification of available wastewater supply within the Town.
- A reuse market assessment to identify potential reclaimed water customers and reclaimed water demands.
- Identification of potential water reclamation facility sites within the Town's service area.
- Identification and evaluation of alternative water reclamation and reuse options.

The study identified several important benefits to the Town if it implemented a reuse program, including minimizing regional groundwater overdraft conditions (which was leading to land subsidence and formation of earth fissures), preserving potable water supplies, and reducing the costs paid to Scottsdale for wastewater treatment and disposal. It was also found that a water reclamation and reuse program was entirely feasible from a technical perspective because well-developed and reliable treatment processes were available, and nuisances such as noise and odors could be effectively controlled. Weighed against these findings were the costs of constructing and maintaining the reuse system.

This section presents a discussion of current water reclamation and reuse planning to determine 1) the current disposal methods for the Town's wastewater effluent and benefits gained by Scottsdale, and 2) the current potential for reuse within the Town, including potential customers, level of demand, and potential direct and indirect benefits if the reuse potential could be realized.

8.1 Scottsdale's Current Effluent Management

The City of Scottsdale's primary water reclamation facilities are located at the Water Campus, the Gainey Ranch Water Reclamation Facility (WRF), and the SROG 91st Avenue WWTP. The Town's wastewater is either pumped back to the Water Campus or conveyed to the 91st Avenue WWTP. The current Paradise Valley/Scottsdale IGA for wastewater management specifies that once the Town's wastewater flows enter the Scottsdale system, ownership of the flows revert to Scottsdale.

8.1.1 Water Campus

The Water Campus treats wastewater generated in north and central Scottsdale and includes a 20 mgd WRP which uses a conventional activated sludge process to produce reclaimed water for irrigation. The reclaimed water is delivered to over 21 golf courses in north Scottsdale through the City's Reclaimed Water Delivery System (RWDS), which consists of five booster pump stations and over 14 miles of reclaimed water primary transmission pipe. The Water Campus also includes a 20 mgd AWT plant that uses state-of-the-art technology to further treat the WRP effluent with the following process components:

- Microfiltration (MF) membranes
- Reverse osmosis (RO) membranes
- Ultraviolet Light (UV) photolysis
- Post treatment consisting of decarbonation towers and lime addition

The primary purpose of the AWT is to provide advanced treatment of Water Campus WRP effluent for 1) groundwater recharge and 2) as a blend source to meet RWDS sodium concentration obligations. The excess AWT product water is recharged to the aquifer through vadose zone recharge wells.

Scottsdale benefits from operation of the Water Campus because groundwater recharge helps to achieve the City's safe yield objectives and provide groundwater sustainability (gaining water storage credits that can be added to the City's water supply portfolio). The City also benefits from the RWDS deliveries because the reclaimed water delivered is not counted as part of the City's overall per capita water demands for Assured Water Supply accounting. The RWDS customers also contribute to capital improvements at the WRP and AWT facilities, and they pay the City a reclaimed water rate to further offset capital and annual O&M expenses at the Water Campus.

8.1.2 Gainey Ranch WRF

The Gainey Ranch WRF is a 1.67 mgd conventional activated sludge wastewater treatment facility located on the southeast corner of Scottsdale Road and Mountain View Road. The facility is a scalping plant that operates to produce reclaimed water for golf course and landscape irrigation within the Gainey Ranch development (the plant capacity is also the peak reuse demand). During periods of low demand, the facility is

operated at less than capacity at a loss of efficiency. Any excess reclaimed water not used by the development is returned to sewer and becomes part of the flows that are pumped back to the Water Campus or conveyed to the 91st Avenue WWTP.

Scottsdale benefits from operation of the Gainey Ranch WRF by revenue that is generated from sale of the reclaimed water to the Gainey Ranch development. The development has a “take or pay” arrangement with the City which means they must take a minimum amount of reclaimed water at all times, if they take less they still have to pay for the minimum amount. However, none of Paradise Valley’s wastewater is managed at the Gainey Ranch WRF.

8.1.3 91st Avenue WWTP

Scottsdale owns capacity in the SROG 91st Avenue WWTP, which provides wastewater treatment for Glendale, Mesa, Phoenix, Scottsdale and Tempe. Flow is conveyed to the 91st Avenue WWTP via Scottsdale’s capacity ownership in the SRO interceptor. The SRO also conveys flows from Mesa, Phoenix and Tempe. Scottsdale’s wastewater is treated at the 91st Avenue WWTP and is either 1) conveyed to the Arizona Nuclear Power Plant (ANPP) to fulfill the City’s allocation commitment to the ANPP, or 2) discharged through the Tres Rios Wetlands to the Buckeye Irrigation District (BIC) for agricultural irrigation reuse.

Scottsdale’s effluent commitments to the ANPP vary throughout the year. The committed flows have not yet been finalized, but the latest values that the City is obligated to deliver into the SROG system generally varies from a low of 7.7 mgd in January to a high of 10.6 mgd in June, with an annual average of 8.8 mgd. The City operates its wastewater pump back system (to the Water Campus) in a manner to deliver a portion of flow from its northern drainage basins to supplement its southern area flows to meet the SROG commitment. Flows above the commitment can be pumped to the Water Campus.

Both the ANPP and BIC pay for the reclaimed water received, the revenue generated from the sale of water is reverted back to the SROG member cities who then utilize the revenue to offset their share of capital and O&M expenditures for the regional SROG facilities. Scottsdale benefits from its usage of the SROG facilities by receiving relatively low cost wastewater and sludge treatment and disposal for the flows that it sends to the facilities.

8.2 Potential for Reuse within the Town

The 1991 Water Reclamation and Reuse Alternatives Study identified the potential reuse customers within the Town's service area shown on **Table 8-1**. The potential customers were considered to have the most acreage for potential irrigation reuse. A cursory review of current aerial photography and a current list of resorts, churches and schools provided by the Town indicate that land uses have not changed much since 1991 with respect to potential irrigation reuse

Table 8-1 Potential Reuse Customers within the Town's Service Area

Potential Customer	Irrigated Acreage	Winter Demand (mgd)	Annual Average Demand (mgd)	Summer Demand (mgd)
Golf Courses				
Camelback Country Club	370	0.30	1.00	2.00
Paradise Valley Country Club	120	0.15	0.45	1.00
Mountain Shadows Country Club	50	0.10	0.35	0.70
Subtotal	540	0.55	1.80	3.70
Resorts				
La Posada[1]	2	0.001	0.01	0.01
Camelback	9	0.003	0.02	0.04
Subtotal	11	0.004	0.03	0.05
Schools				
Cherokee	15	0.008	0.02	0.04
Judson[2]	13	0.007	0.02	0.03
Kiva	14	0.007	0.02	0.04
Subtotal	42	0.02	0.06	0.11
Grand Totals	**593**	**0.57**	**1.89**	**3.86**
Grand Totals without La Posada Resort and Judson School	**578**	**0.56**	**1.86**	**3.82**

Notes:

1. Now called the Montelucia Resort.
2. No longer exists, is now a subdivision.

Of the potential customers in **Table 8-1**, the irrigated acreage at the former La Posada Resort and the Judson School do not appear to exist anymore. As the Town's projected wastewater flows are currently just under 0.5 mgd annual average and 0.9 mgd peak, the Town would not have the supply for all identified reuse customers.

The Camelback Country Club has the most potential reuse demand and is closest to the greatest amount of wastewater supply, and is therefore the best candidate for reuse within the Town. However, this golf course had its own groundwater well and the unit cost to operate the well was less than a third of what the rate for reclaimed water would have been in 1991. The reclaimed water rate was assumed to be 70 percent of the prevailing potable water rates in the area. Even for this single user, the Country Club would have to supplement the Town's reclaimed water supply for most of the year. The Camelback Country Club does not have the incentive that other golf courses have, that the use of reclaimed water could increase their irrigation water allotments under State law. The Club's groundwater use predated the State regulations so its water use had been grandfathered in as part of the laws.

The next largest potential user, the Paradise Valley Country Club had, in 1991, proposed to the Town that it would buy reclaimed water at prevailing market rates when it became available.

The 1991 Water Reclamation and Reuse Alternatives Study also identified and evaluated two potential reclamation treatment sites within the Town's service area, one near the intersection of Tatum Boulevard and Lincoln Drive, and one near the Indian Bend Wash and Scottsdale Road. The area around the intersection of Tatum and Lincoln appears to have filled in since 1991. The area around the Indian Bend Wash and Scottsdale Road appears to still be available. The latter area was preferred as it was closer to a large wastewater supply, it was surrounded by less development, and it had the potential for multiple educational and/or recreational uses. However, the Town could not convey all its wastewater flows to this location without significant capital expenditures. Instead, the Town could enter into an agreement with Scottsdale to access the interceptor in Scottsdale Road for wastewater supply while maintaining the current conveyance system.

Alternatively, Town could take delivery of reclaimed water from the Gainey Ranch WRF and/or the Water Campus. Because the current Gainey Ranch WRF is sized to provide irrigation water only to the Gainey Ranch development, Scottsdale investigated, in its 2012 Water Reuse Master Plan Update (Carollo, et. al., July 2013), alternatives for increasing reuse in the area by expanding the Gainey Ranch WRF or by constructing a reclaimed water pipeline from the Water Campus to the Gainey Ranch area. The Water Campus option involved construction of a 4-mile reclaimed water pipeline to the Gainey Ranch area (this line would have to be extended another 2 miles to reach the Camelback Country Club area). After review of costs and other advantages/ disadvantages, the Water Reuse Master Plan Update recommended that the Gainey

Ranch WRF be kept at its current capacity, but operated at a lower rate during low demand periods, and that the reclaimed water pipeline from the Water Campus not be built.

8.3 Potential Benefits of Water Reuse

The opportunity for water reuse within the Town appears challenging as the Town does not generate enough wastewater to serve all potential demands (or even the most preferable demands), constructing and operating a Town water reuse system would be costly as demonstrated by the 1991 study, and constructing reclaimed water pipelines from Scottsdale reclaimed water facilities to the Town would also be costly. If reclaimed water is obtained from Scottsdale, potential reuse customers would also have to pay the prevailing Scottsdale reclaimed water rate.

However, if the Town could implement water reuse, either by constructing and operating its own water reclamation and reuse system or by entering into an agreement with Scottsdale, the following benefits (direct and indirect) could be realized:

<u>Direct Benefits</u>

- Reduction of wastewater treatment and disposal costs that the Town currently pays Scottsdale. This benefit would, however, be offset by the costs to construct and operate a Town reuse system or by rates that customers would have to pay to access Scottsdale's reclaimed water.

- Revenues from sale of reclaimed water. These revenues would only apply if the Town constructs and operates its own reuse system and could offset a portion of the costs to construct and maintain the reuse system.

<u>Indirect Benefits</u>

- Conservation of potable water supplies. This would benefit the local water providers in meeting their Arizona Department of Water Resources conservation and per capita consumption goals.

- Incentive water allotments for the larger irrigation users (golf courses). Utilization of reclaimed water instead of groundwater or surface water may entitle the users to increase their allotted irrigation water uses.

- Credit towards State Groundwater Replenishment Act obligations. Most of Paradise Valley is currently supplied with groundwater. In order to meet the obligations of the Act, reliance on groundwater must be reduced and use of reclaimed water would count as credit towards the obligations.

- If the Town constructs its own water reclamation facility, it could provide facilities and programs to educate the public concerning water resources and conservation.

- If the Town constructs its own water reclamation facility, it could be designed for multi-purpose functions. For example, effluent storage lakes could be placed in park settings and be used for boating, fishing and other recreational purposes.

- Reduction of groundwater withdrawals would help reduce local groundwater overdraft which may still be leading to further land subsidence, and would assist regional efforts to achieve safe yield objectives and provide groundwater sustainability.

8.4 Options for Obtaining Value from Wastewater Resources

Since the current wastewater IGA with Scottsdale stipulates that ownership of the Town's wastewater reverts to Scottsdale once it enters their system, the stipulation would have to be negotiated out of the agreement before the Town would realize any benefit from its wastewater resource. In addition, any option for obtaining value for the wastewater resource would have to be negotiated into the IGA or other agreement with Scottsdale. The options that the Town has for obtaining value from its wastewater resource would generally include the following:

- Receive an offset or credit in the wastewater rate paid to Scottsdale for the value that the wastewater resource represents as a new water supply to Scottsdale. The Town could define the value of the additional water resource based on current costs for new water supplies in Arizona. The cost as a new water supply would not include the cost to convey a new water supply to Scottsdale since the new supply (reclaimed water) is already delivered to Scottsdale.

- Receive reclaimed water back from Scottsdale and sell to customers. The revenues from the sales could offset a portion of the wastewater treatment and disposal rate paid to Scottsdale. However, the Town would have to obtain all the regulatory approvals and permits required, establish and operate a new reclaimed water utility, and build and maintain the required infrastructure.

- Receive the water storage credits for reclaimed water recharged by Scottsdale at the Water Campus and sell the credits to local water suppliers (such as EPCOR, Berneil Water Company, Phoenix, and/or Scottsdale) or the Central Arizona Groundwater Replenishment District (CAGRD). The CAGRD is actively investigating procurement of unused groundwater recharge credits in the State. The revenues from sale of the recharge credits could offset a portion of the wastewater fees paid to Scottsdale.

9. Recommended Improvements

Based on the findings and conclusions reached and described in the preceding chapters, the types of wastewater system improvement recommendations are grouped as follows:

- Improvements that can be scheduled in a Wastewater CIP:
    - Drainage basin modifications – includes re-grading of existing pipes and new pipe to reconfigure drainage basins from a 13-meter to a 6-meter program to capture all Town flows.
    - Additional capacity in the Scottsdale system.
    - Upgrading existing pipes to serve future connections.
    - Rehabilitation of existing pipes that were found to have defects based on previous pipe inspections.
- Improvements that will allow service to future customer connections, but cannot be scheduled (i.e., Master Plan Additions to serve future septic and vacant parcel connections).

9.1 Near-Term and Long-Term Phasing Methodology

In the near term (in 2016), the Town expects to proceed with design and construction of the drainage basin and meter program modifications. Based on the assumption that construction of the 5-Star Development will begin in 2018 and maximum occupancy can be expected shortly thereafter, the Town will also be required to purchase additional Scottsdale system capacity in 2017. Based on guidance given for future septic and vacant parcel connections, the Town would require additional Scottsdale capacity in 2021.

Because no clear historical trends exist to guide the phasing of new sewer connections (septic and vacant parcels), system improvements that will be required as a result of new connections upstream of Basin 3 are projected on a flow, rather than a time basis. The analysis showed that the Town would need to upgrade existing 8-inch mains to 12-inch mains upstream of new Meter 3 once dry weather flow in new Basin 3 reaches 0.2 mgd. However, as noted previously, these same mains were also required to be

upgrade for basin modification purposes. In order to prevent making upgrades twice to the same pipe, the Town should make the 12-inch upgrade at the time the drainage basin modifications are made.

9.2 Basis of Capital Cost Opinions

The opinions of conceptual capital costs presented herein were based on available existing studies, recent projects with similar components, standard construction cost estimating manuals, and engineering judgment (**Table 9-1**).

The level of accuracy for the cost estimates corresponds to the Class 4 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International. This level of engineering cost estimating is approximate and is generally made without detailed engineering data and site layouts, but is appropriate for preliminary budget-level estimating. The accuracy of a Class 4 estimate is minus 15 to plus 20 percent in the best case and minus 30 percent to plus 50 percent in the worst case.

The unit costs include materials of construction, installation, contractor costs (overhead, profit, bonding, mobilization), and engineering. All costs include a 30 percent factor for engineering and construction administration, and a 30 percent factor for project consistencies. All costs were in February, 2015 dollars referenced to an Engineering News Record Construction Cost Index (ENR CCI) of 9962.

The unit cost of treatment capacity was derived from the Town's Wastewater Land Use Assumptions and Infrastructure Improvement Plan (Raeftelis, November 22, 2013).

Table 9-1 Basis of Unit Costs

Item	Unit Cost	Units	Base CCI	2015 CCI	Cost (Feb 2015)	Included in Unit Cost
PVC Pipe (inches)						
8	$110.47	$/LF	9681	9962	$113.67	8" PVC Sewer Pipe, SDR 26, Backfill
12	$127.40	$/LF	9681	9962	$131.10	12" PVC Sewer Pipe, SDR 26, Backfill
Wastewater Treatment Capacity						
	$11.57	$/gpd	-	-	$11.57	Wastewater treatment and conveyance to WWTP by Scottsdale

9.3 Recommended Rehabilitation and Replacement Program

As discussed in Section 3.6, a review of available collection system inspection reports was conducted to identify any rehabilitation and/or replacement projects that should be targeted in the Town's wastewater CIP. **Appendix D** contains the details of the review and analyses that were conducted. The analyses were performed for the 19.5 miles of pipe that were included in the inspection reports (out of estimated 69 miles in the entire system, or 28 percent). Of the 441 pipes inspected, just 54 pipes of the pipes were found to have structural defects and 202 pipes had O&M defects. No collapsed or partially collapsed pipes were found.

The following sections summarize the recommended repairs and improvements to the collection system and the associated costs for the inspected pipes to be completed over the next 5 years, as well as a recommended system inspection and rehabilitation and repair program for the next 10 years

9.3.1 Recommendations Based on Review of Pipe Inspection Records

Of the 54 pipes identified with structural defects, 21 are recommended for repairs including CIP pipe lining, CIP point repairs, and excavated spot repairs. In addition, 19 pipes are likely candidates for repair following another inspection to confirm current condition or to determine the best repair method. The remaining 14 pipes had insignificant structural defects and require no further action.

Of the 202 pipes identified with O&M defects, 75 are recommended for inspection and investigation to determine need for further action such as routine FOG or root control. Eleven pipes also had structural pipes and are recommended for repairs. The remaining 116 pipes had insignificant O&M defects and require no further action.

The estimated cost to execute the recommendations above is $290,000k, excluding follow-on work resulting from the re-inspections recommended above for pipes with questionable structural condition or requiring follow-up for potential O&M issues. Assuming that the conditions of, and repair recommendations for, the 19 additional pipes is consistent with those for the initial 21 pipes, then the additional cost to repair these pipes is estimated at $203,000. The total cost to perform the repairs and corrections to the previously inspected pipes is estimated at approximately $493,000. It is recommended that these inspections and repairs be completed within the next five years with an annual budget of $99,000.

9.3.2 Recommendations and Costs for Evaluating and Repairing the Balance of the System

The above inspections and recommendations account for 28 percent of the Town's system. Assuming that the rest of the system is of similar construction and condition, a rough projection can be made based on the analysis above to estimate the cost of implementing an inspection and rehabilitation program for the full system. It is recommended that the remainder of the system be inspected over a 5-year period and to identify repairs and improvements to be made to the system within 10 years of the start of the inspection program. The cost to inspect the remainder of the system (approximately 50 miles) in the first 5-year period is $326,000. Assuming that the pipe conditions and resulting repair recommendations are similar to the previously inspected pipes, the cost for repairs can be estimated at $1.25 million. Manholes were not included in the pipe inspection reports provided by the Town. It is recommended that manholes should follow a similar inspection and repair program. Based on experience with similar collection systems across the country, a failure rate for manholes of approximately half the rate found for the inspected pipes was assumed. The estimated cost for inspection and rehabilitation of manholes over a 5-year cycle is $245,000. These estimated costs total approximately $1.82 million over 10 years, or an annual budget of $182,000.

The inspection program will cover 20 percent of the system annually. Within the first 5 years the entire system will have been inspected and all pipes requiring repair identified. This annual inspection rate is aggressive but not uncommon and is recommended to avoid letting the system fall into further disrepair, which would result in greater expenditures in the future. The 10-year repair program will repair 3 percent of system annually, or 30 percent over 10 years. The inspection and repair rates and budgets can be reconsidered after the first inspection cycle (5 years) to determine if the program needs to be more or less aggressive.

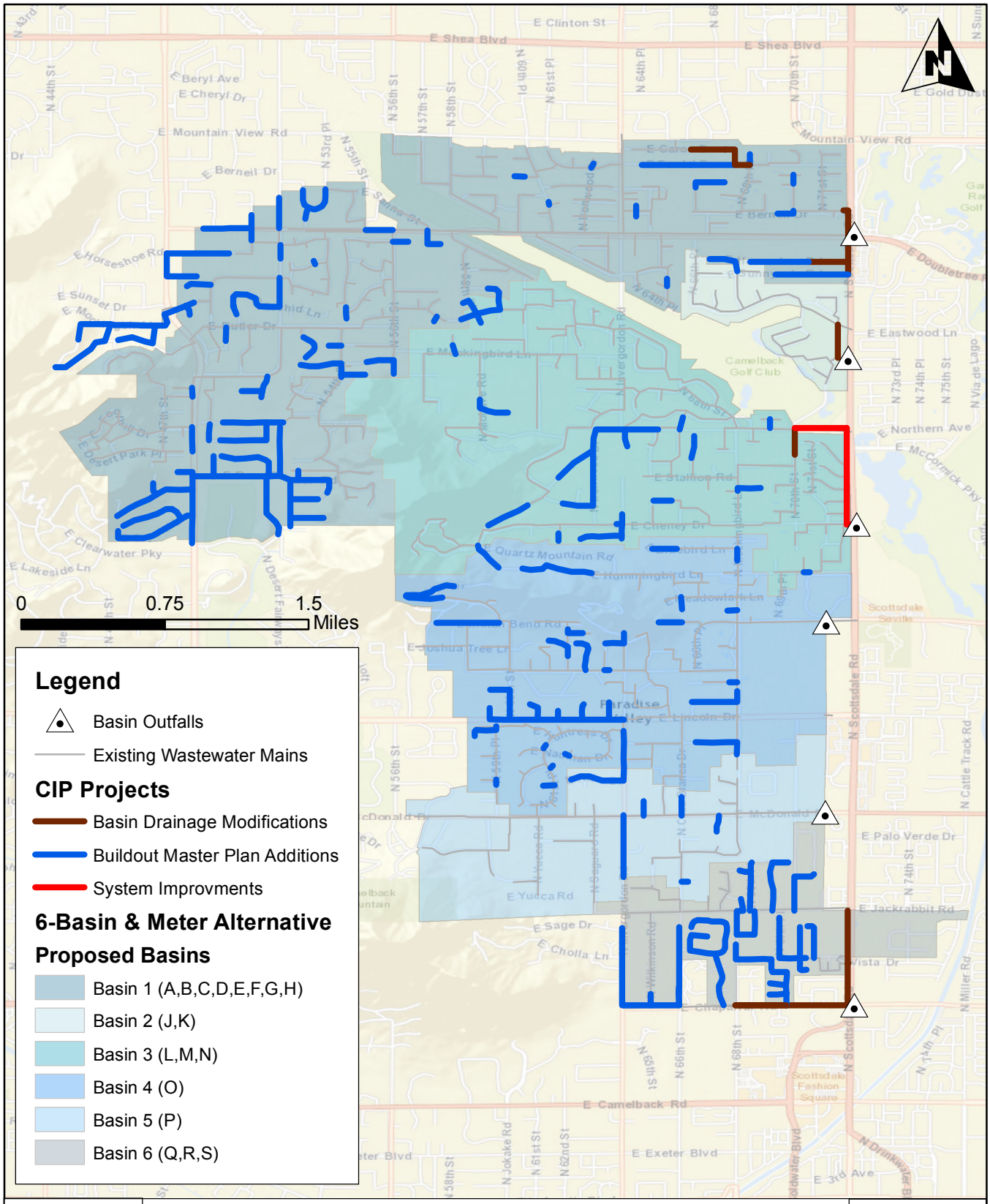
9.4 Recommended System Improvements that can be Scheduled

The recommended capital improvement projects that can be reliably scheduled are summarized in **Table 9-2**, including a timeline for the capital expenditures. The recommended improvements are also illustrated on **Figure 9-1**.

Table 9-2 Recommended Scheduling of Required Wastewater System Improvements

Type of Project	Opinion of Probable Construction Costs ($ million)										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Projected System Improvements											
Drainage Basin Modifications[1]	-	$2.77	-	-	-	-	-	-	-	-	$2.77
Additional Scottsdale Capacity	-	-	$6.71	-	-	$1.24	-	-	-	-	$7.95
Rehabilitation and Replacement Program											
Rehabilitation Based on Pipe Inspection Records	$0.099	$0.099	$0.099	$0.099	$0.099	-	-	-	-	-	$0.49
Evaluation and Repair of Balance of System	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$1.82
Grand Total[2]	**$0.28**	**$3.05**	**$6.99**	**$0.28**	**$0.28**	**$1.52**	**$0.18**	**$0.18**	**$0.18**	**$0.18**	**$13.03**

Note:
Includes new 12-inch pipe upstream of new Meter 3, instead of regarding of 8-inch pipe and new 8-inch pipe required for basin modifications. New 12-inch pipe will accommodate all anticipated new connections upstream of new Meter 3.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Recommended Capital Improvements

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FIGURE 9-1

9.5 Recommended System Improvements that cannot be Scheduled

The Master Plan Addition projects include a total of 24.3 additional miles of sewer mains. These additions are only needed if and when the existing parcels on septic systems and vacant parcels are connected to the system. **Appendix H** provides a detailed list and cost estimates for the individual system additions, and a map of the corresponding locations. **Table 9-3** presents a summary of the Master Plan Additions grouped according to the modified wastewater drainage basins (for reference, the existing drainage basins comprising the modified basins are also provided). The Town can implement these projects based on customer demand and/or the success of a public information program or Town encouragement to connect to the system.

Table 9-3 Summary of Master Plan Additions

Item	Amount	Total Cost
Basin 1 New 8-in Pipe for System Expansion *(Original Basins A, C, B, D, E, F, G, H, I)*	56,039 LF	$10,200,000
Basin 2 New 8-in Pipe for System Expansion *(Original Basins J & K)*	875 LF	$160,000
Basin 3 New 8-in Pipe for System Expansion *(Original Basins L, M, N)*	15,718 LF	$2,860,000
Basin 4 New 8-in Pipe for System Expansion *(Original Basin O)*	23,408 LF	$4,260,000
Basin 5 New 8-in Pipe for System Expansion *(Original Basin P)*	3,211 LF	$590,000
Basin 6 New 8-in Pipe for System Expansion *(Original Basins Q, R, S)*	25,979 LF	$4,730,000
TOTAL		**$22,780,000**

10. Recommendations for Transforming the Wastewater Utility

A good defense against regulatory intervention is a thorough understanding of all aspects of the collection system, a program for managing the system, thorough and detailed documentation, and good organization. The ability to access detailed information immediately demonstrates good practices. The drivers for improving processes are:

- Improve management, operation, and maintenance of the system,
- Identify and investigate capacity constrained areas of the collection system,
- Respond to, mitigate and reduce sanitary sewer overflow (SSO) events,
- Shift from a reactive mode to a proactive mode,
- Provide a high level of service to customers,
- Reduce regulatory noncompliance,
- Optimize use of human and material resource

The ideal situation would be to have answers at the ready when any question is asked by a regulator. However it takes time to reach that level of sophistication. It may seem difficult to achieve all of this as a whole but it can be taken in small steps by establishing performance goal targets that seem achievable and developing specific activities to meet the goals. The success of each activity is evaluated periodically by collecting information on current systems and activities as well as by monitoring management practices to determine if performance goals are met and whether overall system efficiency is improving. The activities can then be adjusted to better meet the performance goals and as improvements are seen, performance goals can change. For example, an initial goal may be to develop a GIS database of the system. Once the GIS is complete, a new goal might be to use the GIS to track emergency calls followed by a goal that could be to use the information collected to improve maintenance planning.

This section presents specific activities that the Town could begin implementing now to improve its wastewater utility. These are organized into several topical categories which approximate focus areas identified in the USEPA's Capacity, Management, Operations, and Maintenance (CMOM) guidance documents for regulatory compliance. The section ends by identifying the highest priority activities that the Town could focus on first. Many of the activities can be addressed initially by simply documenting practices or processes that have been in place informally and then ensuring that they

are followed in the future. As the Town progresses in its improvements, many of these topics can be revisited in more depth to further improve and refine them, each step bringing the Town incrementally closer to achieving the big picture goals described above.

10.1 Current Practices

Current collection system management, operation and maintenance practices were identified through a workshop conducted on October 1, 2014 with staff from the Town and Scottsdale. The key points from the workshop which drive the recommendations that follow include the following:

- It was found that there is no CIP budget for collection system improvements.
- There is no budget allocation for collection system maintenance activities. Scottsdale proactively cleans the system on a routine basis.
- Inspection and repair activities by the Town are largely reactive in response to customer reports or potential issues identified during cleaning operations.
- Town staff dedicates approximately 25 to 30 percent of one full-time-equivalent effort to collection system related activities. Most of that effort is by a senior engineering technician.
- It is apparent that the Town has not had major issues with the system and the senior engineering technician has a fair sense of the system.
- Complete historical records and documentation of plans and procedures seem to be lacking, although Scottsdale is implementing the Virtual Call Center (VCC), a complaint and response tracking system which the Town also utilizes.
- Until the Town has established plans and procedures and a thorough and reliable recording-keeping system, much of the institutional knowledge about the system and its operation will be lost upon the retirement or other departure of the senior engineering technician from the organization which would pose a significant challenge for the Town.

10.2 Overflows and Capacity Assurance

The most critical function of the collection system is to convey the wastewater to the treatment plant without endangering the environment or public health. This means keeping the waste in the pipe. There are two fundamental mechanisms by which the system could fail to achieve this and result in and overflow from a manhole or backup

into a house: 1) some obstruction in the pipe stops flow, or 2) the hydraulic capacity of some portion of the system is exceeded, resulting in excess flow escaping the system. Upon initiating a review of a utility's practices and performance, the first thing a regulator is likely to inquire about is frequency of overflows and the process for assuring adequate capacity.

The first issue is addressed simply by adequate record keeping and performing root-cause investigation and analysis when overflows are experienced. It is also advisable to write and follow an overflow emergency response plan. Some good initial activities will be to establish the annual frequency of overflows as well as an overflow emergency response plan. A follow-on goal would be to implement a plan for performing root-cause investigation and analysis for future overflows. Another subsequent goal would be to reduce overflows to a manageable percentage of the initial value.

Capacity assurance is more challenging because it involves the development and adequate updating of a hydraulic capacity model. Fortunately the first part of this goal has been met through the master planning efforts described in the preceding sections, the Town should keep the model updated to keep pace with system expansions and new development.

10.3 Maintenance and Customer Service

Proper maintenance of the collection system is critical to preventing overflows and customer complaints. Initial activities that will promote better maintenance practices will be written plans and documentation of: the pre-treatment program (if required); collection system inspection and cleaning; and public services, relations and complaint response. In time it will be important to develop programs to mitigate or manage any chronic issues found such as: roots; hydrogen sulfide corrosion; debris buildup; and fats, oils, and grease (FOG). Ultimately the development of a Management Information System to document all maintenance activities and customer interactions will be critical to the success of a good maintenance program. This should be an electronic system and could be as simple as a well-designed Microsoft Excel spreadsheet or Microsoft Access database. Ideally it would be linked to the GIS for easy mapping and analysis. This will require the establishment of unique and unchanging identifiers for each pipe and manhole so that data can easily be linked to the GIS. This will greatly improve the Town's ability to analyze data and trends over time. Also, a procedure should be established for updating/correcting GIS information routinely based on new data from field investigations, inspections, construction, and rehabilitation.

10.4 Budgeting

It is important to establish a Capital Improvement Plan as well as an annual maintenance budget. The CIP is already in development based on the results of this Wastewater Master Plan. A maintenance budget is often subdivided into three areas: preventive maintenance, corrective maintenance, and emergency maintenance; however, the Town's maintenance budget may be small enough not to warrant this granularity, but each type should be considered when setting the budget. The sewer fee structure should be reviewed and adjusted on a periodic basis to ensure it continues to meet current and future needs.

10.5 Design and Construction

The policies already in place regarding design and construction of new sewers and sewer rehabilitation should be documented in writing. These include: design requirements; design review and permitting process; and construction inspection, testing requirements and acceptance procedures for new and rehabilitated sewers, such CCTV inspection and vacuum testing for manholes.

10.6 Organization

The Town's public works organization is small enough that this area is a simple one and of lower priority than the others. Eventual activities that should be done are updating the safety program to ensure it addresses all collection system related topics such as: confined space entry; traffic control; personal protective equipment; and Material Safety Data Sheets. The training plan should likewise be updated to ensure it adequately addresses the following topics as they relate to the collection system: communication; customer relations; record keeping; and plans and policies. Many of these topics could initially be addressed by references to the various plans mentioned throughout these recommendations.

10.7 Initial Steps

The following summarizes the initial activities the Town can undertake almost immediately:

- Develop a hydraulic model to assess capacity. This action has been completed. However, there are two additional steps that should be taken to increase the usefulness of the hydraulic model:

  - The GIS portion of the model should continue to be verified and improved.
  - The hydraulic model itself should be updated frequently (annually at a minimum) to add new connections and new developments over the previous year. The pace of the upgrades can be tailored to match the pace of development.

- Develop a CIP for wastewater system improvements, based on the results of this Wastewater Master Plan.
- Establish unique and unchanging asset identifiers for each manhole and pipe in the system, as part of improving the system GIS.
- Document or refine existing programs, plans, policies and procedures:
  - Training Plan
  - Safety Plan
  - Public Services and Relations Plan including Complaint Response
  - Design Requirements
  - Construction Requirements

The Town is currently negotiating a new IGA with Scottsdale for wastewater services and desires to include a formal agreement for collection system O&M services. The following topics and activities should be addressed in the new O&M agreement:

- SSOs: first determine the frequency, and then develop a plan for SSO root-cause investigation and analysis.
- Maintenance budget: first establish an annual budget, and then periodically re-evaluate the budget and the rate structure that supports it.
- Cleaning: first establish a cleaning frequency for pipes and manholes, and then develop a cleaning plan.
- Inspection: first establish an inspection frequency for pipes and manholes, and then develop an inspection plan.
- Establish a Management Information System (MIS) that is linked to the wastewater system GIS.
- Develop the following programs or document or refine existing ones:
  - Pre-treatment Program
  - Emergency Overflow Response
  - Complaint Response and Customer Service

Appendix A

Drainage Basin Modifications

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Imagine the result

Wastewater Planning Services

Technical Memorandum

Task 1.5 Assess Potential for Modifying Drainage Basins and Meter Locations

March, 2015

Timothy Francis, P.E.
Principal Environmental Engineer

Venkat Radhakrishnan
Project Engineer

Technical Memorandum

Assess Potential for Modifying Drainage Basins and Meter Locations

Prepared for:
Town of Paradise Valley

Prepared by:
ARCADIS U.S., Inc.
410 N. 44th Street
Suite 1000
Phoenix
Arizona 85008
Tel 602 438 0883
Fax 602 438 0102

Our Ref.:
00776004.0001

Date:
March, 2015

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A Basin Evaluations

B Detailed Cost Estimates for Drainage Basin Alternatives

Acronyms and Abbreviations

IGA	Intergovernmental Agreement
SROG	Sub-Regional Operating Group
WWTP	Wastewater Treatment Plant
GIS	Geographic Information System
AACE	Association for the Advancement of Cost Engineering
ENR CCI	Engineering News Record Construction Cost Index

1. Introduction

Wastewater treatment and disposal services within the Town of Paradise Valley (Town) service area are provided by the City of Scottsdale. The continuity and conditions of these services are ensured through an Intergovernmental Agreement (IGA) between the Town and Scottsdale. Under the IGA, the status of the Town's capacity ownership is tracked based on wastewater flow monitoring in 13 of the 19 sewer basins draining the Town's service area. In the 6 unmetered basins, flows are calculated based on measured flow per dwelling unit for the largest metered drainage basins.

The Town and Scottsdale have indicated a desire to base all implement 100 percent metering of wastewater flows from the Town's service area that is discharged to the Scottsdale system. The purpose of this task was to assess the current drainage basin configuration and to identify alternatives for modifying drainage basins and meter locations to achieve 100 percent metering of the Town's entire collection system.

2. Methodology

This section describes the process used for reviewing existing meter locations and drainage basin configurations; evaluating unmetered basins; and proposing alternative configurations which could help the Town achieve 100 percent metering of its service area.

2.1 Review of Existing Meter Locations

All existing meter locations were reviewed to confirm that they capture all flows from their designated drainage basins. Using the Town's GIS data, supplemented with GIS data provided by the City of Scottsdale, and as-built data made available via the Town's EMS Viewer, general sewer flow paths were established with the goal of determining flow directions and basin connectivity. Where the existing basin delineations were found to be incorrect, revisions to the drainage basin boundaries were made.

2.2 Evaluation of Unmetered Basins

Using the GIS and as-built data, the Town's 6 unmetered basins were evaluated to determine how they can be included in the metering program to achieve 100 percent coverage. Multiple options were explored, including combining unmetered basins,

connecting metered basins, and identifying suitable locations for installation of new meters.

2.3 Evaluation of Alternative Configurations

Based on updated GIS, as-builts, and elevation data, alternative basin configurations were evaluated. The objective of this task was to find alternatives that will provide 100 percent meter coverage for the entire collection area with the same or fewer meter locations. Three alternatives are developed:

- Alternative A, requiring minimal infrastructure changes, achieves 100 percent metering of the Town's wastewater service area using the existing number of meters.
- Alternative B, involving a greater amount of infrastructure changes, achieves 100 percent metering with 6 drainage basins monitored by 6 meters.
- Alternative C requires the greatest amount of construction but achieves 100 percent metering with 2 flow meters.

3. Review of Existing Meter Locations and Coverages

Existing meter locations and basin configurations were analyzed to evaluate whether meters are capturing all flows from their designated drainage basins. The delineation of each of the 13 metered basins was analyzed to determine whether it conformed to the meter location, layout of the sewer mains, and invert elevation data.

Figure 3-1 presents the existing basin delineation, as presented by the Town to ARCADIS as of July 2014. The Town's service area is subdivided into 19 sewer drainage basins. Basins A-H discharge into a 30" line running West to East along East Doubletree Ranch Road. City of Phoenix flows enter the line around 56th Street and combine with Paradise Valley flows. The Doubletree Ranch Road main conveys these combined flows to a lift station, where Paradise Valley, City of Phoenix, and Scottsdale flows are combined and pumped north to the Scottsdale Water Campus. Basins I-O discharge into the Scottsdale-operated sewer main running south along Scottsdale Road until Indian Bend Road, at which point flows are conveyed east to the main running south along Hayden Road. The Hayden Road line conveys all incoming flows to the 91st Avenue Wastewater Treatment Plant via the SROG interceptor. Basins P, Q, R, and S flow to Scottsdale Road, falling into the SROG-bound collector line further south, and joining Basin I-O flows on their way to the 91st Avenue WWTP.

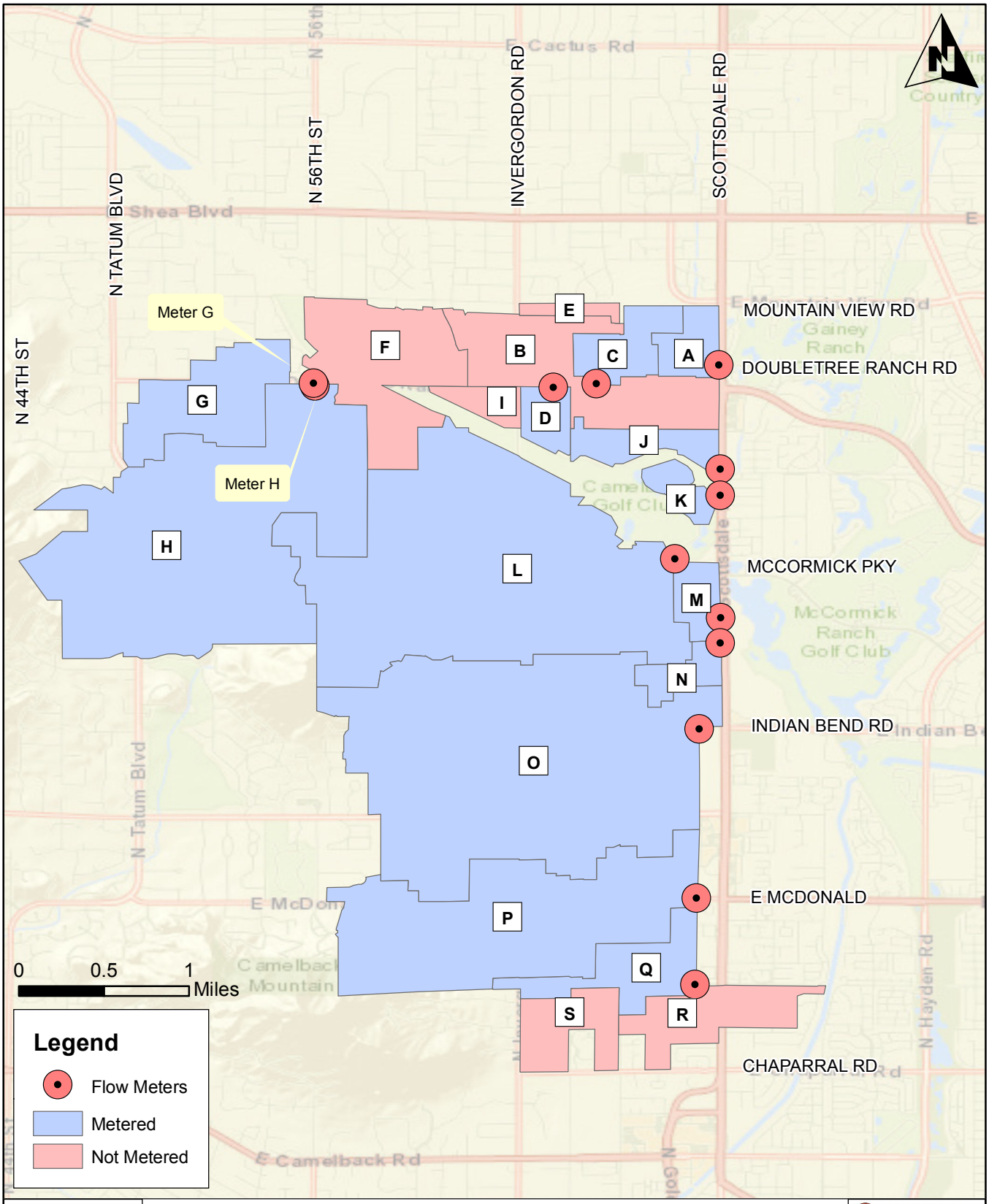
The analysis revealed that some basin delineations did not conform to known manhole invert elevations and pipe layouts. Figure 3-2 shows the amended delineation superimposed on the original, and the location of existing meters. Hatched areas represent modifications made to the original sewer basin boundaries.

Table 3-1 presents a summary of updated parcels counts. As shown in the figure and table, parcels are added to Basins A, J, F, L, N, and Q, and subtracted from Basins C, B, D, F, G, H, and P according to the amended delineations.

Table 3-1 Updated Drainage Basin Summary

Basin	Metered?	Drainage Direction	Parcels in Revised Basin Drainage Area			
			Total Revised (Original)	Sewer Revised (Original)	Septic Revised	Vacant Revised
A	☑	North	75 (70)	67 (63)	7	1
B	-	North	314 (280)	199 (153)	104	11
C	☑	North	95 (100)	68 (72)	25	2
D	☑	North	40 (45)	37 (41)	3	0
E	-	North	21 (21)	19 (19)	2	0
F	-	North	276 (256)	182 (177)	92	2
G	☑	North	140 (188)	62 (83)	74	4
H	☑	North	745 (761)	387 (392)	323	35
I	-	North	0 (36)	0(36)	0	0
J	☑	South	94 (73)	75 (67)	18	1
K	☑	South	37 (37)	36 (36)	1	0
L	☑	South	754 (733)	447 (448)	245	62
M	☑	South	82 (82)	74 (74)	7	1
N	☑	South	69 (60)	45 (37)	21	3
O	☑	South	810 (810)	307 (307)	321	182
P	☑	South	328 (342)	152 (152)	146	30
Q	☑	South	152 (138)	20 (20)	121	11
R	-	South	171 (171)	29 (29)	140	2
S	-	South	92 (92)	13 (13)	77	2
		Totals	**4,295 (4,295)**	**2,219 (2,219)**	**1,727**	**349**

Appendix A provides the detailed descriptions of the amended basin boundaries and the rationale behind the revisions.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Existing Sewer Basin Configurations and Meter Locations

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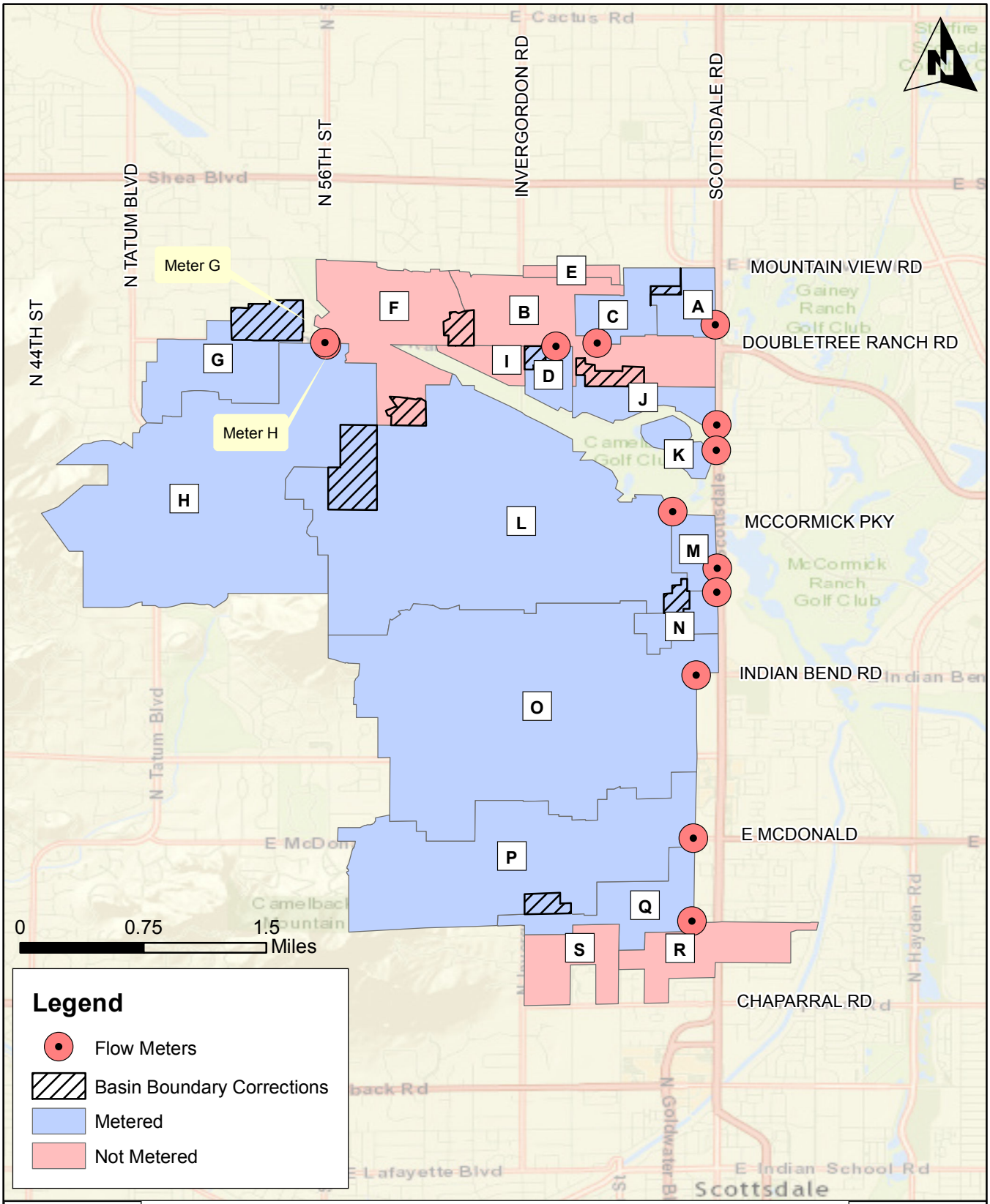
FIGURE 3-1



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Amended Sewer Basin Configurations

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FIGURE 3-2

4. Evaluation of Alternative Configurations

In keeping with the Town's desire to provide 100 percent coverage of its service area by meters, three alternatives are proposed:

1. Alternative A uses the existing number of meters to achieve this goal. Of the Town's 13 existing meters, 11 would remain in place, and 2 would be relocated.
2. Alternative B uses 6 meters, of which 4 existing meters remain in place, and 2 are relocated.
3. Alternative C reduces the number of drainage basins and meters to 2. All north-bound flows are metered upstream of the intersection of the East Doubletree Ranch Road line and the pipe carrying flows to the Scottsdale Water Campus via a lift station. A parallel pipe collecting all south-bound flows is proposed to run south along Scottsdale Road and connect to the SROG interceptor via Chaparral Road and North Hayden Road.

Metering the entirety of Paradise Valley flows using 1 meter would necessitate building a parallel collection pipe that would have to be sized to accommodate City of Phoenix flows, because Paradise Valley flows also enter the main that conveys Phoenix flows along Doubletree Ranch Road. Thus, alternatives of fewer than 2 meters are not proposed.

In all three cases, 100 percent coverage is achieved through a combination of basin merges, meter relocations, and changes to sewer network connectivity via pipe re-grading and new construction. Each alternative is described in the sections below.

4.1 Alternative A: Use Existing Meters

The following steps were used to achieve full metering of the Paradise Valley sewer system area using the existing number of meters:

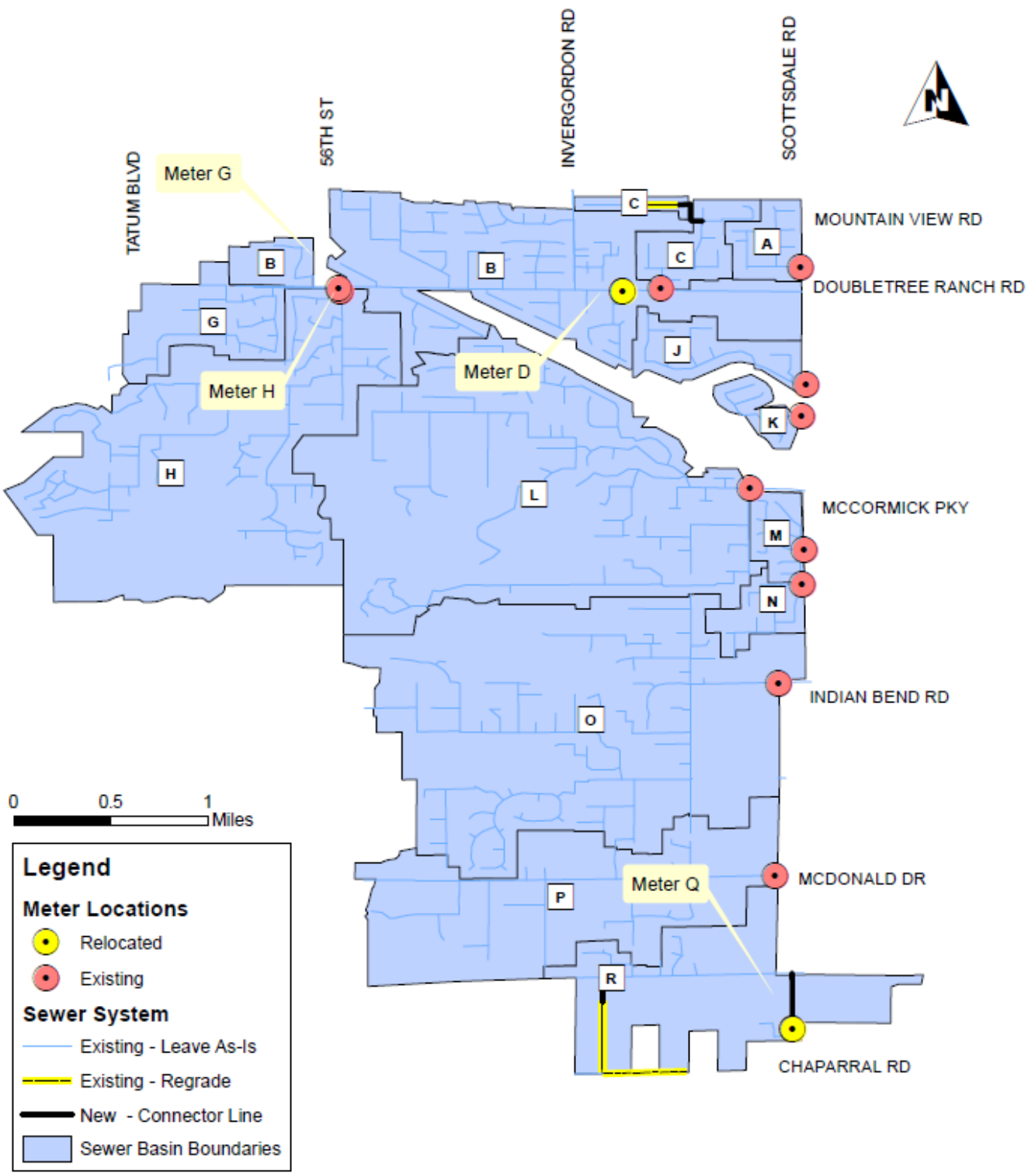
1. Relocating meters from basins which have been merged with one or more other metered basins.
2. Re-grading pipes to connect unmetered sections of the Town's service area to existing or relocated meters.

3. Connecting pipes (laying new pipe) to capture more flow using existing or relocated meters.
4. Changing basin boundaries to conform to known GIS data and/or proposed connectivity via re-grading and installation of new pipes.

Table 4-1 provides a summary of recommendations falling under each of the 4 methods and the rationale for the proposed modifications. Figure 4-1 displays the sewer basin boundaries which would result from these changes, as well as changes to pipes and meter locations.

Table 4-1 Summary of Requirements – Alternative A

Recommendation	Description	Rationale
Relocate meters (2 total)	Relocate **Meter D** from the outflow of metered Basin D to outflow of unmetered Basin B.	Relocating Meter D will capture upstream flow from basins, and meter 3 unmetered basins (B,I,F).
	Relocate **Meter Q** from the outflow of metered Basin Q to outflow of unmetered Basin S.	Once Basins S & Q connect to Basin R, relocating Meter Q will meter 2 unmetered basins (R&S).
Re-grade 8" pipe (1.08 miles total)	0.29 mile length of **Basin E**, along East Caron Drive to East Mountain View Road and East Caron Drive to North 68th Street.	Re-grading pipe will connect unmetered Basin E to flow into metered Basin C.
	0.79 mile length of **Basin S**, along Chaparral Road and Wilkinson Road.	Re-grading pipe will connect unmetered Basin S to flow into metered Basin Q.
Lay 8" pipe (0.69 miles total)	0.14 miles of **Basin E** pipe along E Caron Drive to N 68th Street, and N 68th Street to N 68th Place	Laying new pipe will connect unmetered Basin E to flow into metered Basin C.
	0.04 mile length of **Basin S** along 68th Street.	Laying new pipe will connect unmetered Basin S to flow into metered Basin Q.
	0.51 mile length of **Basin R** parallel to Scottsdale Road b/w Jackrabbit Road and Chaparral Road.	Laying new pipe will connect Basins Q, S, and R to the meter re-located at Basin R outlet.
Change basin boundaries	Basin delineations will be updated based on known manhole invert elevations and re-grading/pipe connections	Refer to Figure 4-1 for existing basin delineations overlaid on proposed delineations based on Alternative A.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Proposed Sewer Drainage Basin Configuration
Alternative A - 100% Metering, 13 Meters

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FIGURE 4-1

4.2 Alternative B: Use 6 Meters

To achieve full coverage of the Paradise Valley sewer system area using 6 meters, the same 4 primary methods were used:

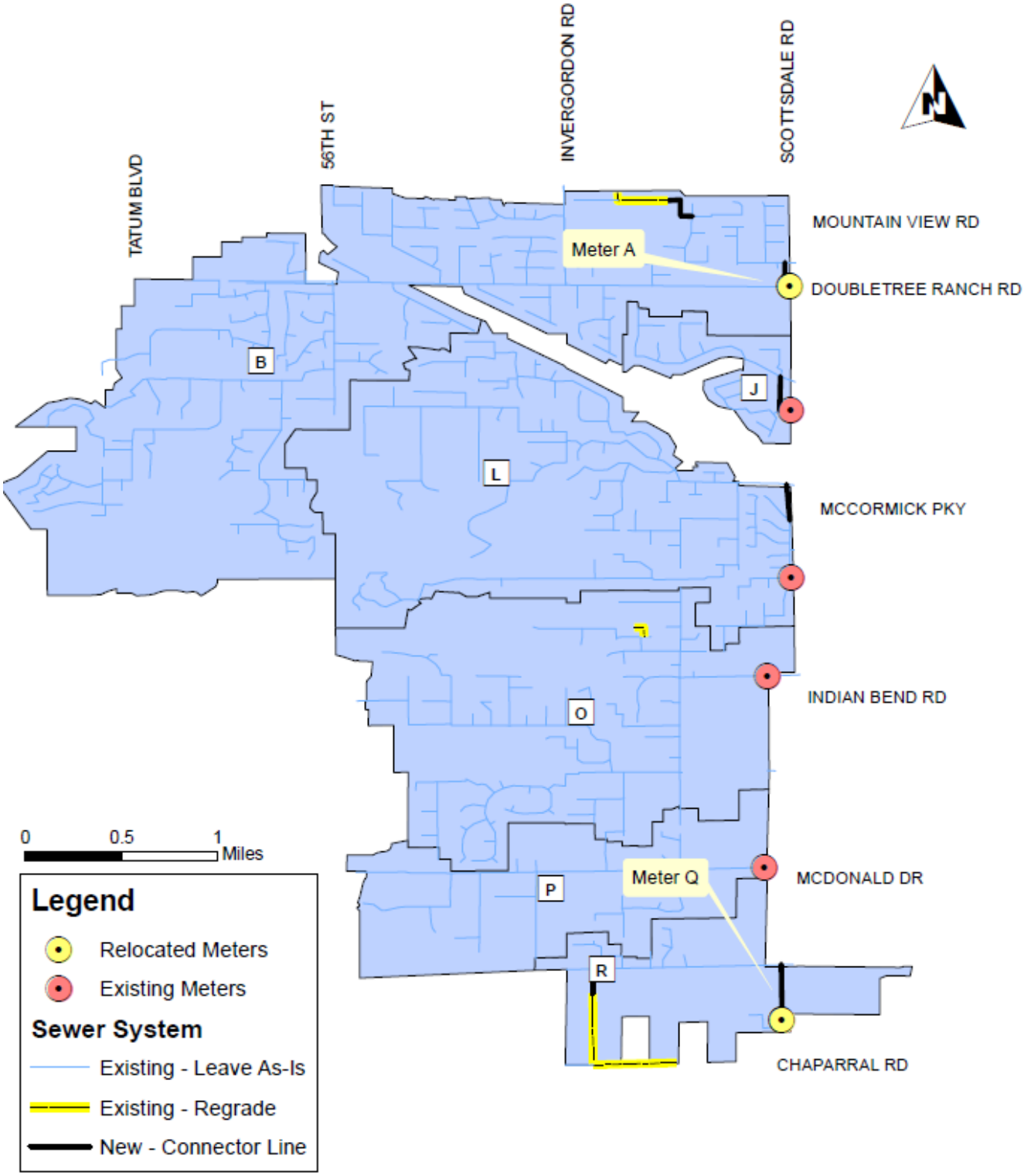
1. Relocating meters from basins which have been merged with one or more other metered basins.
2. Re-grading pipes to connect unmetered sections of the service area to existing or relocated meters.
3. Connecting pipes (laying new pipe) to capture more flow using existing or relocated meters.
4. Changing basin boundaries to conform to known GIS data and/or proposed connectivity via re-grading and installation of new pipes.

Table 4-2 provides a summary of recommendations falling under each of the 4 methods and the rationale for the proposed modifications. Figure 4-2 displays the sewer basin boundaries which would result from these changes, as well as changes to pipes and meter locations.

Table 4-2 Summary of Requirements – Alternative B

Recommendation	Description	Rationale
Relocate meters (2 total)	Relocate **Meter D** from the outflow of metered Basin D to outflow of unmetered Basin B.	Relocating Meter D will capture upstream flow from basins, and meter 3 unmetered basins (B,I,F).
	Relocate **Meter Q** from the outflow of metered Basin Q to outflow of unmetered Basin S.	Once Basins S & Q connect to Basin R, relocating Meter Q will meter 2 unmetered basins (R&S).
Re-grade 8" pipe (1.08 miles total)	0.29 mile length of **Basin E**, along East Caron Drive to East Mountain View Road and East Caron Drive to North 68th Street.	Re-grading pipe will connect unmetered Basin E to flow into metered Basin C.
	0.79 mile length of **Basin S**, along Chaparral Road and Wilkinson Road.	Re-grading pipe will connect unmetered Basin S to flow into metered Basin Q.
Lay 8" pipe (1.05 miles total)	0.14 miles of **Basin E** pipe along E Caron Drive to N 68th Street, and N 68th Street to N 68th Place	Laying new pipe will connect unmetered Basin E to flow into metered Basin C.
	0.04 mile length of **Basin S** along 68th Street.	Laying new pipe will connect unmetered Basin S to flow into

Recommendation	Description	Rationale
		metered Basin Q.
	0.51 mile length of **Basin R** parallel to Scottsdale Road b/w Jackrabbit Rd & Chaparral Rd.	Laying new pipe will connect Basins Q, S, and R to the meter re-located at Basin R outlet.
	0.17 mile length of **Basin J** parallel to Scottsdale Road.	Pipe will connect metered J and K to eliminate 1 meter.
	0.19 mile length of **Basin M** parallel to Scottsdale Road.	Pipe will connect metered Basins L, M, and N to eliminate 2 meters.
Change basin boundaries	Basin delineations will be updated based on known manhole invert elevations and re-grading/pipe connections	Refer to Figure 4-2 for existing basin delineations overlaid on proposed delineations based on Alternative B.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN
Proposed Sewer Drainage Basin Configuration
Alternative B - 100% Metering, 6 Meters

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FIGURE 4-2

4.3 Alternative C: Use 2 Meters

To achieve full coverage of the Paradise Valley sewer system area using 2 meters, the same 4 primary methods are recommended:

1. Relocating meters from basins which have been merged with one or more other metered basins.
2. Re-grading pipes to connect unmetered sections of the Town's service area to existing or relocated meters.
3. Connecting pipes (laying new pipe) to capture more flow using existing or relocated meters.
4. Changing basin boundaries to conform to known GIS data and/or proposed connectivity via re-grading and installation of new pipes.

The primary difference between Alternative C and the previous two alternatives is the extent to which basins are merged and the length of pipe requiring re-grading or installation. The construction associated with a 2-meter program is significantly greater than that required for 13-meter or 6-meter programs that capture 100 percent of Paradise Valley flows.

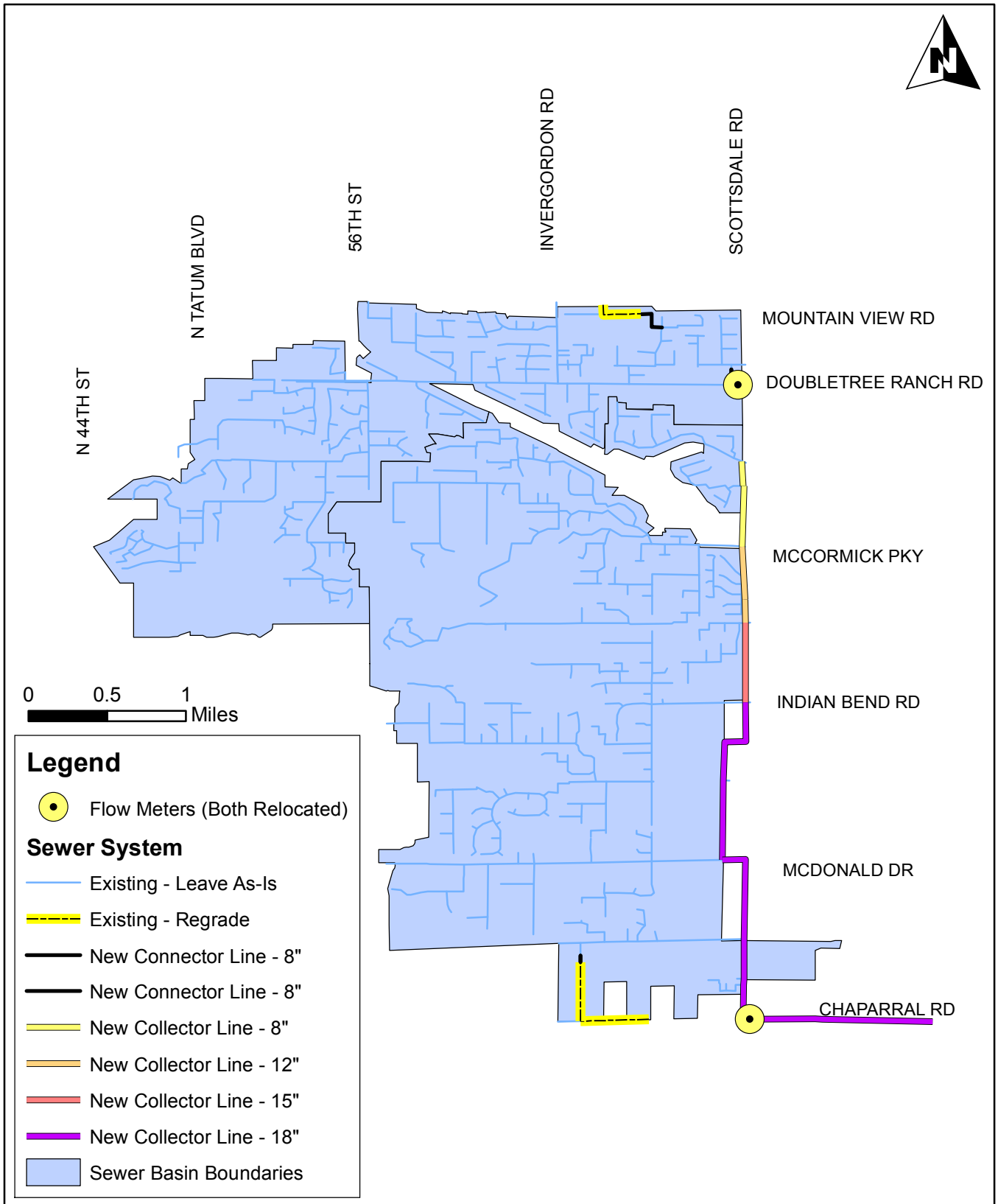
The new pipes for this alternative have been sized theoretically using the observed peak wet weather flow and an assumed pipe slope (1%). These will be refined later in the project using hydraulic modeling.

Table 4-3 provides a summary of recommendations falling under each of the 4 methods and the rationale for the proposed modifications. Figure 4-3 displays the sewer basin boundaries which would result from these changes, as well as changes to pipes and meter locations.

Table 4-3 Summary of Requirements – Alternative C

Recommendation	Description	Rationale
Relocate meters (2 total)	Relocate **Meter A** from the outflow of metered Basin A to outflow of Doubletree Ranch Road into the line carrying flow to Scottsdale Water Campus.	Relocating Meter A will capture all north-bound flows and include Basins A, B, C, D, E, F, G, H, and I in the metering program with no need to subtract upstream flows.
	Relocate **Meter Q** from the outflow of metered Basin Q to outflow of unmetered Basin S.	Once Basins S & Q connect to Basin R, relocating Meter Q will meter 2 unmetered basins (R&S).

Recommendation	Description	Rationale
Re-grade 8" pipe (1.08 miles total)	0.29 mile length of **Basin E**, along East Caron Drive to East Mountain View Road and East Caron Drive to North 68th Street.	Re-grading pipe will connect unmetered Basin E to flow into metered Basin C.
	0.79 mile length of **Basin S**, along Chaparral Road and Wilkinson Road.	Re-grading pipe will connect unmetered Basin S to flow into metered Basin Q.
Lay 8" connector pipe (0.79 miles total)	0.14 miles of **Basin E** pipe along E Caron Drive to N 68th Street, and N 68th Street to N 68th Place	Laying new pipe will connect unmetered Basin E to flow into metered Basin C.
	0.04 mile length of **Basin S** along 68th Street.	Laying new pipe will connect unmetered Basin S to flow into metered Basin Q.
	0.51 mile length of **Basin R** parallel to Scottsdale Road b/w Jackrabbit Road and Chaparral Road.	Laying new pipe will connect Basins Q, S, and R to the meter re-located at Basin R outlet.
	0.10 mile length of **Basin A** parallel to Scottsdale Road	Pipe will connect Basin A to all remaining north-bound flow.
Lay new 8" collector line	0.87 mile length parallel to Scottsdale Road, collecting Basin J flow, b/w **Basins J** & **K**	Laying a new collector line will capture all south-bound flows and transport them southwest to the SROG interceptor line, to be metered at the outlet.
Lay new 12" collector line	0.48 mile length parallel to Scottsdale Road, collecting Basin J, K, L & M flow, b/w **Basins K** & **N**	
Lay new 15" collector line	0.50 mile length parallel to Scottsdale Road, collecting Basin J, K, L, M, & N flow, b/w **Basins N** & **O**	
Lay new 18" collector line	1.11 mile length parallel to Scottsdale Road and Chaparral to Hayden Road, collecting Basin J, K, L, M, N, O, P, Q, R & S flow, b/w **Basins O** & **S**	
Change basin boundaries	Basin delineations updated based on manhole inverts and re-grading/pipe connections	Refer to Figure 4-3 for existing basin delineations overlaid on proposed delineations based on Alternative B.



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER MASTER PLAN

Proposed Sewer Drainage Basin Configuration
Alternative C - 100% Metering, 2 Meters

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FIGURE 4-3

5. Conceptual Cost Opinions

Opinions of conceptual costs were developed to assist the Town in making a decision on the appropriate alternative to achieve 100 percent metering of the Town's sewer flows.

The opinions of conceptual capital costs presented herein were based on available existing studies, recent projects with similar components, standard construction cost estimating manuals, and engineering judgment.

The level of accuracy for the cost estimates corresponds to the Class 4 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International. This level of engineering cost estimating is approximate and is generally made without detailed engineering data and site layouts, but is appropriate for preliminary budget-level estimating. The accuracy of a Class 4 estimate is minus 15 to plus 20 percent in the best case and minus 30 percent to plus 50 percent in the worst case.

The unit costs include materials of construction, installation, contractor costs (overhead, profit, bonding, mobilization), and engineering. All costs include a 30 percent factor for engineering and construction administration, and a 30 percent factor for project contingencies. All costs were in September 2014 dollars referenced to an Engineering News Record Construction Cost Index (ENR CCI) of 9870.

The primary difference between the first and second alternatives is the extent to which basins are merged and the length of pipe requiring re-grading or installation. Because the construction associated with Alternative A (13-meter program) is not significantly greater than that required for Alternative B (6-meter program) that captures 100 percent of Paradise Valley flows, the costs of the two alternatives are relatively similar. By contrast, the cost of Alternative C is notably greater than that of Alternatives A or B.

Table 5-1 summarizes the conceptual cost opinions for the three drainage basin alternatives. A detailed breakdown of cost estimates is presented in Appendix B. All cost estimates are rounded up to the nearest $1,000.

Table 5-1 Summary of Conceptual Capital Cost Opinions

Alt.	Summary of Upgrades	Construction	Eng & Admin	Contingency	Total
A	9,346 LF 8” PVC pipe	$1,314,000	$395,000	$513,000	$2,222,000
B	11,246 LF 8” PVC pipe	$1,580,000	$474,000	$617,000	$2,671,000
C	14,467 LF 8” PVC pipe 2,534 LF 12” PVC pipe 2,640 LF 15” PVC pipe 5,861 LF 18” PVC pipe	$4,967,000	$1,491,000	$1,938,000	$8,396,000

Technical Memorendum

Assess Potential for
Modifying Drainge Basins
and Meter Locations

Attachment A

Basin Evaluations

1. Evaluation of Drainage Basins

1.1 Basin A

The meter in Basin A is capturing all flows from its designated collection area. Sewer mains within the basin are hydraulically connected. All flows collect and drain to the southwest, where they are metered before entering the main running along North Scottsdale Road. However, currently, the delineation of Basin A does not capture 5 parcels from neighboring Basin C, which enter Basin A in the northeast. 4 of the 5 parcels are connected to the sewer system. The wastewater flow from the remaining parcel is treated by a septic system. Flow from these parcels is metered at Meter A, and thus, should be included within the area of Basin A. Figure A-1 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).

1.2 Basin B

Basin B is the second-largest of the Town's 6 unmetered basins. In addition to flows from within its own drainage area, Basin B currently captures a portion of flows from metered Basin D and unmetered Basin F. 25 Basin F parcels, all connected to the sewer system, discharge to Basin B. Basin B captures flow from 5 parcels in Basin D, 4 of which are connected to the sewer system and 1 which is on septic. In the southeast, Basin B contributes some flow to Basin J from 21 parcels (8 connected to sewer; 13 currently on septic). Although Basin B is currently not metered, all flows collect centrally at a single manhole which discharges to the main flowing west-to-east along East Doubletree Ranch Road. Figure A-2 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).

1.3 Basin C

Flow within Basin C collects in the southwest, is captured by the meter at the outlet, and discharges into the main along East Doubletree Ranch Road. The Town's GIS data show a gap between the sewer network adjoining the meter at the basin outlet, and the remainder of the system upstream. Using EMS Viewer, this has been confirmed to be an error. In reality, the basin is fully hydraulically connected. As discussed previously in Section 3.1.1, the delineation of Basin C incorrectly includes 5 parcels (4 connected to sewer, 1 septic) which are metered at Meter A, and thus, should be included within the area of Basin A. Figure A-3 shows the original basin delineation and the revised subtraction of parcels from Basin C to Basin A (hatched) which comprises the edited delineation (outlined in black).

1.4 Basin D

Flow within Basin D flows south-to-north and is metered before it is discharged into the main running east-to-west along East Doubletree Ranch Road. The northeastern portion of Basin D connects to a sewer line which flows into Basin B and bypasses Meter D. Consequently, these 5 parcels (4 sewer and 1 septic) belong within the bounds of Basin B. Figure A-4 shows the original basin delineation and the revised subtraction of parcels from Basin D to Basin B (hatched) which comprises the edited delineation (outlined in black).

1.5 Basin E

Basin E is the smallest of the 6 unmetered basins, located in the north of the Town's service area. Basin E consists of 21 parcels, all connected to the sewer system. Flow in Basin E collects east-to-west and west-to-east along East Caron Drive, and drains into a main running along East Mountain View Road via a short south-to-north connector line. All parcels within Basin E are hydraulically connected and distinct from sewer sections flowing into other basins. Figure A-5 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).

1.6 Basin F

Basin F is the largest unmetered sewer within the Paradise Valley service area. In addition to its own flows, Basin F also captures flows from the northern portion of metered Basin G. Basin F contributes flows to unmetered Basin B and metered Basin L. Flows within Basin F collect and discharge to the main running west-to-east along East Doubletree Ranch Road. Figure A-6 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).48 parcels (21 connected to sewer, 27 septic) from the north segment of metered Basin G currently contribute flow into unmetered Basin F and should be included within the Basin F boundary. In the southeast, 14 parcels currently considered to fall within Basin F actually flow into metered Basin L. Of these 14, 2 are connected to the sewer system and 12 are on septic. Finally, in the eastern portion of Basin F, 25 parcels currently contribute flow to unmetered Basin B. All 25 parcels are connected to the sewer system.

1.7 Basin G

Basin G flows from the southwest to the northeast and is metered before discharging into the southern of two mains running west-to-east along East Doubletree Ranch Road. The northern portion of Basin G flows into unmetered Basin F by bypassing Meter G and entering the main line directly. This area comprises 48 parcels, of which 21 are connected to the sewer system and 27 are currently served by septic. Figure A-7 shows the original basin delineation and the revised subtraction of parcels from Basin G to Basin F (hatched) which comprises the edited delineation (outlined in black).

1.8 Basin H

Basin H borders Basin G to the west and similarly to Basin G, flows from the southwest to the northeast and is metered before discharging into the southern main running west-to-east along East Doubletree Ranch Road. The basin is fully hydraulically connected, and the meter captures all flows within the basin, with one exception: in the eastern portion of Basin H, a sewer line flows into Basin L. This area comprises 16 parcels, of which 5 are connected to the sewer system, 9 are currently served by septic, and 2 are vacant. These flows are currently recorded by Meter L. Figure A-8 shows the original basin delineation and the revised subtraction of parcels from Basin H to Basin L (hatched) which comprises the edited delineation (outlined in black).

1.9 Basin I

The western portion of Basin I flows northeast and discharges into the sewer main running along East Doubletree Ranch Road. The eastern portion of Basin I flows north into the same main. Because Basin I is composed of two distinct sewer lines, it is not hydraulically connected into a single drainage area as currently assumed. Figure A-9 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black). The eastern portion of Basin I (25 parcels, all connected to the sewer system) currently flows into Basin B. The western portion of Basin I (11 parcels, all connected to the sewer system) currently flow into Basin F.

1.10 Basin J

Flow in Basin J collects from the northwest to the southeast, where it is metered before discharging to the main along North Scottsdale Road. In addition to flows from within Basin J, the meter also captures flows from the southern portion of Basin B, comprising 21 parcels total (8 connected to sewer, 13 septic). Basin J is fully hydraulically

connected. Figure A-10 shows the original basin delineation and the revised addition of parcels from Basin B to Basin J (hatched) which comprises the edited delineation (outlined in black).

1.11 Basin K

Basin K collects and conveys flows to the west, where flow exists into the main running along North Scottsdale Road after being metered by Meter K. Basin K is fully hydraulically connected, and the drainage basin and meter configuration fully captures all required areas. No revisions to the basin boundaries are necessary. Figure A-11 shows the basin delineation.

1.12 Basin L

Basin L is hydraulically connected. All flows exit the basin at the metered outlet. In the west, a fraction of Basin L flows are currently captured by the meter in Basin N. In the northeast, Basin H (metered) and Basin F (unmetered) are contributing flows to Basin L, which are conveyed further downstream until they reach the Basin L meter at the outlet. Basin L is one of the Town's largest existing drainage basins and is hydraulically well-connected. Figure A-12 shows the original basin delineation and the revised addition of parcels from Basins L and F, and the subtraction of parcels from Basin H (hatched) which comprises the edited delineation (outlined in black).

1.13 Basin M

Basin M is fully hydraulically connected. All flows within its drainage area are captured at the flow outlet, located immediately before the point of discharge into the main running along North Scottsdale Road. No revisions to the basin boundaries are necessary. Figure A-13 shows the basin delineation.

1.14 Basin N

Basin N is fully hydraulically connected and all flows exit the basin at the metered outlet. In the west, a fraction of Basin L flows are currently captured by the meter at Basin N. This area includes 9 parcels, 8 of which are connected to the sewer system, and 1 parcel which is currently being served by septic. Figure A-14 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).

1.15 Basin O

In the southwest, additional flows from metered Basin Q enter Basin O. All portions of Basin O are hydraulically connected and flow is transferred to the meter at the basin outlet. Figure A-15 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).

1.16 Basin P

Basin P flows to the west, where it is metered before entering the main running along North Scottsdale Road. In the southeast, 14 parcels from Basin P flow into Basin Q, where they are captured by Meter Q. Of these 14, 0 are currently connected to the sewer; 4 are on septic, and 10 are vacant. Figure A-16 shows the original basin delineation and the revised subtraction of parcels from Basin P to Basin O (hatched) which comprises the edited delineation (outlined in black).

1.17 Basin Q

In the southwest, Basin Q contributes flow to metered Basins O and P. The remaining portions of the basin are hydraulically connected and all flow is transferred to the meter at the basin outlet, located prior to the sewer line's discharge into the main running along North Scottsdale Road. Since the adjoining basins to which Basin Q contributes flow (Basins O & P) are both metered, aside from updating the basin delineation and the Town's dwelling unit per drainage basin data, no further action is required. Figure A-17 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).

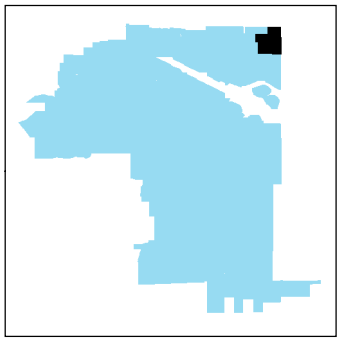
1.18 Basin R

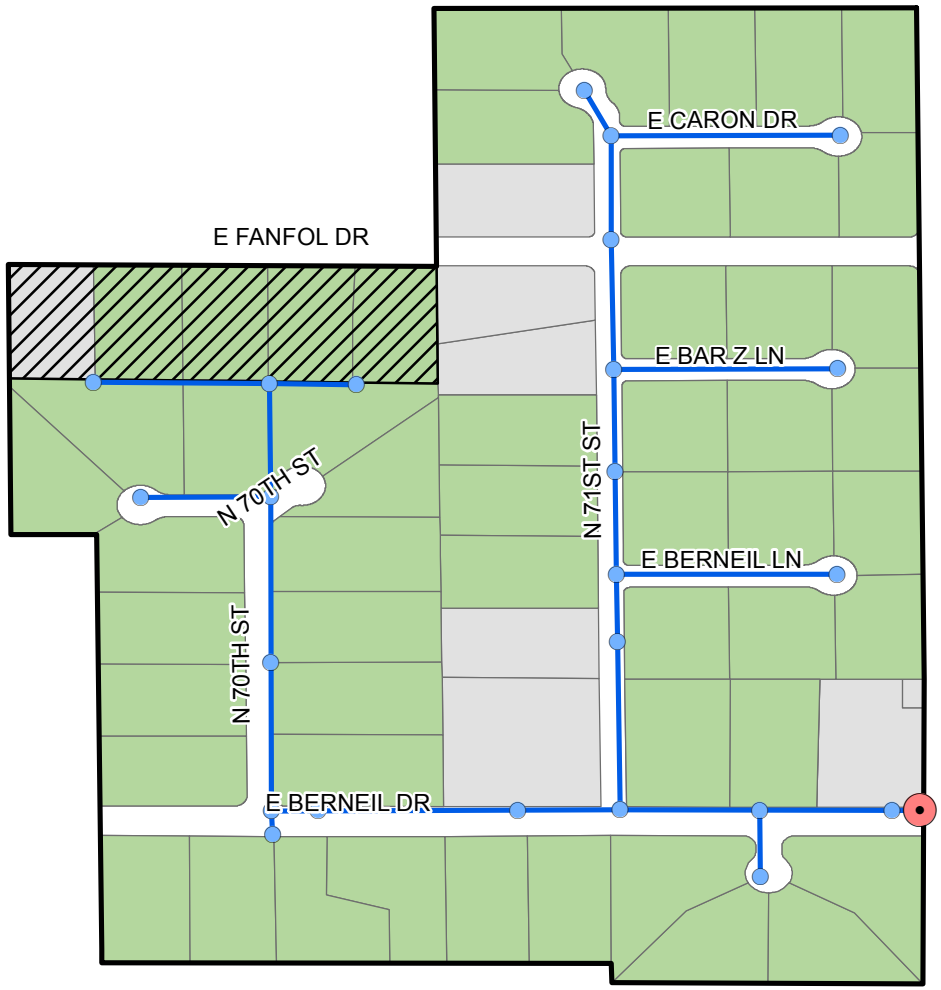
The majority of Basin R is currently unconnected to the sewer system; however, there is a small section of parcels discharging wastewater into the sewer system in the south-central section of the basin, where it borders North Scottsdale Road between East Vista Drive and East Orange Blossom Lane. Figure A-18 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).

1.19 Basin S

Basin S flows are characterized by collecting and flowing north-to-south along North Wilkinson Road towards East Chaparral Road. Sewer mains draining Basin Q begin

just north of Basin S mains. However, whereas Basin S drains towards the south, Basin Q drains north and east. Figure A-19 shows the original basin delineation and the revised addition (hatched) which comprises the edited delineation (outlined in black).





0 0.075 0.15 Miles

Legend

- Flow Meter
- Manholes
- Sewer Mains
- Revised Basin Boundary
- Area Added to Basin A
- Sewer Connected Parcels
- Septic of Vacant Parcels

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin A

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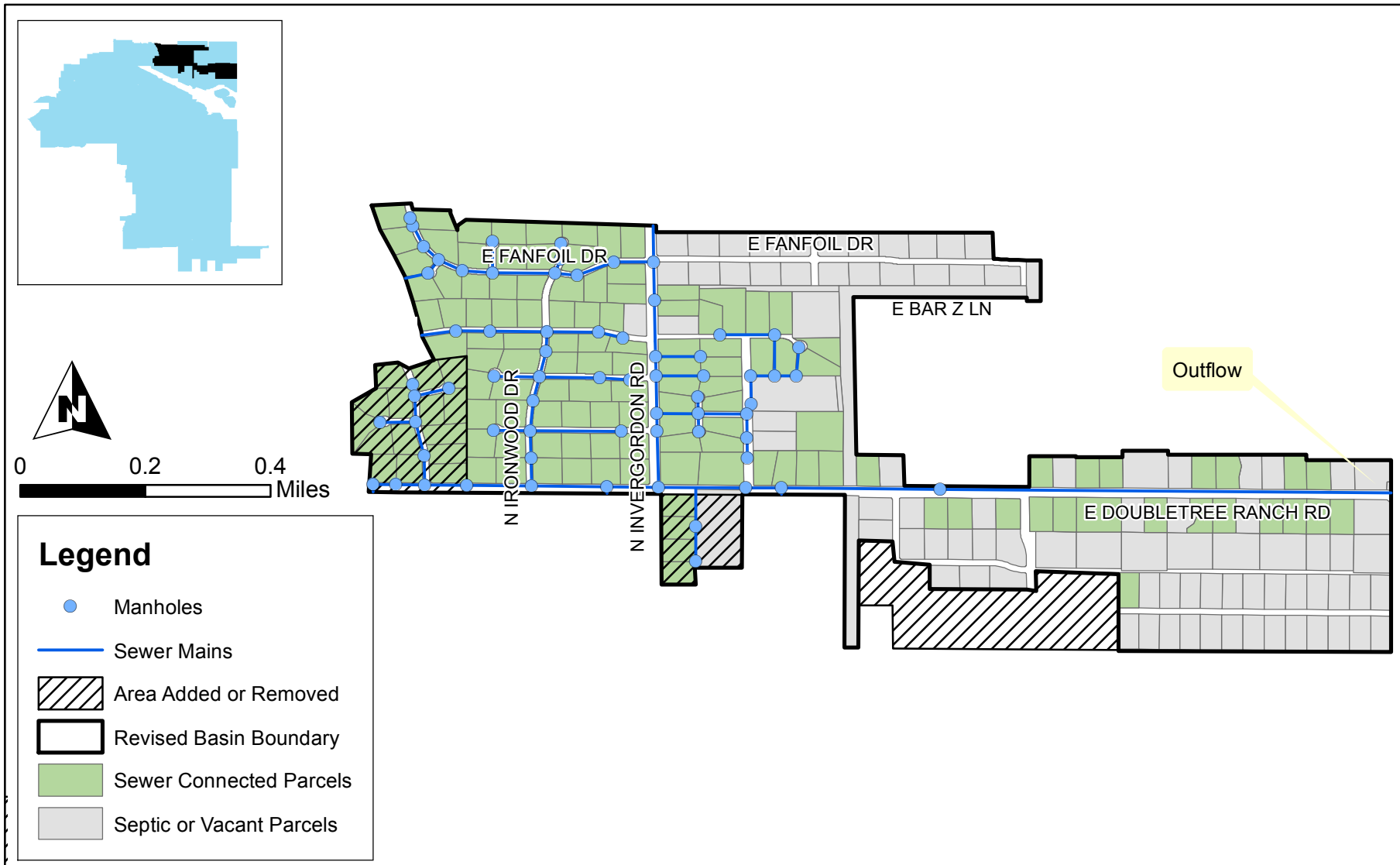
FIGURE A-1



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WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin B

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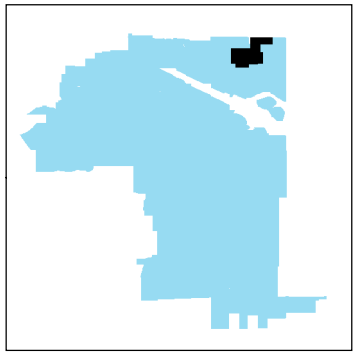
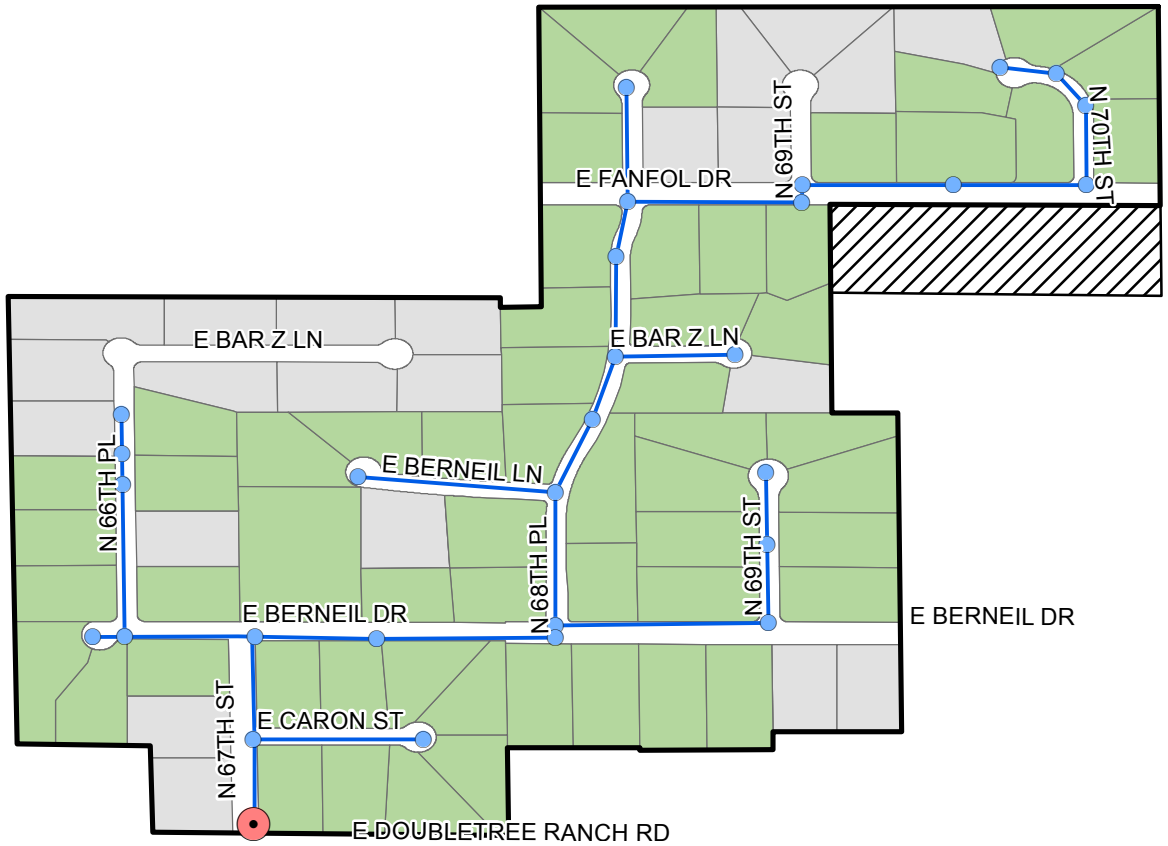
FIGURE A-2





0 0.125 0.25 Miles

Legend

- Manholes
- Flow Meter
- Sewer Mains
- Revised Basin Boundary
- Sewer Connected Parcels
- Septic or Vacant Parcels
- Area Removed from Basin C

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin C

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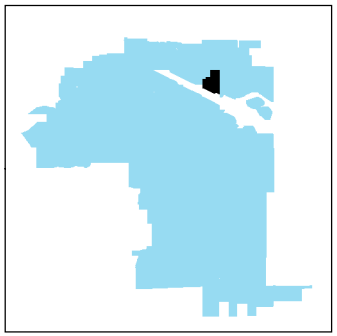
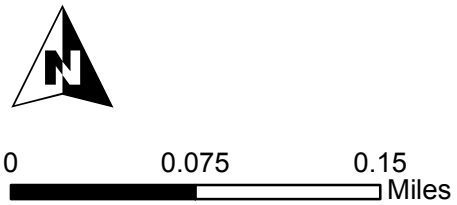
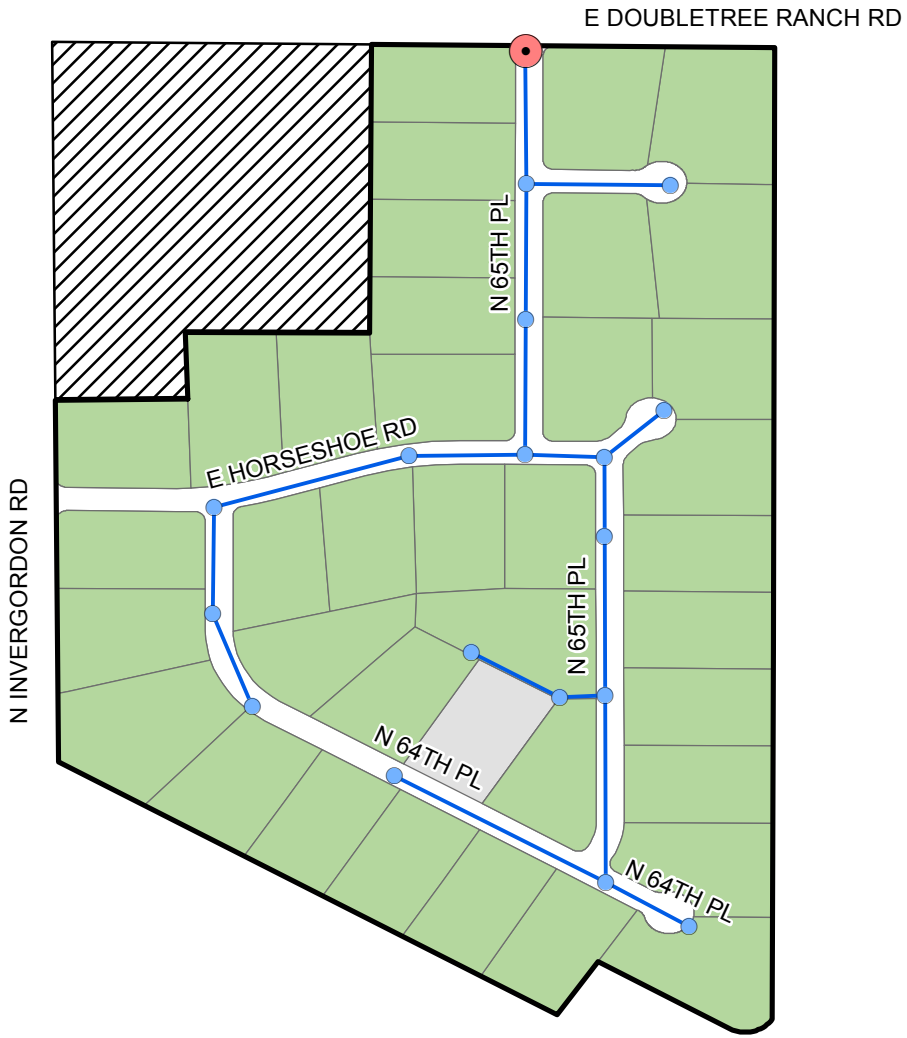
FIGURE A-3







Legend

- Flow Meter
- Manholes
- Sewer Mains
- Revised Basin Boundary
- Sewer Connected Parcels
- Septic or Vacant Parcels
- Revised Basin Boundary
- Area Removed from Basin D

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin D

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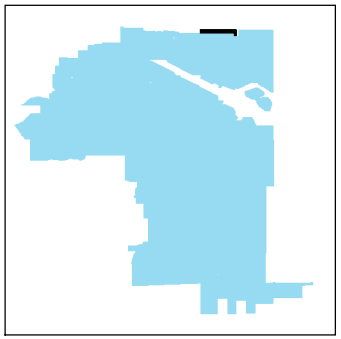
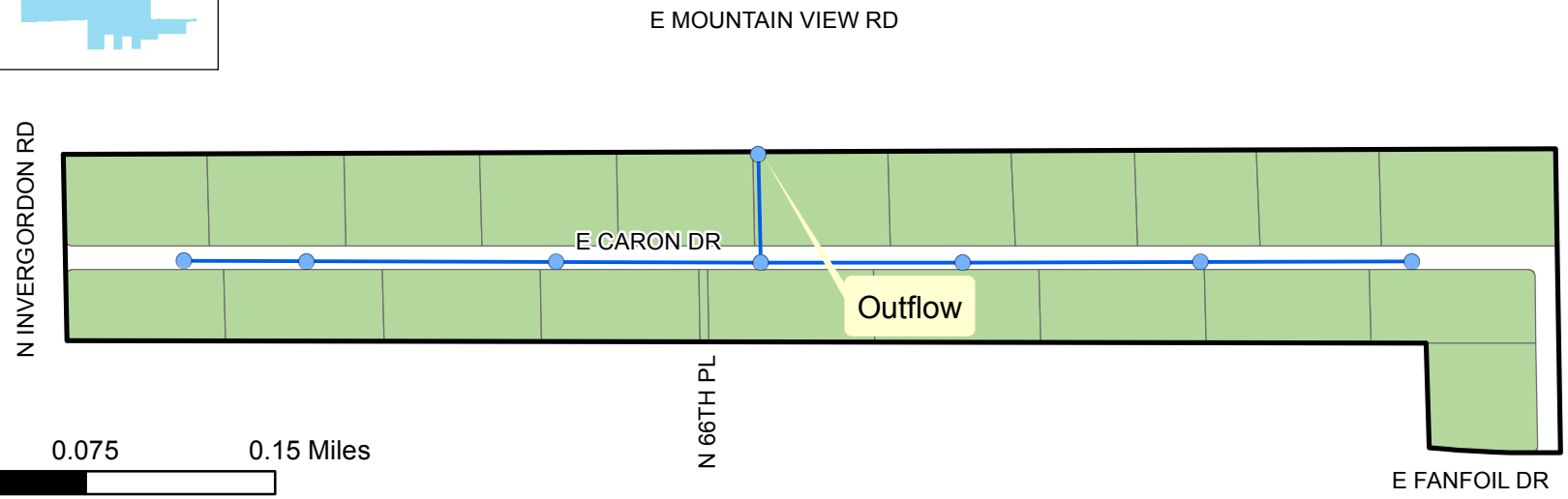
FIGURE A-4





Legend

- Manholes
- Sewer Mains
- Basin Boundary
- Sewer Connected Parcels

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin E

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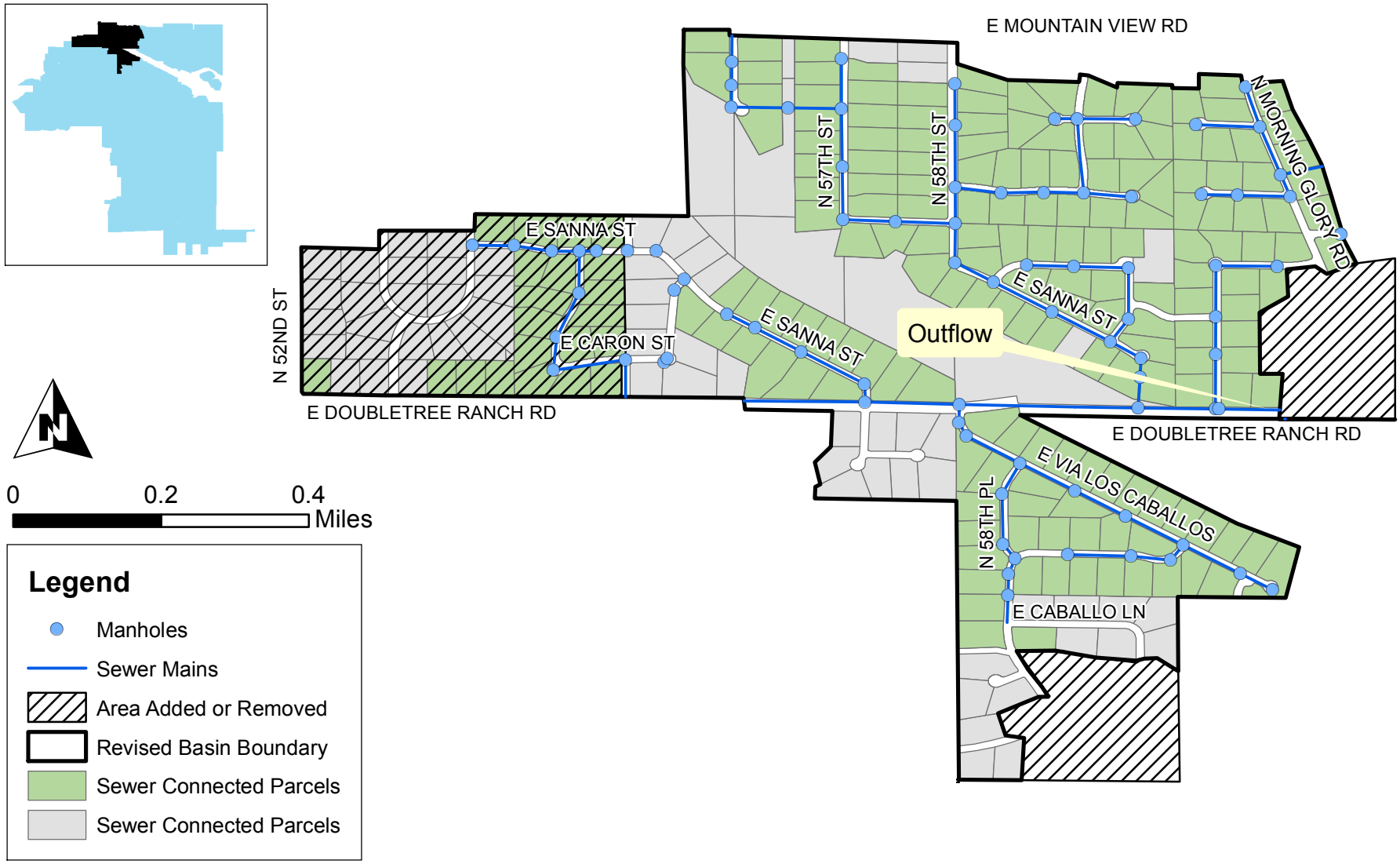
FIGURE A-5



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin F

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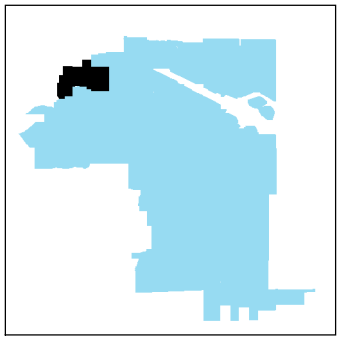
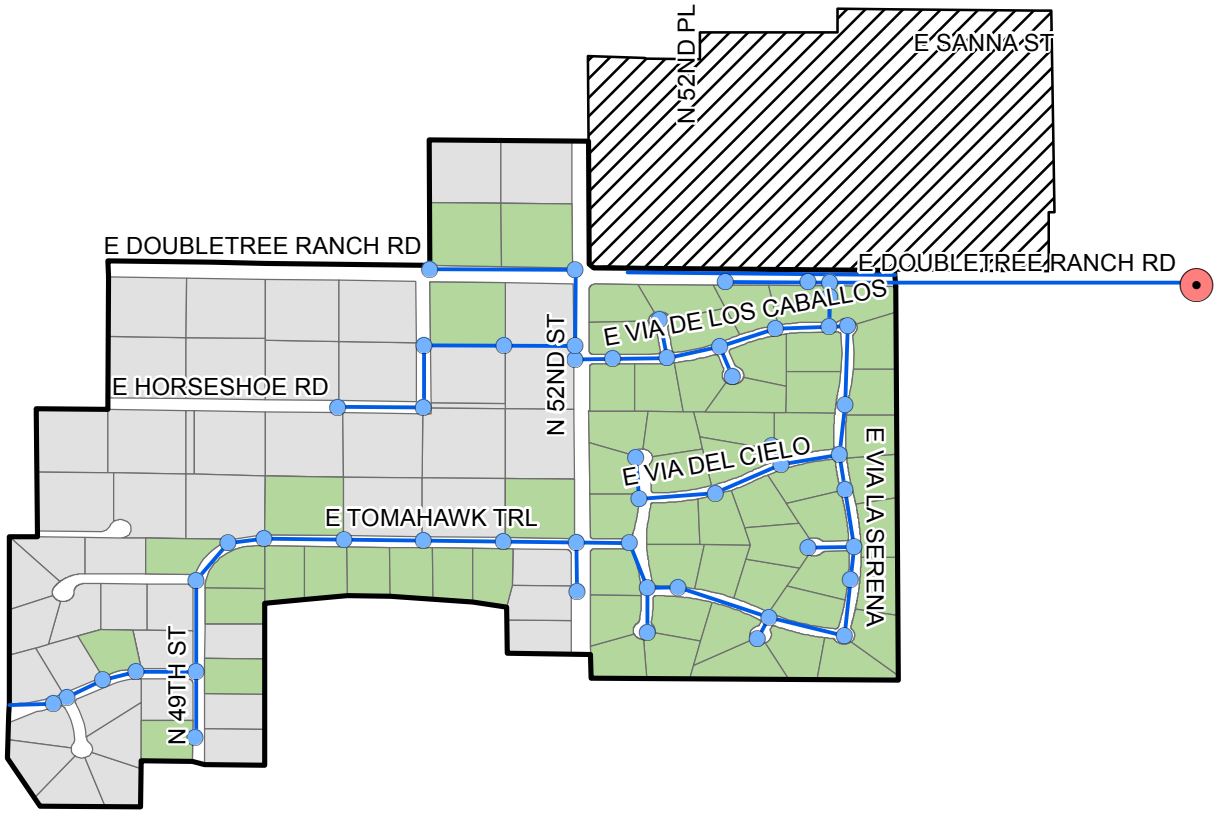
FIGURE A-6





0 0.2 0.4 Miles

Legend

- Flow Meter
- Manholes
- Sewer Main
- Revised Basin Boundary
- Sewer Connected Parcels
- Septic or Vacant Parcels
- Area Removed from Basin G

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin G

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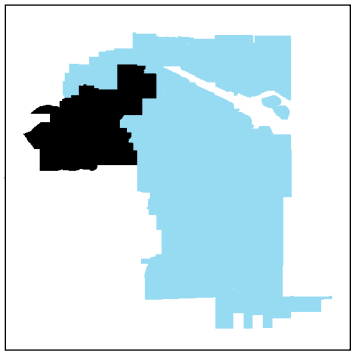
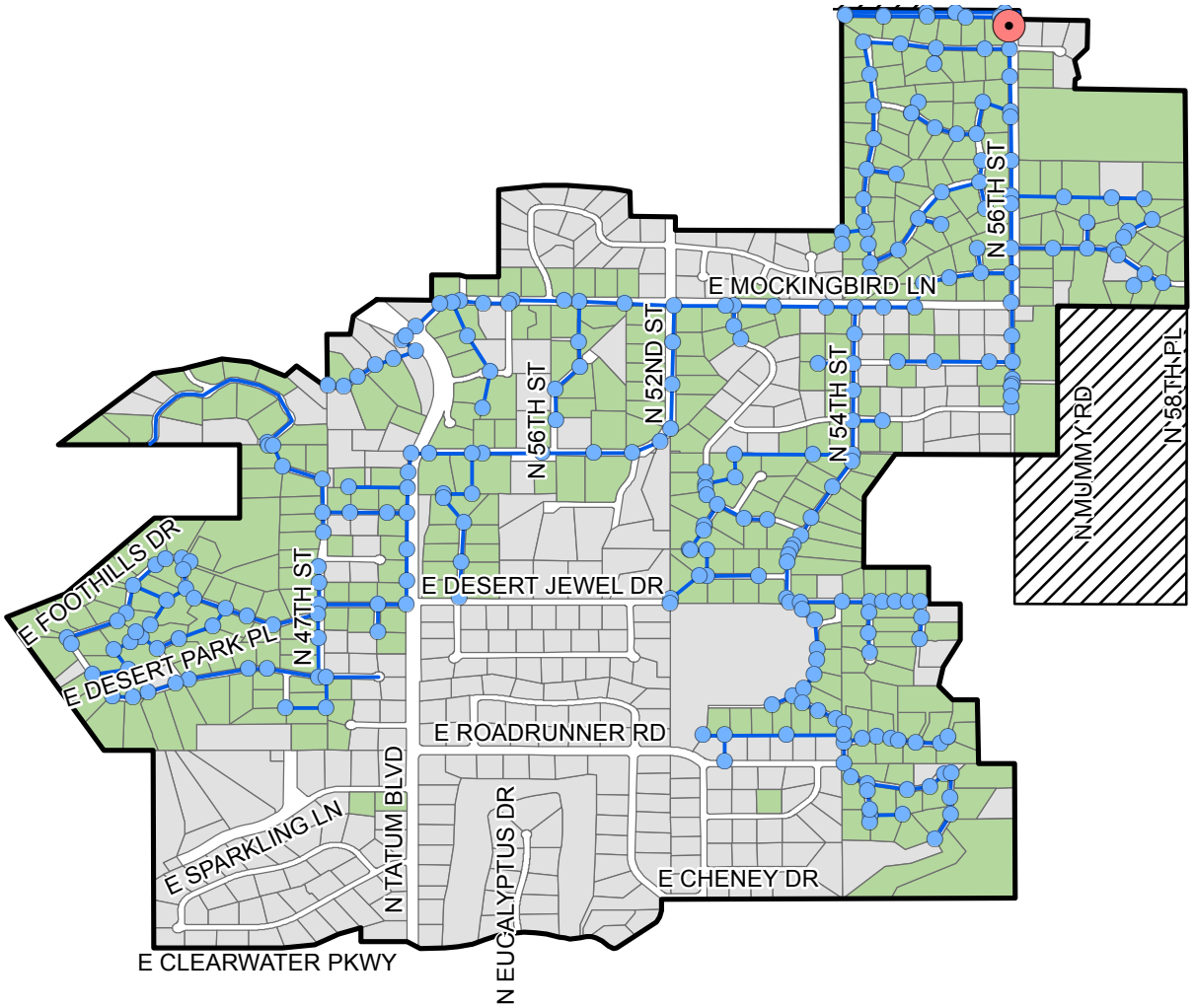
FIGURE A-7





0 0.325 0.65 Miles

Legend

- Flow Meter
- Manholes
- Sewer Mains
- Revised Basin Boundary
- Sewer Connected Parcels
- Septic or Vacant Parcels
- Area Removed from Basin H

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin H

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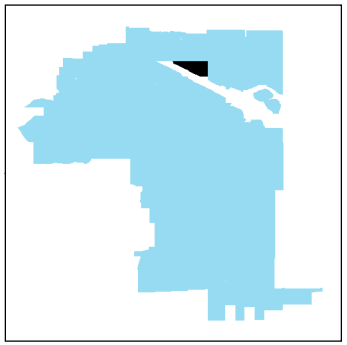
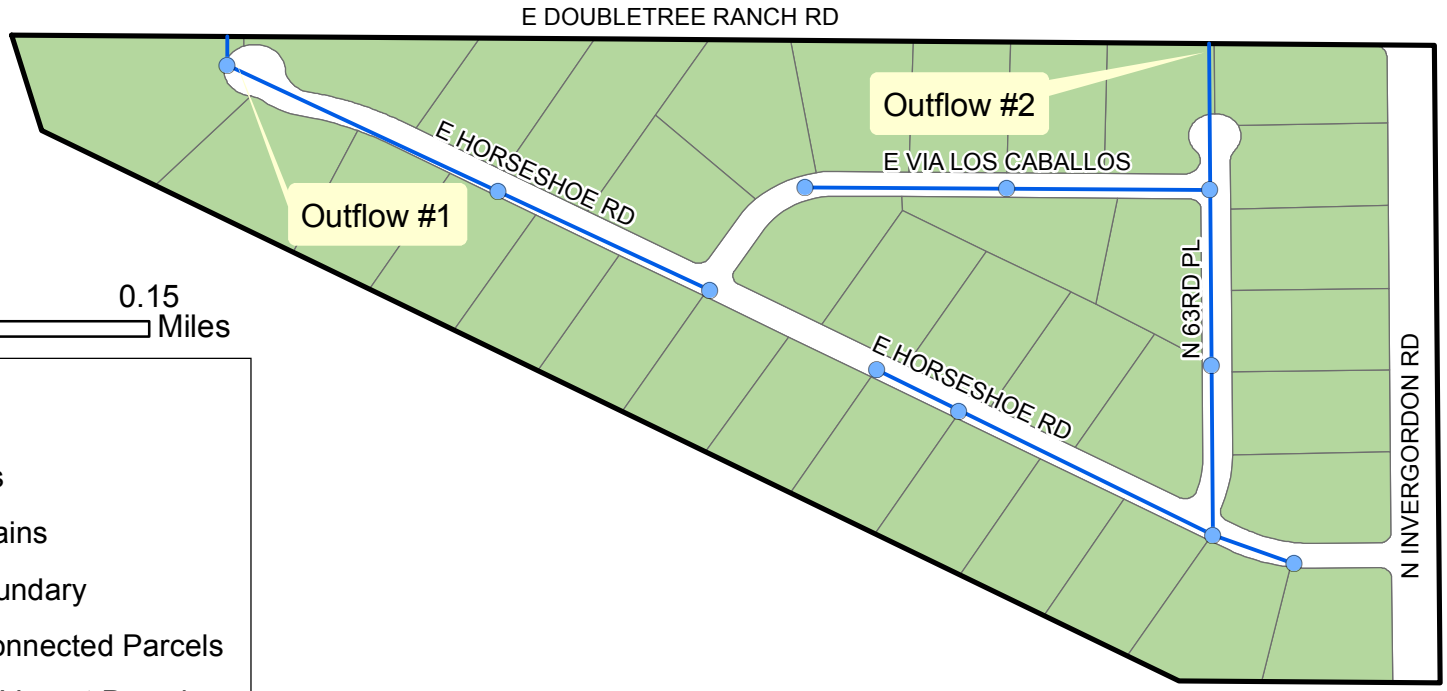
FIGURE A-8





0 0.075 0.15 Miles

Legend

- Manholes
- Sewer Mains
- Basin Boundary
- Sewer Connected Parcels
- Septic or Vacant Parcels

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin I

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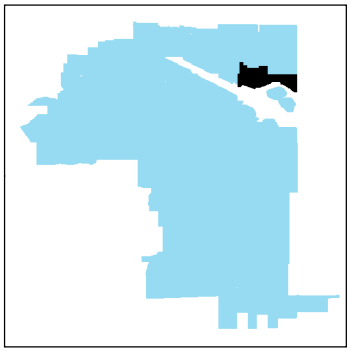
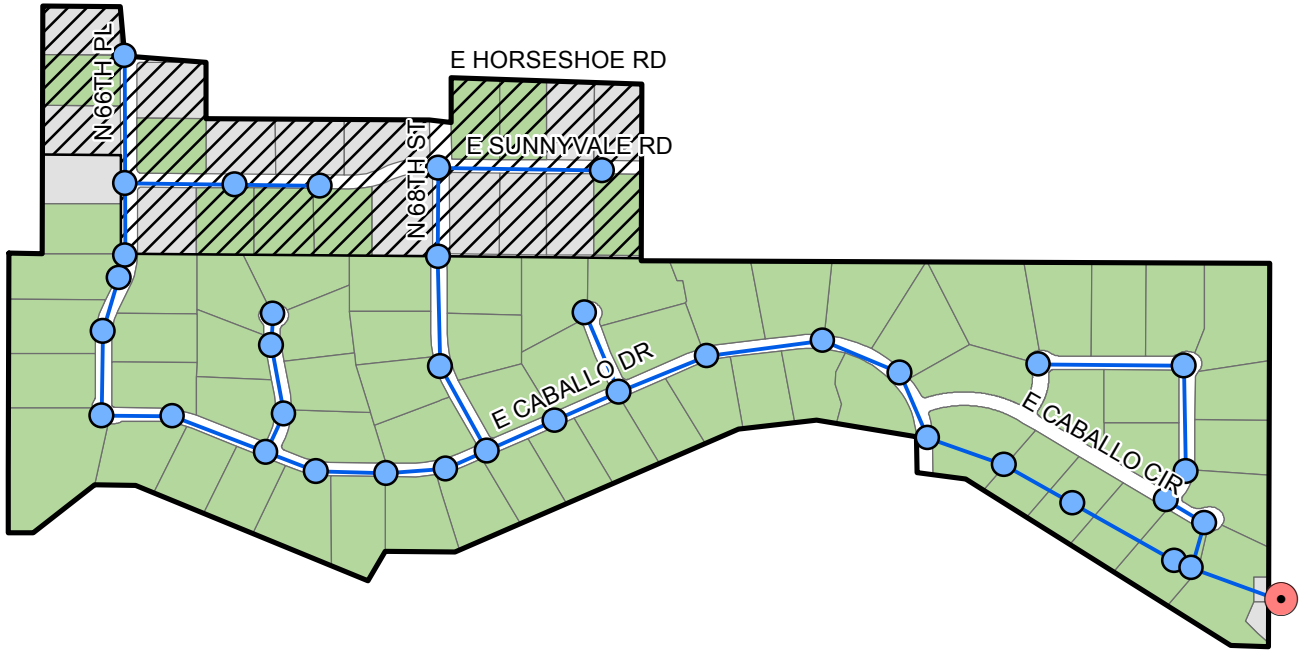
March 2015
FIGURE A-9





0 0.125 0.25 Miles

Legend

- Flow Meter
- Manholes
- Sewer Mains
- Revised Basin Boundary
- Area Added to Basin J
- Sewer Connected Parcels
- Septic or Vacant Parcels

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin J

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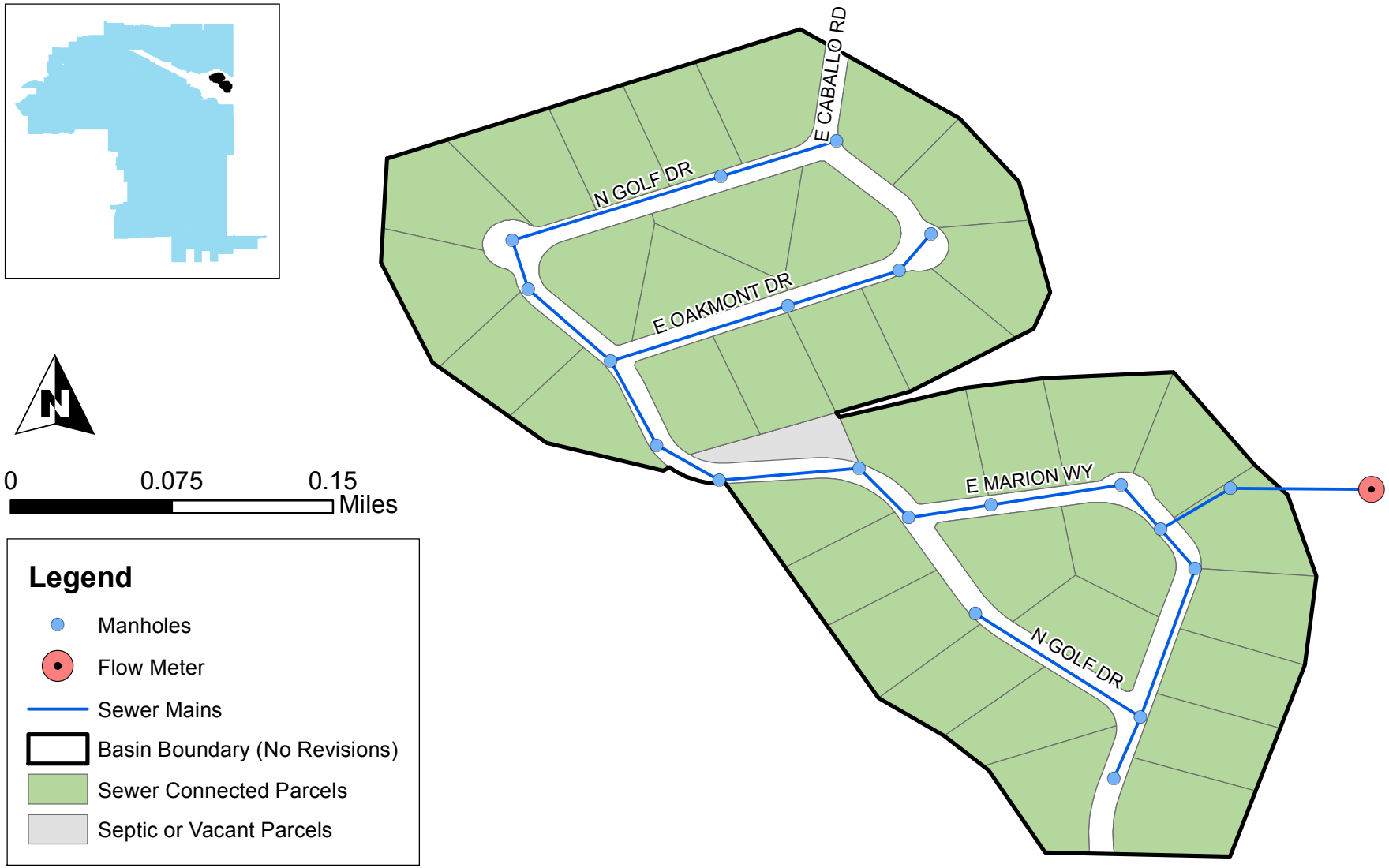
April 2015
FIGURE A-10



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin K

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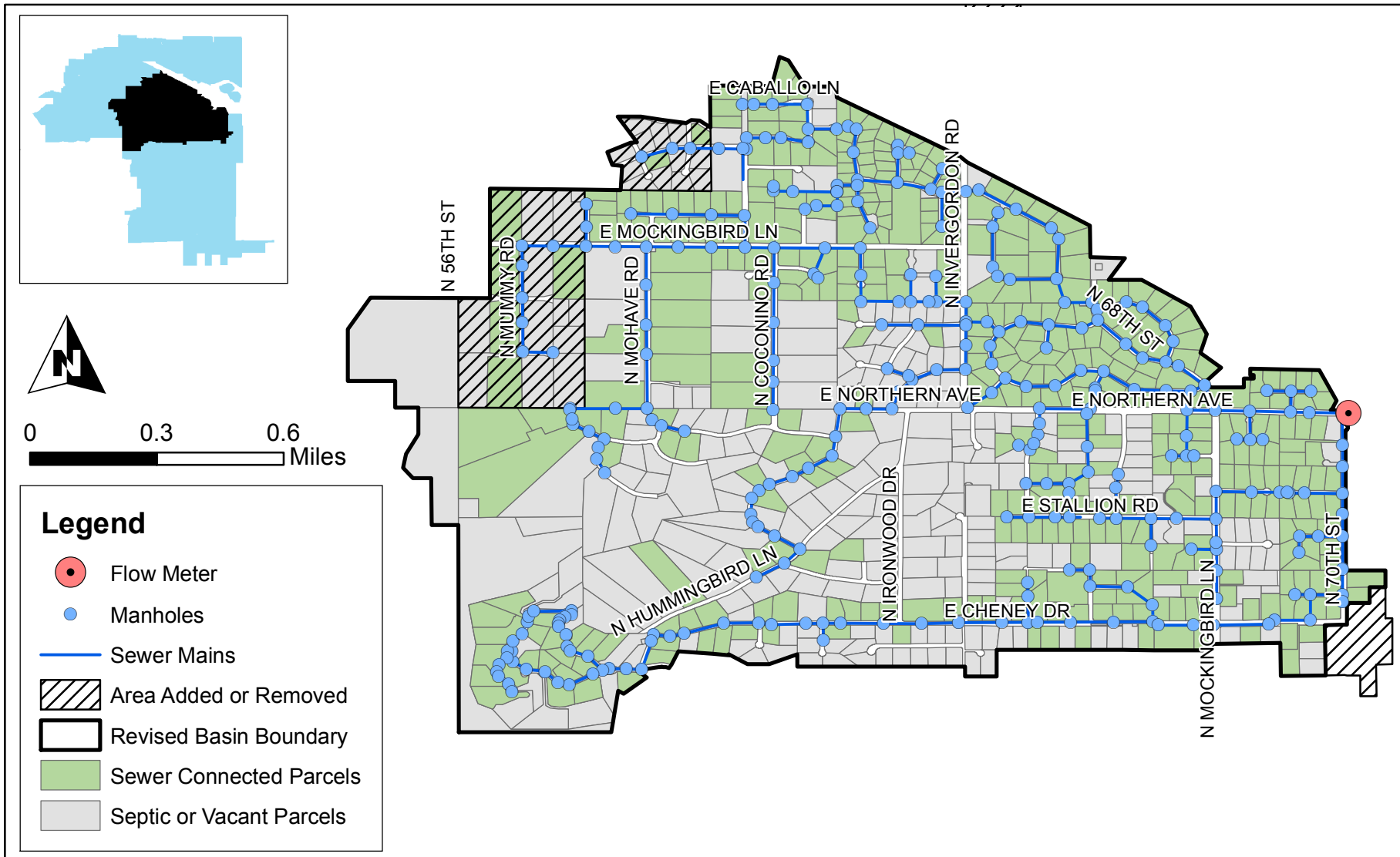
March 2015
FIGURE A-11



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin L

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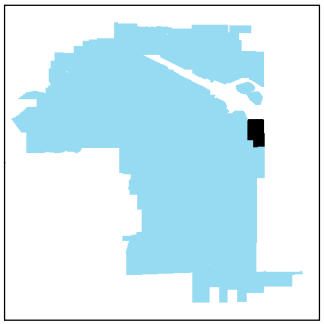
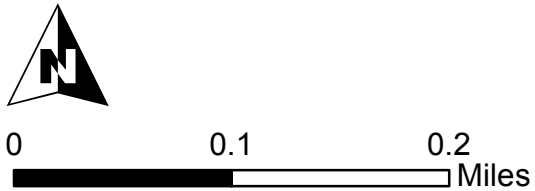
March 2015
FIGURE A-12





Legend

- Manholes
- Flow Meter
- Sewer Mains
- Basin Boundary (No Revisions)
- Sewer Connected Parcels
- Septic or Vacant Parcels

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin M

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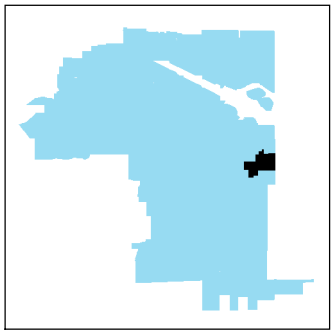
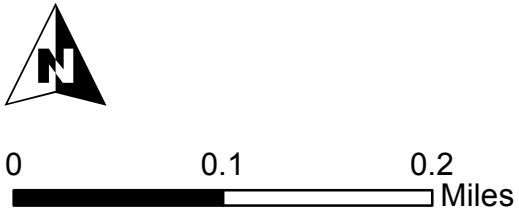
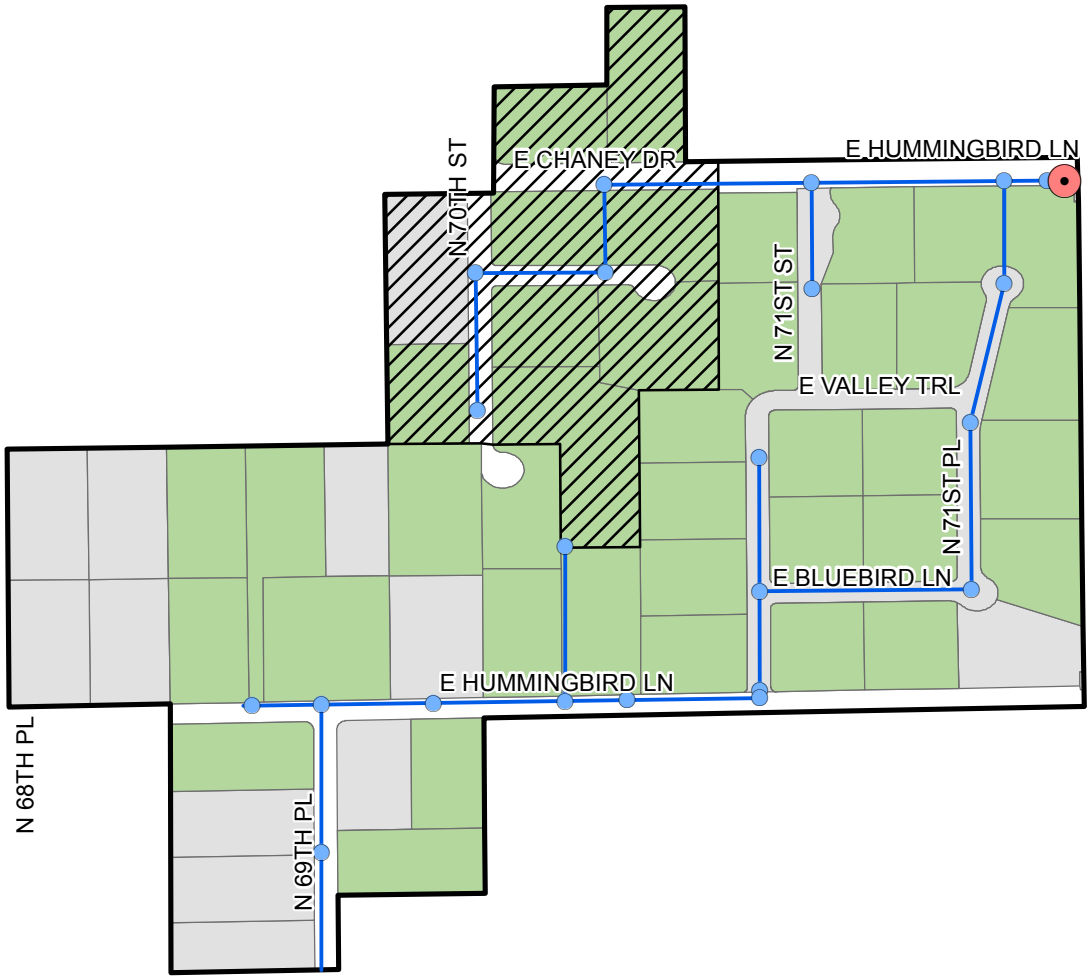
March 2015
FIGURE A-13







Legend

- Flow Meter
- Manholes
- Sewer Mains
- Revised Basin Boundary
- Area Added to Basin N
- Sewer Connected Parcels
- Septic or Vacant Parcels

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin N

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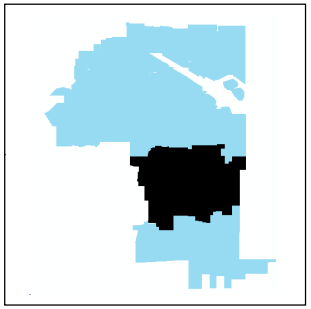
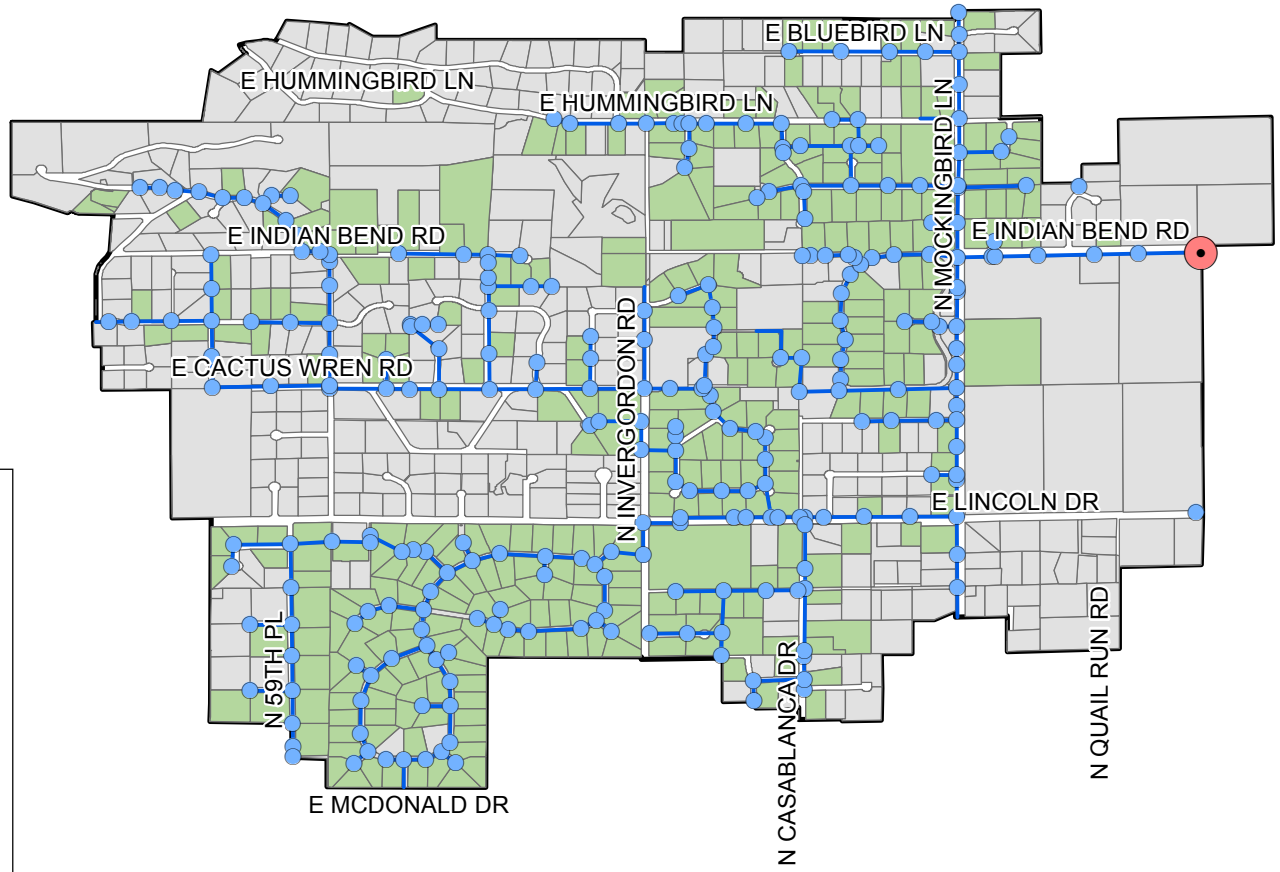
March 2015
FIGURE A-14





N

0 0.325 0.65 Miles

Legend

- Flow Meter
- Manholes
- Sewer Mains
- Sewer Connected Parcels
- Septic or Vacant Parcels
- Revised Basin Boundary

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin O

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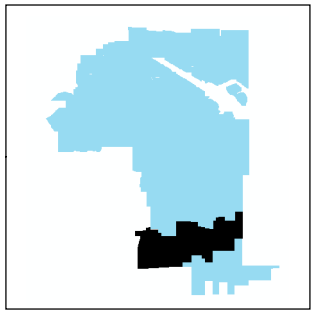
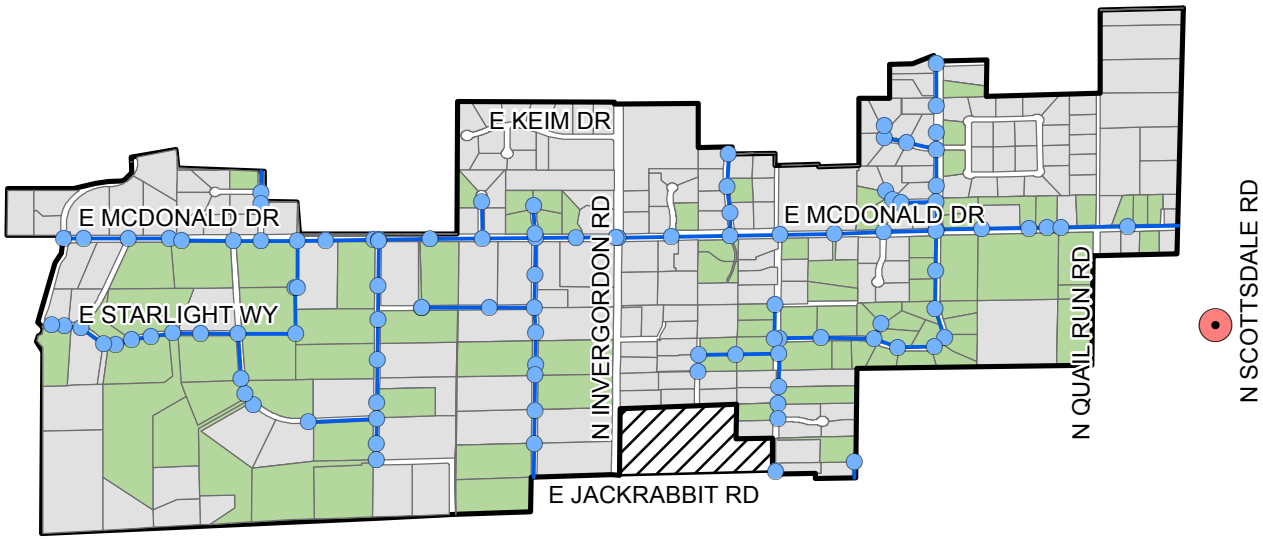
March 2015
FIGURE A-15





0 0.3 0.6 Miles

Legend

- Manholes
- Flow Meter
- Sewer Mains
- Revised Basin Boundary
- Area Removed from Basin P
- Sewer Connected Parcels
- Septic or Vacant Parcels

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin P

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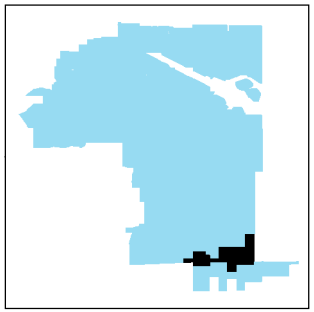
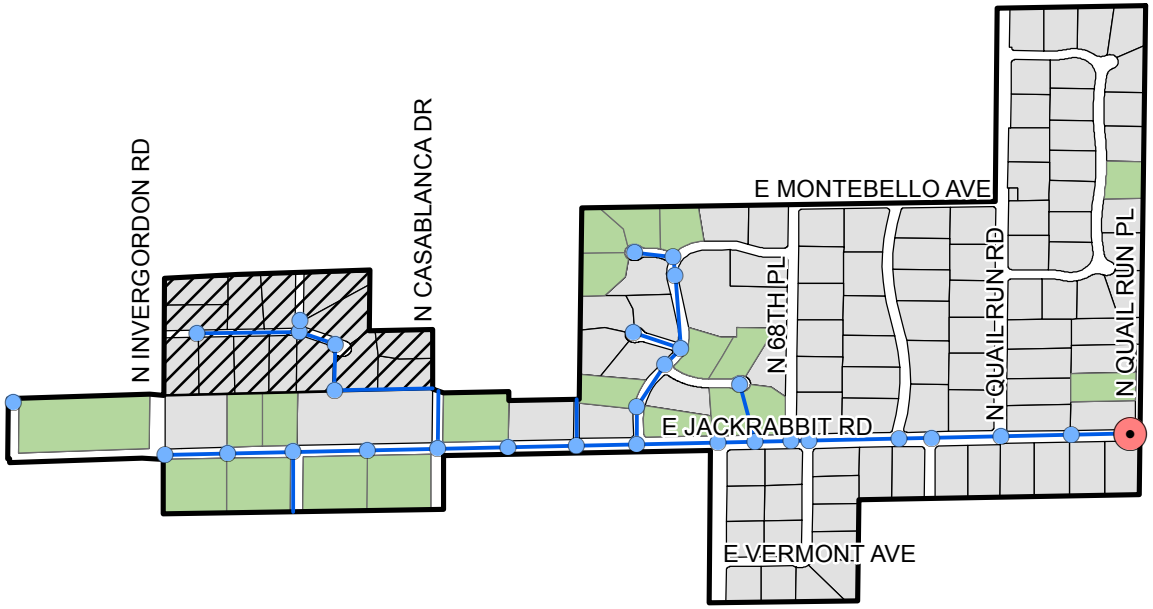
March 2015
FIGURE A-16





N

0 0.2 0.4 Miles

Legend

- Flow Meter
- Manholes
- Sewer Mains
- Revised Basin Boundary
- Area Added to Basin Q
- Sewer Connected Parcels
- Septic or Vacant Parcels

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Drainage Basin Modifications - Basin Q

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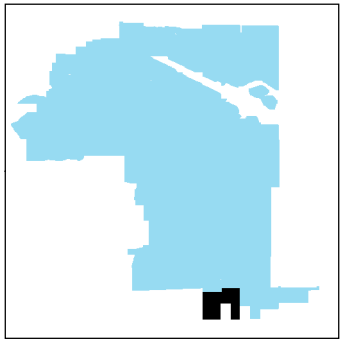
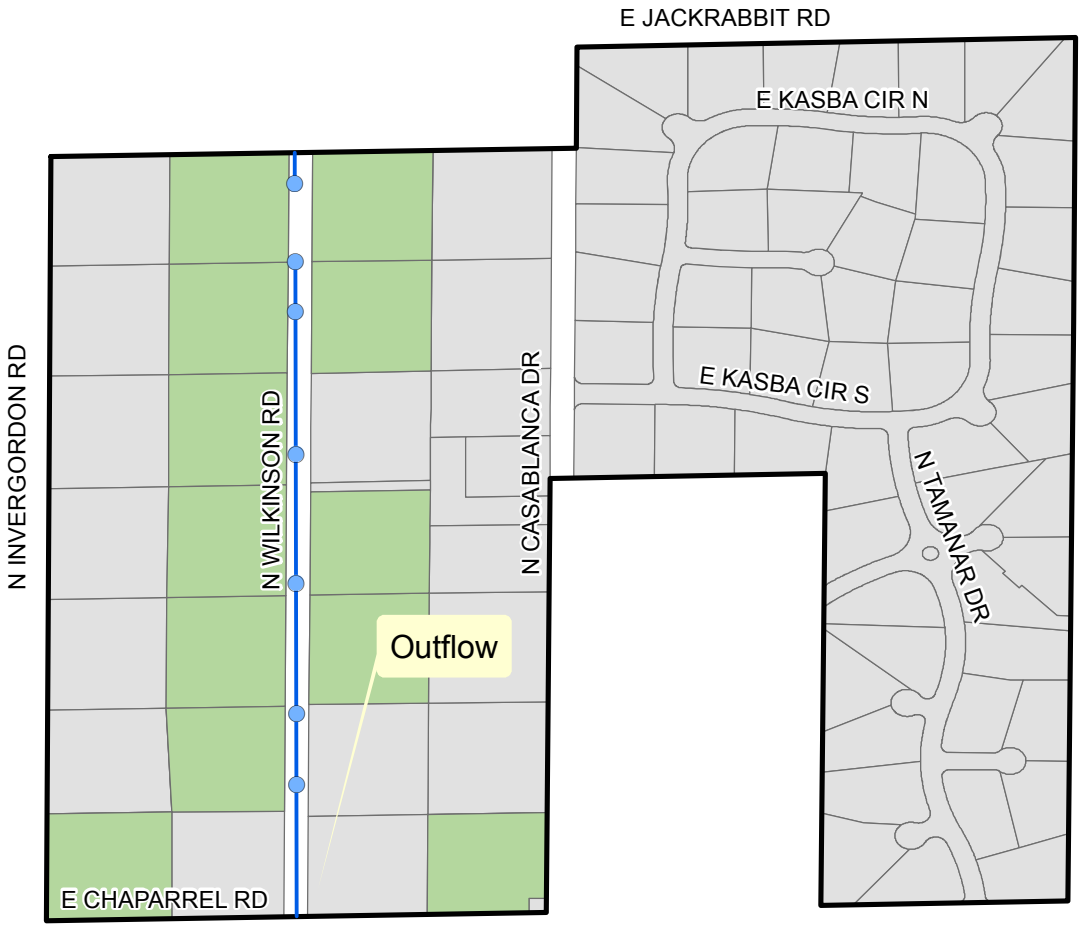
FIGURE A-17





0 0.1 0.2 Miles

Legend

- Manholes
- Sewer Mains
- Basin Boundary
- Sewer Connected Parcels
- Septic or Vacant Parcels

TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin R

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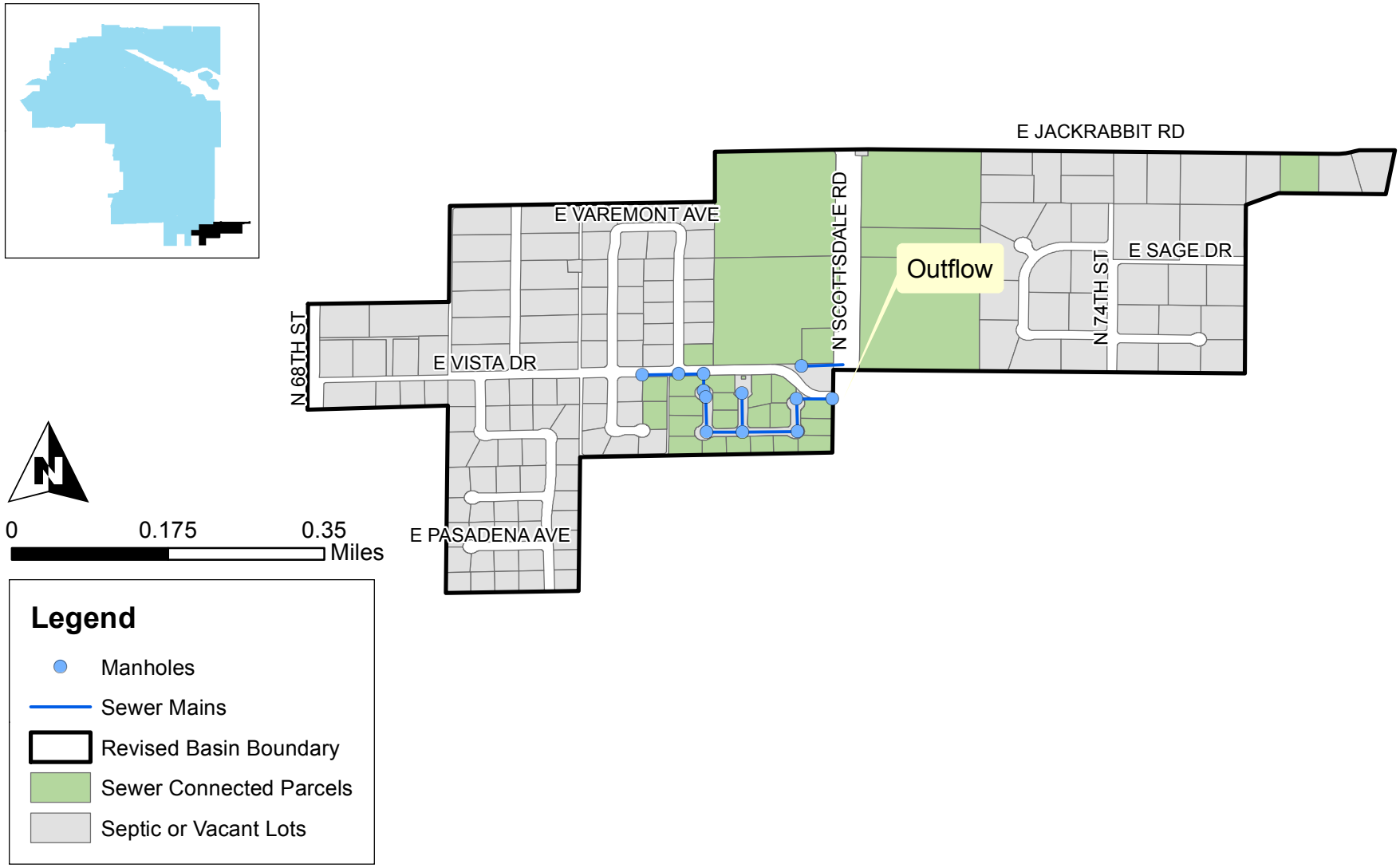
FIGURE A-18



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WASTEWATER PLANNING SERVICES

Drainage Basin Modifications - Basin S

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FIGURE A-19

Technical Memorendum

Assess Potential for
Modifying Drainge Basins
and Meter Locations

Attachment B

Detailed Cost Estimates for Drainage Basin Alternatives

Table B Detailed Summary of Cost Estimates

Alternative A				
Line Item	**Units**	**Unit**	**Unit Cost**	**Total Cost**
Re-grade existing line (8")	5,702	LF	$139.00	$793,000.00
Install new connector line (8")	3,643	LF	$139.00	$507,000.00
Install new collector line (8")	0	LF	$139.00	-
Install new collector line (12")	0	LF	$187.00	-
Install new collector line (15")	0	LF	$215.00	-
Install new collector line (18")	0	LF	$ 245.00	-
Bypass pumping (≤ 1 MGD, 8")	47	days	$284.00	$14,000
Bypass pumping (≤ 1 MGD, 12")	0	days	$284.00	-
Bypass pumping (≤ 1 MGD, 15")	0	days	$284.00	-
Bypass pumping (≤ 1 MGD, 18")	0	days	$284.00	-
Additional traffic control – major roadway	0	mi	$100,000.00	-
			Subtotal:	$1,314,000.00
			Engineering and Construction Administration (30%)	$395,000.00
			Contingency (30%)	$513,000.00
			TOTAL:	$2,222,000.00

Alternative B				
Line Item	**Units**	**Unit**	**Unit Cost**	**Total Cost**
Re-grade existing line (8")	5,702	LF	$139.00	$793,000.00
Install new connector line (8")	5,544	LF	$139.00	$771,000.00
Install new collector line (8")	0	LF	$139.00	-
Install new collector line (12")	0	LF	$187.00	-
Install new collector line (15")	0	LF	$215.00	-
Install new collector line (18")	0	LF	$ 245.00	-
Bypass pumping (≤ 1 MGD, 8")	56	days	$284.00	$16,000.00
Bypass pumping (≤ 1 MGD, 12")	0	days	$284.00	-
Bypass pumping (≤ 1 MGD, 15")	0	days	$284.00	-
Bypass pumping (≤ 1 MGD, 18")	0	days	$284.00	-
Additional traffic control – major roadway	0	mi	$100,000.00	-
			Subtotal:	$1,580,000.00
			Engineering and Construction Administration (30%)	$474,000.00
			Contingency (30%)	$617,000.00
			TOTAL:	$2,671,000.00

Alternative C				
Line Item	**Units**	**Unit**	**Unit Cost**	**Total Cost**
Re-grade existing line (8")	5,702	LF	$139.00	$793,000.00
Install new connector line (8")	4,171	LF	$139.00	$580,000.00
Install new collector line (8")	4,594	LF	$139.00	$639,000.00
Install new collector line (12")	2,534	LF	$187.00	$474,000.00
Install new collector line (15")	2,640	LF	$215.00	$568,000.00
Install new collector line (18")	5,861	LF	$ 245.00	$1,436,000.00
Bypass pumping (≤ 1 MGD, 8")	72	days	$284.00	$21,000.00
Bypass pumping (≤ 1 MGD, 12")	17	days	$284.00	$5,000.00
Bypass pumping (≤ 1 MGD, 15")	26	days	$284.00	$8,000.00
Bypass pumping (≤ 1 MGD, 18")	78	days	$284.00	$23,000.00
Additional traffic control – major roadway	4.2	mi	$100,000.00	$420,000.00
			Subtotal:	$4,967,000.00
			Engineering and Construction Administration (30%)	$1,491,000.00
			Contingency (30%)	$1,938,000.00
			TOTAL:	$8,396,000.00

Appendix B

Meter Accuracy Assessment

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Technical Memorandum

Task 1.3 Assess Accuracy of Existing Wastewater Metering Program

March, 2015

ARCADIS

Timothy Francis, P.E.
Principal Environmental Engineer, Project Manager

John Paul Travis
Project Engineer

Technical Memorandum

Assess Accuracy of Existing Wastewater Metering Program

Prepared for:
Town of Paradise Valley

Prepared by:
ARCADIS U.S., Inc.
410 N. 44th Street
Suite 1000
Phoenix
Arizona 85008
Tel 602 438 0883
Fax 602 438 0102

Our Ref.:
00776004.0001

Date:
March, 2015

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2. Site Visits **1**

3. Data Assessment and Analysis **2**

3.1 Range of Data Assessed 2

3.2 Review of Reported Data Values 3

3.3 Identification of Data Anomalies 4

3.4 Overall Meter Accuracy Assessment 4

4. Conclusions **6**

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Tables

Table 3-1 Baseline Meter Assessment

1. Introduction

The Town of Paradise Valley currently tracks the status of its flow capacity ownership in the City of Scottsdale wastewater treatment system based on wastewater flow metering conducted for 13 out of 19 total wastewater drainage basins. The Town has retained ARCADIS to provide wastewater planning services. One of the tasks under the Wastewater Planning Services project is to assess the accuracy of the Town's existing wastewater flow metering program using wastewater flow data from the Town's new Wastewater Flow Management Tool. The Tool is loaded with available historical flow data from 2005 to present. This technical memorandum summarizes the work conducted which generally included the following:

- Data completeness, data loss - Generally, meters are considered providing "complete" data if their percent data availability (or uptime) is greater than 90 percent.
- Data assessment - Review of data to determine if meters report within the expected range Included in this step was comparison with expected flows in basins using population and typical flow generation factors.
- Meter locations – Review of meter locations and flow conditions to evaluate potential issues including sedimentation and flow turbulence that could potentially impact the flow data.
- Sensor drift – Velocity and depth data were to be evaluated for potential drift issues. However, velocity and depth data were not available and could not be evaluated; only wastewater flow data was available. The available flow data was analyzed for completeness, data drifts, and anomalies.
- Sensor anomaly – Sudden data drops or pops that do not correspond with a specific condition and that greatly affect the data were identified and assessed.

2. Site Visits

Site inspections were conducted at all 13 metering stations to view and assess their set-ups. All of the Town's metering stations have a similar design. A Palmer-Bowlus flume has been inserted into the pipe at the metering location. An ultrasonic Magnetrol flowmeter measures the flow depth and calculates the corresponding flow. The flow values are sent to Scottsdale's SCADA database via radios.

The meters currently appear to be installed and functioning correctly. Meters are checked each month and the flumes are cleaned as necessary. Additionally, the meters are calibrated annually. There have been, however, physical metering issues

in the past, such as shovels being left in the flume, and data logging meter issues, including blocked line-of-site radio transmissions, which have caused inaccurate data. Inaccurate data was flagged during data analysis. All of the physical metering issues have been corrected.

Overall, the meters appear to be located, designed, and maintained appropriately. However, a tree root is growing into the concrete base of the panel for Basin A causing the panel to lean. If the tree root continues growing, the wires connecting the equipment may become damaged, which may eventually prevent data transmission. Otherwise, the current meter set-ups and locations appear to be sufficient for monitoring Paradise Valley's sewer flows based on the meter accuracy assessment.

3. Data Assessment and Analysis

3.1 Range of Data Assessed

The Town's new Wastewater Flow Management Tool is loaded with historical flow data going back to January 1, 2005. Figure 3-1, shows the flow per dwelling unit data extracted from the Tool and shows that the flow factors fluctuated greatly until recent years.

An assessment was conducted of the flow data collected in each drainage basin from January 1, 2013 to August 1, 2014 and showed that the data consistently followed the expected diurnal pattern of high and low flow throughout the day for this time period. Therefore, the time period of January 1, 2013 to August 1, 2014 was selected for the meter accuracy assessment. This sample is considered large enough to obtain meaningful results and is based on the most recent, consistent, and applicable data.

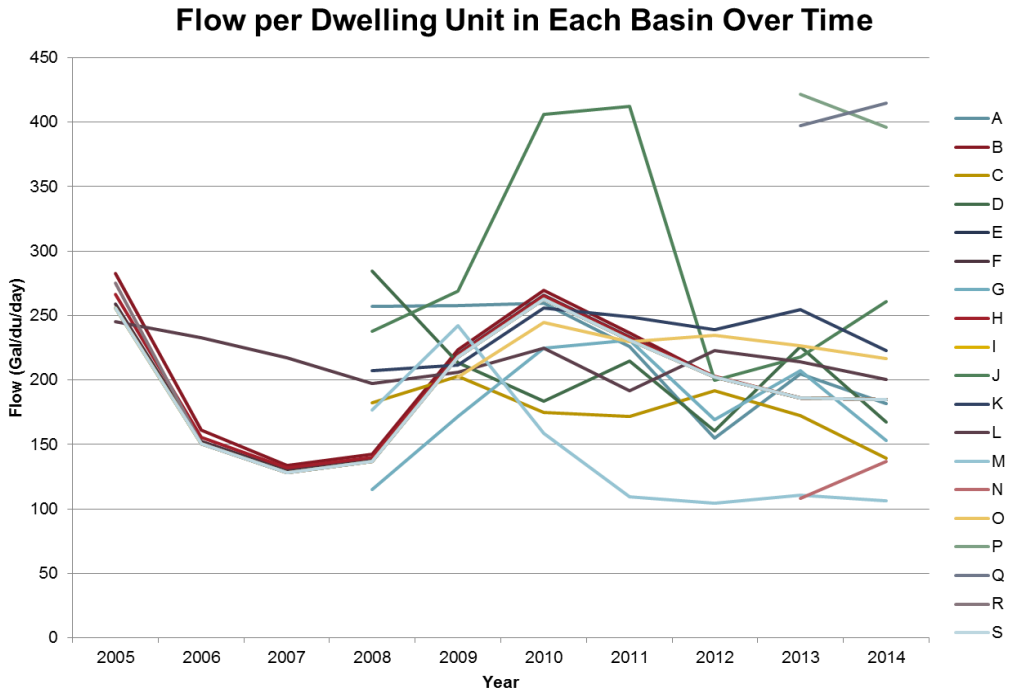

Figure 1: Flow per Dwelling Unit over Time

3.2 Review of Reported Data Values

The daily average, minimum, and maximum flow values reported were evaluated to ensure the meters were reporting flow values below the maximum pipe capacity. The meters reported average flows of 90 GPH to 3,700 GPH and the highest flow value reported was 4,348 GPH.

Expected flows in each basin were estimated based on the pipe size, number of dwelling units in each basin, and an assumed average household size per dwelling unit (2.5 people per unit[1]). Since it is impractical to assess the accuracy of Paradise Valley's meter data using the meter data itself as a comparison, Scottsdale's average flow of 67.5 gallons per capita per day (GPCPD)[2] was used for the expected range of flows. Scottsdale is the neighboring city whose population characteristics are most similar to Paradise Valley. Since Paradise Valley is a unique community, the actual flows are not expected to perfectly match the flow estimates; however, the estimated values serve as a check to ensure the metered values are reasonable. This assumed average sewer flow of 67.5 GPCPD, results in an estimate of 168.75 gal/dwelling unit/day. Based on these assumptions, the estimated average flows from the drainage

basins generally range from 85 GPH to 3,000 GPH, all within an order of magnitude of the reported flows for each basin (90 GPH to 3,700 GPH).

It should be noted that some basins produced flows lower than the estimated 168.75 gal/dwelling unit/day, particularly basin M. Due to the small number of dwelling units in each basin, these values could be greatly impacted if several houses have fewer than 2.5 people, use improved water conservation technology, etc. Despite these variables, basin M also produced a flow within an order of magnitude of the predicted value so the data is considered reasonable.

3.3 Identification of Data Anomalies

Anomalies in the data were noted and analyzed for potential causes, such as high flows during rain events, and unexplained anomalies were flagged as “bad data.” Additionally, all flow readings of 0 and readings where the meters appeared to be “stuck” and reported the same value at least 5 hours in a row were marked as “bad data.” It should be noted that all basins had a least one out-of-place, unusually high, and invalid reading. This is expected since no meter will report 100% perfect data. Each occurrence was flagged and used to determine meter uptime.

3.4 Overall Meter Accuracy Assessment

Table 3.1 summarizes the assessment of meter accuracy in each metered basin.

Table 3-1 Basin Meter Assessment for Metered Basins

Basin	Data Assessment	Sensor drift	Sensor anomalies	Uptime since 1/1/2013
A	Reasonable Flow Values	February 2013	A few weeks of erratic data in April 2013	90.7%
C	Reasonable Flow Values	24 hour shift in February 2014	Meter stuck in early June 2014	98.4%
D	Reasonable Flow Values	N/A	A few weeks of erratic data in May 2013; Meter stuck in early June 2014	96.9%
G	Reasonable Flow	2 day shift in October	Meter stuck in January 2013 and June 2014	98.2%

Basin	Data Assessment	Sensor drift	Sensor anomalies	Uptime since 1/1/2013
	Values	2013		
H	Reasonable Flow Values	N/A	A few days of erratic data in early October 2013; meter stuck in June 2014	98.6%
J	Reasonable Flow Values	2 day shift in April 2014	Very small number of invalid points	99.4%
K	Reasonable Flow Values	May 2013	Very small number of invalid points	96.8%
L	Reasonable Flow Values	N/A	A tree blocked proper data transmission from late January 2013 – end of October 2013; meter stuck June 2014 – August 2014	48.9%
M	Reasonable Flow Values	N/A	Very small number of invalid points	99.7%
N	Reasonable Flow Values	N/A	A few days of erratic data in August 2013 and March 2014	94.2%
O	Reasonable Flow Values	2 day shifts in July 2013 and June 2014	A few weeks of erratic data in January and February 2013; Meter stuck in January 2013	91.4%
P	Reasonable Flow Values	2 day shift in July 2013	Meter stuck in January 2013	97.5%
Q	Reasonable Flow Values	A few day shift in March 2013, July 2013, August 2013, September 2013, and July 2014	Meter stuck in early January 2013 and late December 2013	89.5%

Only Basin L and Basin Q have incomplete data, using the definition of "complete" data as having a meter uptime greater than 90%. The low uptime for basin L is due to the fact that a tree blocked proper data transmission for more than 9 months. Basin Q had an 89.5% uptime, so it is very close to providing complete data. Although most basins had a few data shifts and periods of repeat data, these problems were resolved quickly with the exception of Basin L.

Having basins with low flow can make determining accurate flows difficult. However, most basins had flows close to the predicted flow and all basins had flows of the same order of magnitude as the predicted flow, so the overall values were deemed reasonable. Since the data transmission problem in basin L has been resolved, all of the meters assessed are considered to be currently providing good data.

4. Conclusions

Analysis of the data has led to the following conclusions:

- 11 of the 13 meters provided complete data for the analyzed time period of January 2013 – August 2014.
    - One meter with incomplete data, the meter for Basin L, has been fixed and is now transmitting data properly.
    - The meter for Basin Q provided very near complete data.
- The Magnetrol 341/345 meters and the Palmer Bowlus flumes appear to be properly installed and maintained
- Transmitted data appears reasonable based on the number of connections in each basin, average household size, and pipe size.

Therefore, the historical meter data for every basin, except Basin L, is considered good for the analyzed period. With the correction of Basin L meter issues, all meters are currently considered to be providing accurate data.

5. References

1. City of Peoria Utilities. (2009). Final Sanitary Sewer Report - 2009. Retrieved from http://www.peoriaaz.gov/uploadedFiles/Peoriaaz/Departments/Utilities/ FINAL_SEWER_REPORT_2009.pdf
2. (2012). City of Scottsdale 2012 Water Reuse Master Plan Update.

Appendix C

Meter Technology Assessment

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Wastewater Planning Services

Technical Memorandum

Task 1.4 Assess Wastewater Metering Technology

March, 2015

ARCADIS

Timothy Francis, P.E.
Principal Environmental Engineer, Project Manager

John Paul Travis
Project Engineer

Technical Memorandum

Assess Wastewater Metering Technology

Prepared for:
Town of Paradise Valley

Prepared by:
ARCADIS U.S., Inc.
410 N. 44th Street
Suite 1000
Phoenix
Arizona 85008
Tel 602 438 0883
Fax 602 438 0102

Our Ref.:
00776004.0001

Date:
March, 2015

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1. Introduction **1**

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3. Available Wastewater Metering Technologies **1**

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Tables

Table 4-1 Technology Comparison

Table 4-2 Flume Comparison

1. Introduction

The Town of Paradise Valley currently tracks the status of its flow capacity ownership in the City of Scottsdale wastewater treatment system based on wastewater flow metering conducted for 13 out of 19 total wastewater drainage basins. The Town has retained ARCADIS to provide wastewater planning services. One of the tasks under the Wastewater Planning Services project is to assess the current method of wastewater metering and to compare the existing technology to appropriate alternative metering technologies. This technical memorandum summarizes the following:

- Results from the site visits to each of the 13 metering including a description of the current metering technologies and installation
- Identification and assessment of alternative metering technologies
- Comparison of existing and alternative technologies
- Conclusions and recommendations for future flow monitoring

2. Current Metering Configuration

The Town's current metering program is based on metering sites that utilize Palmer-Bowlus flumes and Magnetrol 341 or Magnetrol 345 depth meters. Since the flume controls the flow, knowing the water depth in the flume allows the flow to be determined using Palmer-Bowlus flume equations. Recorders at the sites calculate the flow values and transmit the flow data to Scottsdale via radio. In 2013, ARCADIS developed a Wastewater Flow Management Tool that takes updated flow data on a daily basis, and assists in graphical display and visualization of flow information for any time period and drainage basin (or collection of basins) desired. The Tool is loaded with flow data from January 1, 2005 to the present.

Based on data in the Wastewater Flow Management Tool, the average wastewater flows in each drainage basin have ranged from 90 to 3,600 gallons per hour (GPH) or 1.5 to 60 gallons per minute (GPM). Low flow conditions are often present, as observed during the site visits to each basin where the flow depth ranged from 0.5 inches to 2.9 inches in the 8 inch pipes. This range of flows and flow depths are important in the consideration of alternative metering technologies.

3. Available Wastewater Metering Technologies

Many types of meters can be used to measure flow in pipes, but the practicality of meters is dependent on the flow conditions (flow depth, velocity, etc.). This assessment considered a wide variety of technologies and reviewed specific models

of the most practical technologies for Paradise Valley's sewer flows. One of the alternative technologies considered was the ISCO ADFM flow meter which is a type of area-velocity meter (described later in this Section). The City of Scottsdale prefers the ISCO technology for its wastewater flow metering purposes.

According to the Wastewater Planning Services scope of work, one other alternative technology was identified and was compared to the current meters, Magnetrol 341/345 technology with Palmer-Bowlus flumes, and the ISCO ADFM technology.

3.1 Brief Technology Overview

The following metering technologies were considered. The first five technologies were looked at in further detail in Section 3.2 and the flumes were analyzed in Section 3.3. The remaining technologies were deemed impractical for Paradise Valley's sewer basins as they currently exist.

Meters

1. Electromagnetic meters
2. Ultrasonic with flume
    a. Transit time[13]
    b. Doppler shift[13]
3. Area-velocity
4. Bubbler with flume
5. Radar

---

6. Positive displacement – intended for clean liquids[13]
    a. Example - Nutating Disk
7. Mechanical flow meters – clog in wastewater applications[14]
    a. Turbine – likely to clog; not intended for low flows[13]
8. Vortex – not intended for low flows[13]
9. Variable area – not intended for low flows[13]
10. Differential pressure – often "drift" and must be checked weekly[17]
11. Target – not ideal for wastewater[12]

Flumes with Depth Meters

12. Parshall flume
13. Palmer-Bowlus flume

3.2 Meters

Ultrasonic Meters (with Flume)

Ultrasonic meters measure the distance between the meter and the top of the fluid. The distance from the meter to the bottom of the pipe is known.[4] This method works well in non-surcharged conditions since the actual water depth is not measured but is computed by subtracting the distance between the meter and the top of the fluid from the distance between the meter and the bottom of the pipe.

- Magnetrol 341/345 [3,4]
  - Accuracy of +/- 0.25% of calibrated range (+/- 0.02 in for an 8 in calibrated range).
  - Currently installed in each Paradise Valley metered basin.
- ISCO 4210[8]
  - Accuracy of +/- 0.24 in.
  - No characteristics were superior to that of the currently installed meters, so was not considered further.

Area-Velocity Meters

Area-Velocity meters measure both velocity and depth to compute the flow rate. [8]

- ISCO ADFM [9]
  - Preferred by Scottsdale.
  - Pulse-Doppler velocity profiling to determine the velocity distribution.
  - Low flow velocity profiler is rated to work for depths above 3 in.
- ISCO 4250 [8]
  - Rated for measuring depths of 0.05 ft (or 0.6 in) to 10 ft with an accuracy of +/- 0.005 in and velocities of -5 to 20 ft/s, with 0.1ft/s accuracy.
  - On-paper, an accuracy superior to that of the currently installed technology, so this technology was considered in more detail.
- ISCO LaserFlow Non-contact Velocity Sensor[15]
  - Rated for velocities above 0.5 ft/s. This technology was not considered further because estimated low flow velocities in the Paradise Valley meters are likely less than 0.4 ft/s, particularly for the smaller basins.

Electromagnetic Meters

Electromagnetic meters measure voltage from liquid passing through magnetic field. This allows the velocity of the fluid to be determined.[13]

- Signet 2551[11,20]
  - For full-pipe flow, so was not considered further.
- Ultra Mag[10,15]
  - Mount directly into pipeline.
  - Requires a flow of at least 33 GPM for an 8 in pipe. This technology was not considered further because Paradise Valley flows are generally less than 33 GPM, especially in the smaller basins, and these meters are generally used in full pipe flow conditions.

Bubbler (with Flume)

Bubblers measures depth based on the pressure required to send bubbles out of a tube at the bottom of the pipe. [8]

- ISCO 4230 – no benefits over Magnetrol 451/455 [8]
  - Depth range of 0.12 in to 10 ft.
  - Depth measurements have an accuracy of +/- 0.06 in.
  - The technology is designed to hold up against debris and solids such as those flowing through sewers.
  - This technology is practical for sewer flows and would meet the Town's needs. However, it does not offer benefits over the currently installed meters and was not considered further.

Radar

Radar meters use the Doppler Effect to measure velocity. Meters must also measure the fluid depth and compute flow based on the measurements.[16]

- Marsh-McBirney Flo-Dar Sensor [18]
  - Rated for velocities above 0.75 ft/s. This technology was not considered further because, as noted above, estimated low flow velocities in the Paradise Valley meters are likely less than 0.4 ft/s, particularly for the smaller basins.

3.3 Flumes with Depth Meters

This technology is based on a flume that controls the nature of the flow and a meter that measures the depth of flow in the flume. The measured depth in the defined area of the flume is converted to flow values using pre-defined flume equations. Both Parshall and Palmer-Bowlus flumes were considered in the assessment.

The Town currently uses Palmer-Bowlus flumes installed at each metering stations. Palmer-Bowlus flumes have a wide throat, allowing solids and debris to pass without clogging the flume.[1] Additionally, such flumes have an accuracy of +/- 3% during normal flows of 10-90% capacity and an accuracy of 5-6% for lower flows.[5] These flumes are easily installed in existing pipe systems. Since Palmer-Bowlus flumes are often as wide as the pipe, they are not as accurate for measuring low flows, particularly for flows under 5-10 GPM. [5]

Parshall flumes have a wide flow range and can handle low flows.[6] Additionally, they offer higher precision than most other flumes due to their narrow throat. The size of the flume is determined based on expected flows. However, the manufacturer warns that the 1 and 2 inch flumes clog more easily and are not recommended for sanitary sewer flows.[7]

4. Comparison of Metering Technologies

Based on the research summarized in Section 3, the most practical additional flow metering technology for comparison is the ISCO 4250 Area Velocity meter.

4.1 Meter Technology

Table 4-1 compares the ISCO ADFM meter, Magnetrol 341/345 technology, and the ISCO 4250 meter. Each technology is currently being used in a variety of installations, and these are briefly summarized in the table.

Table 4-1: Technology Comparison

Parameter	ISCO ADFM [9]	Magnetrol 341/345 [3,4]	ISCO 4250 Area Velocity [8]
Technology	Pulse-Doppler Velocity Profiling	Sound Waves (to measure depth)	Depth: Pressure Transducer Velocity: Doppler
Range	3 inch minimum depth for lowest-flow version	Max depth reading of 24 feet	Depth: 0.6in – 10 ft Velocity: -5 ft/s - 20 ft/s

Parameter	ISCO ADFM [9]	Magnetrol 341/345 [3,4]	ISCO 4250 Area Velocity [8]
Accuracy	Depth: 0.5% +/-0.1in Velocity: 0.5% +/-0.01ft/s	+/-0.25% of calibrated range (0.02 inches for an 8in range)	Depth: 0.008 ft/ft (0.005 in at 8 in depth) Velocity: 0.1ft/s at 0-5ft/s and +/-2% at 5-20 ft/s
Benefits	No flume to maintain	Works well for low flows	No flume to maintain
Limitations	Not intended for flows below 3 inches	Limited flow range (limitation primarily on the upper end) Not reliable in submerged conditions	Pressure transducer subject to drift Not reliable in low flows (below 0.6 inches according to manufacturer)
Existing Installations	Wastewater Combined sewer systems Irrigation Industrial process Industrial discharge Storm water conveyance	Water and wastewater Slurries Viscous fluids Fuel oils Acids Caustics	Storm Water Runoff Sewer Flow Monitoring Wastewater Treatment Plant Pretreatment Compliance

4.2 Flume Technology

Table 4-2 compares the advantages and limitations of Palmer-Bowlus and Parshall flumes.

Table 4-2: Flume Comparison

Flume	Palmer-Bowlus[1,5]	Parshall[2,6,7]
Advantages	Easily installed in existing pipe systems Not likely to clog	Good for low flows Narrow throat increases precision
Limitations	Less precision Reduced accuracy for low flows	Small flumes clog easily

5. Conclusions and Recommendations

This assessment led to the following conclusions:

- While area/velocity sensors offer more detailed information on the measured flows, the low flow characteristics of Paradise Valley eliminate this technology as a viable option.
    - The ISCO ADFM is designed for flows of no less than 3 inches.
    - The ISCO 4250 is designed for flows exceeding 0.6 inches, according to the literature/specifications. However, it has been ARCADIS' experience that the ISCO 4250 sensor requires flows greater than 0.9 inches and even a 0.9 inch minimum may be risky.
    - Our experience is that the flume/ultrasonic depth combination is superior in the typically low flow, non-surcharged conditions experienced in the Paradise Valley system.
- The Magnetrol 341/345 provides sufficient accuracy and is able to measure low flow depths.
- Using Parshall flumes with Paradise Valley flows would require installing easily-clogging 1 and 2 inch flumes to measure the low flows.
- Palmer-Bowlus flumes are not likely to clog and are, therefore, practical for low flows in a sanitary sewer system.

Based on the comparisons, it is recommended that Paradise Valley continue using the Palmer-Bowlus flumes and the Magnetrol 341/345 flow meters. Using the existing metering and flume technology not only provides reliable and accurate data,

but also eliminates the need to buy new equipment and train staff on new procedures. After careful analysis, the current setup has been deemed as good as or superior to other alternative metering technologies

It should be noted that the conclusions and recommendations provided above are for the existing meters and existing drainage basins. If drainage basin modifications are recommended and approved under Task 1.5 of the Wastewater Planning Services scope of work, the conclusions and recommendations of this technical memorandum should be revisited and adjusted for the new drainage basins and anticipated flow characteristics.

6. Sources

1. Global Water. (2011). Palmer Bowlus Flumes. Retrieved September 18, 2014 from http://www.globalw.com/products/palmer_flume.html.

2. Global Water. (2011). Parshall Flumes. Retrieved September 18, 2014 from http://www.globalw.com/products/parshall_flume.html.

3. Magnetrol International, Incorporated. (2000). Echotel Model 341 & 344 Ultrasonic Non-Contact Transmitters For Level, Volume, or Open Channel Flow Software version 2.0 Instruction Manual and Parts List. Retrieved September 17, 2014 from http://www.magnetrol.com/v2/pdf/MII/51-629_Inst_Man.pdf

4. Magnetrol International, Incorporated. (2011). Echotel Models 344/345 Ultrasonic Non-Contact Transmitters for Level, Volume, or Open Channel Flow. Retrieved September 17, 2014 from http://www.magnetrol.com/v2/pdf/MII/51-129.pdf

5. OpenChannelFlow. (2014). Flow Characteristics. Retreived September 17, 2014 from http://www.openchannelflow.com/products/flumes/palmer-bowlus/flow-characteristics.

6. Plasti-Fab, INC. Parshall Flume General Comments. Retrieved September 18, 2014 from http://www.plasti-fab.com/sites/www.plasti-fab.com/files/document-center/PF-Comments.pdf.

7. Plasti-Fab, INC. Parshall Flume General Flow Range. Retrieved September 18, 2014 from http://www.plasti-fab.com/sites/www.plasti-fab.com/files/document-center/PF-FlowRangeEquations.pdf.

8. Teledyne Isco, Inc. (2007). 4200 Series Flow Meters. Retrieved September 17, 2014 from http://www.isco.com/WebProductFiles/Product_Literature/202/4200_Series_Flow_Meters/4200_Series_Flowmeters_brochure.pdf.

9. Teledyne ISCO. (2013). accQmin Velocity Profiler: Precision measurement in shallow flows and small pipes. Retrieved September 17, 2014 from http://www.isco.com/products/products3.asp?PL=2022020

10. Parameters | Ultra Mag. Retrieved September 19, 2014 from http://www.mccrometer.com/products/parameters_ultramag.asp

11. Georg Fischer Signet LLC. Signet 2551 Magmeter Flow Sensor. Retrieved September 19, 2014 from http://www.instrumart.com/assets/2551-datasheet.pdf

12. Universal Flow Monitors. Target Flowmeter Technology. Retrieved September 19, 2014 from http://www.flowmeters.com/target-technology

13. GE Measurement & Control. More About Flow Meters. Retrieved September 19, 2014 from http://store.ge-mcs.com/MoreAboutCategory?CategoryID=3049

14. FSH 7409.11 – Sanitary Engineering and Public Health Handbook: 12/76 WO Amendment 5. Retrieved September 19, 2014 from http://www.fs.fed.us/dirindexhome/fsh/7409.11/63-63.23.txt

15. Teledyne ISCO INC. (2013) LaserFlow Non-contact Velocity Sensor. Retrieved September 19, 2014 from http://www.isco.com/products/products3.asp?PL=2022720

16. Malcolm Pirnie. Wet Weather Planning and Excess Flow Management.

17. Stevens, P.L. How to Choose an Open Channel Flow Monitoring Technology: A Review of Technical Features to Consider.

18. Tach Company. (2013). Flo-Dar Sensor User Manual, Edition 1. Retrieved September 22, 2014 from http://www.hachflow.com/pdf/FLO-DAR_SENSOR_MANUAL_US_ROW.pdf

19. McCrometer (2007). Ultra Mag. Model UM06 and UM06. Retrieved September 29, 2014 from http://vertassets.blob.core.windows.net/download/09c729ec/09c729ec-0d81-425a-b280-0b22091651c2/30107_09new.pdf

20. Georg Fischer Signet LLC. (2012). Signet 2551 Blind Magmeter. Retrieved September 29, 2014 from http://www.gfps.com/content/gfps/signet/en_US/sensors/flow/sensors/2551.html

Appendix D

Assessment of Rehabilitation and Replacement Priorities

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Technical Memorandum

Task 3.2 Assess Structural Condition and Estimate Remaining Useful Life of Existing Collection System

March 20, 2015

Timothy Francis, P.E.
Principal Environmental Engineer

Paul J. Batman
Project Engineer

Technical Memorandum

Assess Structural Condition and Estimate Remaining Useful Life of Existing Collection System

Prepared for:
Town of Paradise Valley

Prepared by:
ARCADIS U.S., Inc.
410 N. 44th Street
Suite 1000
Phoenix
Arizona 85008
Tel 602 438 0883
Fax 602 438 0102

Our Ref.:
00776004.0001

Date:
March 20, 2015

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A Inspection Results

B Recommendations for Pipe Repairs and Additional Inspections

C Detailed Cost Estimates

Acronyms and Abbreviations

AACE	Association for the Advancement of Cost Engineering
CCTV	Closed Circuit Television
CIP	Cured-in-Place
ENR CCI	Engineering News Record Construction Cost Index
FOG	Fats, Oil and Grease
GIS	Geographic Information System
IGA	Intergovernmental Agreement
NASSCO	National Association of Sewer Service Companies
O&M	Operations and Maintenance
PACP	Pipeline Assessment Certification Program
PVC	Polyvinyl Chloride
VCP	Vitrified Clay Pipe

1. Introduction

Wastewater collection and conveyance within the Town of Paradise Valley (Town) service area is provided by the by the Town for approximately 70 miles of sewer and by the City of Phoenix for the balance of the system. From 2003 through 2014 the Town has had a closed circuit television (CCTV) contractor inspecting portions of the system each year and it was believed that the system had been completely inspected. The Town would like to account for repairs and improvements to the system in the capital improvement planning process. The purpose of this task was to assess the CCTV inspection results and attempt to determine remaining life of the sewers and to establish a plan for improvements.

2. Methodology

This section describes the process used for reviewing the CCTV pipe inspection results, determining recommendations for rehabilitation and improvements, estimating costs of the recommendations, and determining remaining useful life.

2.1 Review of Existing Pipe Conditions

The Town provided 470 pipe inspection reports. Of these, 29 were found to be repeat inspections of pipes inspected previously. The total length inspected was approximately 19.5 miles. This was 28% of the total system which was calculated as 68.9 miles based on available GIS data. Attempts were made to obtain additional inspection reports from the CCTV contractor; however, records were no longer available.

The CCTV pipe inspections appeared to be performed in compliance with the National Association of Sewer Services Companies (NASSCO) Pipeline Assessment Certification Program (PACP) and this became a key assumption in the analysis. Pipe inspection results were extracted from the reports and tabularized for spreadsheet analysis. The number and type of pipe defects and other inspection observations were recorded in the spreadsheet. The PACP process established scores for each type of pipe defect as well as a system for rating and comparing pipes according to these defects. The number and type of defects in each pipe were used to calculate a rating for structural condition for each pipes as well as a rating for operational and maintenance (O&M) condition for each pipe, following the PACP process.

2.2 Determining Rehabilitation Needs

The structural rating, O&M rating, and specific defects were evaluated to determine an appropriate corrective action for each pipe. The following are the typical recommendations made based on the observed PACP defect codes and the general conditions leading to their selection:

- Cured-in-place (CIP) point repair: a 3-foot to 6-foot repair installed by trenchless methods; generally recommended when a single significant structural defect such as fractures, holes, and breaks (but not showing signs of an imminent collapse) was found in the pipe.
- Cured-in-place (CIP) pipe lining: a manhole-to-manhole repair installed by trenchless methods ("a pipe within a pipe"); generally recommended for pipes with structural defects such as fractures, holes, and breaks (but not showing signs of imminent collapse) throughout the length of the pipe.
- Excavated point repair: replacement of a short section of pipe or a manhole-to-manhole replacement by traditional open-cut methods; generally recommended for pipes with severe structural defects that resulted in partial or full collapse of that pipe that could not be repaired by trenchless methods.
- Re-inspect and evaluate for repair: generally recommended when a pipe had minor structural defects such as cracks which may have worsened since the pipe was last inspected.
- Re-inspect for potential Fats Oils and Grease (FOG) issues: generally recommended when significant presences or evidence of FOG were observed; pipe should be re-inspected to determine if the problem has endured or worsened. If the problem has not resolved itself, the pipe should be inspected on a regular basis to determine how quickly FOG is accumulating and determine an appropriate corrective approach.
- Re-inspect for potential root issues: generally recommended when significant presences or evidence of roots were observed; pipe should be re-inspected to determine if the problem has endured or worsened. If the problem has not resolved itself, the pipe should be inspected on a regular basis to determine how quickly roots are growing and determine an appropriate corrective approach.
- Re-inspect for other issues.
- No further action: no issues were observed within the pipe and it requires no further action at this time; these pipes should still be inspected periodically to unexpected failure in the future and to determine a rate of deterioration.

Given the length of time since the inspections, it is recommended that all pipes be inspected immediately prior to repair to confirm the condition has not worsened such that the chosen repair is not adequate. Generally, it is recommended against using more than two CIP point repairs in a single pipe as they can contribute to increased O&M issues. Recommendations were generally made conservatively. In some cases, CIP lining was selected when a CIP point repair might have been sufficient because the pipe condition is likely to have continued to worsen since the time of inspection.

2.3 Development of Rehabilitation Costs

The opinions of conceptual rehabilitation capital costs presented herein were based on available existing studies, recent projects with similar components, standard construction cost estimating manuals, and engineering judgment.

Rehabilitation costs for each pipe were developed from bid tabulations collected from numerous projects over many years and across multiple geographies in North America. These costs are generally applied on a per-foot basis and include overhead, profit, mobilization and ancillary costs like traffic control and bypass pumping.

The level of accuracy for the cost estimates corresponds to the Class 4 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International. This level of engineering cost estimating is approximate and is generally made without detailed engineering data and site layouts, but is appropriate for preliminary budget-level estimating. The accuracy of a Class 4 estimate is minus 15 to plus 20 percent in the best case and minus 30 percent to plus 50 percent in the worst case. All costs were in September 2014 dollars referenced to an Engineering News Record Construction Cost Index (ENR CCI) of 9870.

The above costs are for contracted inspection and construction only and do not include fees for engineering or design.

2.4 Determining Remaining Life

Typically, remaining life for collection systems are determined on an asset by asset basis, and typically for larger “major assets” such as interceptors, trunk lines and force mains. A reliable analysis ideally includes at least two inspections conducted at known intervals in the life of the asset, or at least one inspection at a known time since the construction of the asset. Either approach provides fixed time references over which to determine a rate of deterioration. In the case of the Town’s inspection reports, adequate data for each asset or a geographic subset of assets was not available and

generally only one inspection was made for each asset Thus, determination of a rate of deterioration which could be used to determine remaining useful life was not feasible. However, with the abundance of small diameter pipe in place around the country and the world, there is an abundance of experience upon which to draw some useful conclusions.

The two predominant pipe materials found in the Town's system were vitrified clay pipe (VCP) and polyvinyl chloride pipe (PVC). Clay pipe has been in use for centuries with many examples from Europe of pipe over 100 years old removed from the ground in nearly-new condition. It has been found likewise around North America that clay pipe, properly bedded and installed, and undisturbed by other construction activities or earth disturbance, will remain structurally sound virtually forever. The point of failure for such clay pipe has been joint material that fails and eventually allows potential exfiltration of sewage in dry soil conditions or infiltration of groundwater and rainfall derived infiltration in wet soil conditions. If there is suspicion of joint failure, a well-implemented joint-grouting program can solve this problem, as could a pipe lining program. Structural issues with clay pipe are largely attributed to poor installation, either through improper bedding and backfill which allows excess loads to be introduced to the pipe or through damage done during installation, immediately introducing minor structural defects that worsen over time.

PVC pipe has been in use for approximately 50 years and manufacturers tout lifespans of 50 to 100 years; however, there is not the history to support these claims as there is with clay pipe. As with clay pipe, many defects in PVC are the result of poor installation through improper bedding and backfill which can lead to excess loads and "squashed" pipe or through direct damage done to the pipes during installation. Based on very general pipe age information developed from the Town's subdivision construction records, it has been concluded that the clay pipe is 50 years or less, and very little, if any, PVC pipe was installed in the Town prior to the 1980s meaning most is 30 years old or less. It is a safe assumption that all of the pipe in the system which is currently in good condition can last another 20 years and if pipe rehabilitation recommendations are made then those pipes too will last another 20 years.

3. Pipe Evaluation Findings

Appendix A provides the detailed condition information for each of the pipes included in the evaluation. The inspection reports provided by the Town did not have a consistent and repeatable numbering or locating system for the start and end manholes which

prevented mapping the pipes in GIS. The manhole numbering system also did not consistently match the numbering system in the collection system GIS provided by the Town.

The closest reliable and consistent location data provided were quarter sections. Locating the pipes inspected previously would require maps or instructions that were provided to the CCTV inspection contractor when the inspections were assigned. If that information cannot be found or it did not have identifying information for the manholes, then the contractor would have to supply the logic used for tracking their work and identifying manholes. Given the amount of time that has passed since most of the inspections were conducted, it seems unlikely that the key information necessary to relate all of the pipe inspection reports to the actual manhole and pipe locations will be found.

The pipe evaluation, conducted per the methods discussed above, was performed for the inspected 19.5 miles out of estimated 69 miles (28%). Of the 441 pipes inspected, 233 were PVC and 208 were VCP. Just 12% (54) of the pipes were found to have structural defects and 46% (202) pipes had O&M defects. No collapsed or partially collapsed pipes were found.

The PACP Structural ratings ranged from 0 to 9 and PACP O&M Ratings ranged from 0-13. These ratings are based on the number and severity of defects identified in the pipe. PACP defines each type of defect and assigns a rating on a scale of 1 to 5. A minor structural defect such as a crack has a rating of “1” while a serious structural defects, such as a collapsing section, has a rating of “5”. According to PACP definitions a defect with a rating of 5 is a pipe failure that requires immediate repair. By comparison a defect with a rating of 4 is expected to fail within a few years. The overall structural rating for the pipe is the sum of all individual structural defect ratings within that pipe. It is possible for a pipe with a high overall rating to need a repair less urgently than a pipe with a single defect with rating of 5. Consequently, while the pipe ratings are a useful statistical tool to evaluate the entire system and compare it to other systems, comparing one pipe to another pipe simply on the rating is not a good indicator for prioritizing repairs. Scores for O&M defects works similarly except severity is largely based on how much the pipe is obstructed: a defect that is nearly completely obstructing the pipe, such as a severe root ball, would be rated as a “5” and requires immediate action.

On the whole, the pipe ratings for this system are very low which indicates that, overall, the system is probably in good condition, assuming that the inspected areas are representative of the rest of the system. However, the presence of defects does

indicate that the Town should be thinking proactively about the system to prevent it from reaching a condition that will be more expensive to correct. Table 3-1 presents the number and percentage of pipes for ranges of PACP scores.

Table 3-1 Range of PACP Scores

PACP Score Range	Structural Defects		O&M Defects	
0	387	87.8%	239	54.2%
1 - 3	30	6.8%	130	29.5%
4 - 6	16	3.6%	60	13.6%
7 - 9	8	1.8%	8	1.8%
>=10	0	0.0%	4	0.9%

Figures 3-1 further illustrates the percentage of structural defects observed in inspected pipes. Figure 3-2 indicates that a significant portion of the system that was inspected suffers from common O&M issues.

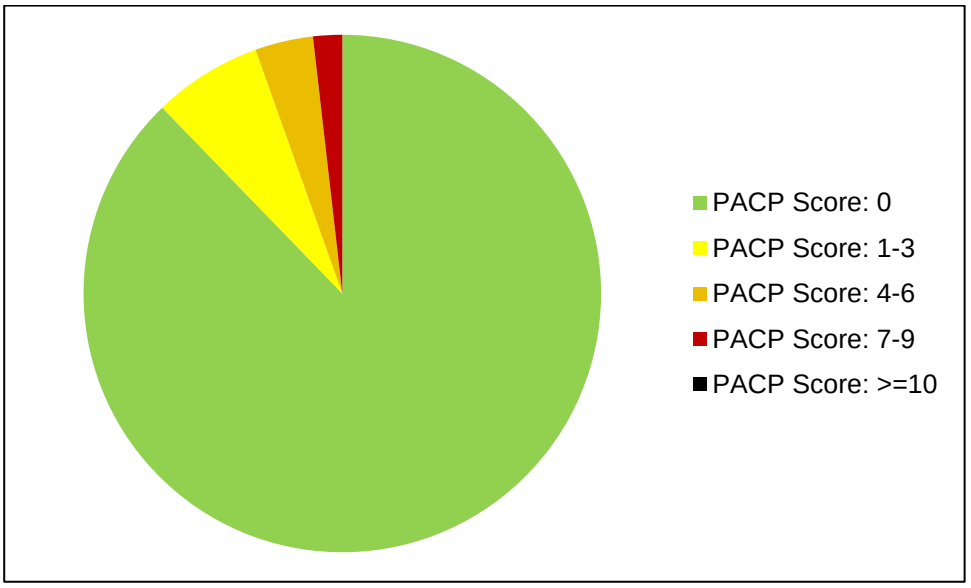


Figure 3-1 PACP Structural Rating Distribution

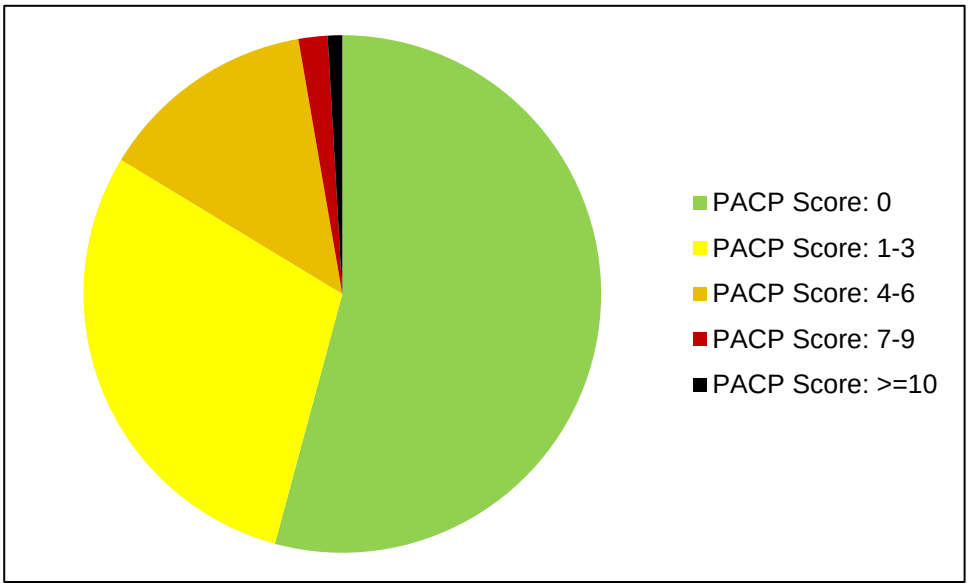


Figure 3-2 PACP O&M Rating Distribution

Table 3-2 presents the effects of age on structural and O&M condition of clay pipe. While O&M condition appears to have little relationship to age of the pipe, the structural condition of the clay pipes is clearly worse for newer pipe.

Table 3-2 Clay Pipe Age and Condition

Approximate Installation Date	Number of Pipes	Number with Structural Defects	Percent with Structural Defects	Number with O&M Defects	Percent with O&M Defects
Early 1970s	41	3	7%	26	63%
Late 1970s	75	6	8%	23	31%
Early 1980s	54	11	20%	26	48%
Late 1980s	26	6	23%	12	46%
Early 1990s	0	-	-	-	-
Late 1990s	29	8	28%	15	52%

On the surface this may seem counter-intuitive; however, it is consistent with findings by other utilities around the country. This is widely believed to be a result of the introduction of more wide-spread use of mechanized equipment in clay pipe installation. Clay pipe is a rigid, brittle material and needs to handled and bedded carefully. As installation methods shifted from hand techniques to using increasingly more mechanized equipment so increased the frequency with which clay pipe was damaged as it was installed. This is potentially exacerbated by competition with installation of plastic pipe which is manufactured in lengths of 10-20 feet, compared to clay pipe's typical 3-5 feet, which meant higher production rates and lower installation cost for PVC pipe.

Table 3-3 presents the effects of age on structural and O&M condition of PVC pipe. There are no obvious relationships between the condition of the pipes and the age or time of installation.

Table 3-3 PVC Pipe Age and Condition

Approximate Installation Date	Number of Pipes	Number with Structural Defects	Percent with Structural Defects	Number with O&M Defects	Percent with O&M Defects
Early 1970s	0	-	-	-	-
Late 1970s	11	1	9%	2	18%
Early 1980s	52	4	8%	15	29%
Late 1980s	82	9	11%	49	60%
Early 1990s	30	6	20%	13	43%
Late 1990s	59	7	12%	27	46%
Early 2000s	11	1	9%	6	55%

4. Recommendations and Repair Costs

This section presents the recommendations for repairs and improvements to the collection system and the associated costs. Appendix B contains the details of the recommendations for pipe repairs. Appendix C presents the detailed cost estimates.

4.1 Recommendations and Repair Costs for the Inspected Areas

Of the 54 pipes identified with structural defects, 21 are recommended for repairs including CIP pipe lining, CIP point repairs, and excavated spot repairs. In addition, 19 pipes are likely candidates for repair following another inspection to confirm current condition or to determine the best repair method. The remaining 14 pipes had insignificant structural defects and require no further action. Table 4-1 summarizes the recommendations for structural repair.

Table 4-1 Structural Repair Recommendations

Pipes with Structural Defects	54
Recommend CIP Lining	8
Recommend CIP Point Repair	9
Recommend Excavated Point Repair	4
Inspect to determine repair method	19
Requires no further action (minor structural defects)	14

Of the 202 pipes identified with O&M defects, 75 are recommended for inspection and investigation to determine need for further action such as routine FOG or root control. Eleven pipes also had structural pipes and are recommended for repairs. The remaining 116 pipes had insignificant O&M defects and require no further action. Table 4-2 summarizes the O&M recommendations.

Table 4-2 O&M Recommendations

Pipes with O&M Defects	202
Recommended for structural repair and inspection	11
Recommend FOG follow-up inspection	49
Recommend Roots follow-up inspection	20
Recommend FOG and Roots follow-up inspection	5
Recommend follow-up inspection for concrete in invert	1
Requires no further action (minor O&M defects)	116

The estimated cost to execute the recommendations above is $290,000k, excluding follow-on work resulting from the re-inspections recommended above for pipes with questionable structural condition or requiring follow-up for potential O&M issues. Assuming that the conditions of and repair recommendations for the 19 additional

pipes is consistent with those for the initial 21 pipes, then the additional cost to repair these pipes is estimated at $203,000. The total cost to perform the repairs and corrections arising out of the initial inspection areas is estimated at approximately $493,000k. It is recommended that these inspections and repairs be completed within the next five years, or an annual budget of $99,000 per year.

4.2 Recommendations and Costs for Evaluating and Repairing the Balance of the System

The above inspections and recommendations account for 28% of the Town's system. Assuming that the rest of the system is of similar construction and condition, a projection can be made based on the costs above to estimate the cost of implementing an inspection and rehabilitation program for the full system. It is recommended that the system be inspected over a 5-year period to identify repairs and improvements to be made to the system within 10 years of the start of the inspection program. The cost to inspect the remainder of the system (approx. 50 miles) in the first 5-year period is $326,000. Assuming that the pipe conditions and resulting repair recommendations are consistent with the previously inspected areas, the cost for repairs can be estimated at $1.25 million.

Manholes were not included in the above evaluation because there was no manhole inspection data provided. It is recommended that manholes should follow a similar inspection and repair program. Manhole structural condition is expected to be better than pipes so a failure rate is estimated at 15% or approximately half the failure found for the inspected pipes. The estimated cost for inspection and rehabilitation of manholes over a 5-year cycle is $245,000. These estimated costs total approximately $1.82 million over a period of 10 years, or an annual budget of $182,000.

4.3 Summary of Costs and Rehabilitation Program

Table 4-3 provides a summary of the repair and program costs discussed in the previous two sections. As indicated above, the recommendations for improvements based on the pipes inspected should be completed in the next five years, while the recommendations for inspecting and improving the remainder of the system should be completed over the next 10 years.

Table 4-3 Cost Summary

Total Cost to Implement Recommendations for Previously Inspected Pipes (28%)	$493,000
Annual Cost to Implement a 5-Year Program	***$99,000/year***
Implement Recommendations for Remainder of System (72%)	
5-year Pipe Inspection Program for Balance of System	$326,000
Implement Rehabilitation for Balance of System	$1,250,000
5-year Manhole Inspection and Rehabilitation	$245,000
Total Cost for Inspection and Rehabilitation Program for Remainder of System (72%)	$1,820,000
Annual Cost to Implement a 10-year Program	***$182,000***

The inspection program will cover 20% of the system annually. Within the first 5 years the entire system will have been inspected and all pipes requiring repair identified. The inspection program should target clay pipe first, starting with the newest, as these were determined to have the highest frequency of serious structural defects. The first year of the inspection program should also include the 75 pipes identified as having potential O&M issues.

The 10-year repair program will start in Year 1 with the worst pipes identified in the recommendations section above. In Year 2 the pipes with structural issues identified in Year 1 of the inspection program should be grouped with and prioritized against the pipes that were previously identified for repair but not addressed during Year 1 of the repair program. The worst of the combined set should be scheduled for repair in Year 2. This process continues through the first 5 years of the rehabilitation program, adding the results of each subsequent year of inspection results and reprioritizing to address the worst pipes first. After 5 years, all pipes will have been inspected and all repairs identified and prioritized for the second half of the repair program.

The annual inspection rate of 20% of system is aggressive but not uncommon and is recommended in this case to avoid letting the system fall into further disrepair which would result in greater expenditures in the future. The 10-year repair program will repair 3% of system annually, or 30% over 10 years. The inspection and repair rates and budgets can be reconsidered after the first inspection cycle (5 years) to determine if the program needs to be more or less aggressive. The annual budgets above could be reduced by lengthening inspection cycle and repair program, but this

does have the potential to allow inspection and repair to fall behind the deterioration rate. Ultimately this is a financial risk decision that the Town must consider.

An alternative inspection and repair prioritization approach would be to first focus strictly on completing a rapid inspection and assessment of the collection system. This would take just over two years if budgeted at the same annual expenditure rate of $231,000 per year as set above. This has two significant advantages: first, any major problems in the system will be identified earlier, potentially preventing a costly emergency; second, the condition of the entire system will be known before deciding which repairs are most critical which could save money for the Town in the long run.

A final key recommendation under any scenario is the implementation of a numbering system for the pipes and manholes that provides each with a unique, unchanging identification number. Without such a system it will be difficult to track inspections, repairs, work orders, and rate of deterioration in the future.

Technical Memorandum

Assess Structural Condition and Estimate Remaining Useful Life of Existing Colleciton System

Attachment A

Inspection Results

Report Name	Inspection (Section) Number	Start MH	Stop MH	Date	Street	Tape/Media Number	Footage	Report Diameter	Material	Esimated Decade Sewer Built	Defect Code 1	Defect Code 2	Defect Code 3	Defect Code 4	Defect Code 5	Defect Code 6	Defect Code 7	Defect Code 8	Defect Code 9	Defect Code 10	CIP Lining or CIP Point Repair	Potential CIP lining or CIP Point Repair	Excavated Repair or CIP Point Repair	Re-inpect then Repair	INSPECT - FOG	INSPECT - ROOTS	INSPECT - OTHER	Struc Score	O&M Score
59th Place	1	5407 59th Pl	Westward	3/28/2005	59th Pl	43938	43.13	8	PVC Polyvinyl Chloride	late 1990s	MSA																	0	5
60th and Indian Bend	1	1	2	1/25/2013	60th St and Indian Bend	1	212.5	8	PVC Polyvinyl Chloride	late 1980s	MWL	JSM	AMH															1	5
60th St 2004	12	5936 South	5936	2/3/2004	60th St	22-7	28.6	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
60th St 2004	9	5995 North	5995 South	2/3/2004	60th St	22-7	35.4	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
60th St 2004	15	6134	6134 West	2/3/2004	62nd/ Indian Bend	22-7	118.2	8	PVC Polyvinyl Chloride	late 1980s	MGO	AMH												X				5	0
60th St 2004	17	6149 South	6149 North	2/3/2004	62nd St	22-7	92.9	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
60th St 2004	10	5995 South	6732	2/3/2004	60th St	22-7	263.1	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
60th St 2004	13	5936 South	6721	2/3/2004	60th St	22-7	304.8	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
60th St 2004	14	6721	6722	2/3/2004	60th St	22-7	309.9	8	PVC Polyvinyl Chloride	late 1980s	TBA	AMH																0	1
60th St 2004	11	6732	5936	2/3/2004	60th St	22-7	331.2	8	PVC Polyvinyl Chloride	late 1980s	TBA	AMH																0	1
61st and Huntress 2004	2	6121	6141	1/26/2004	61st/ Huntress	22-1	245.4	8	VCP Vitrified Clay Pipe	late 1970s	TBA	FC	AMH									X						2	1
61st and Huntress 2004	8	6320	Invergordon	1/26/2004	Huntress	22-1	266.8	8	VCP Vitrified Clay Pipe	late 1970s	CC	CL	CM	CM	AMH									X				9	0
61st and Huntress 2004	10	6340	6351	1/26/2004	Huntress	22-1	321.3	8	VCP Vitrified Clay Pipe	late 1970s	RJ	AMH														X		0	3
61st and Huntress 2004	9	6320	6340	1/26/2004	Huntress	22-1	125.0	8	VCP Vitrified Clay Pipe	late 1970s	TFA	AMH																0	2
61st and Huntress 2004	6	6300	6301	1/26/2004	Huntress	22-1	126.3	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
61st and Huntress 2004	11	6320	6351	1/26/2004	Naumann	22-1	133.4	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
61st and Huntress 2004	12	6320	6311	1/26/2004	Naumann	22-1	167.2	8	VCP Vitrified Clay Pipe	late 1970s	AMH	AMH																0	0
61st and Huntress 2004	7	6301	6320	1/26/2004	Huntress	22-1	172.4	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
61st and Huntress 2004	4	6201	6211	1/26/2004	Huntress	22-1	188.1	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
61st and Huntress 2004	1	6121	6417	1/26/2004	61st/ Huntress	22-1	226.9	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
61st and Huntress 2004	5	6201	6300	1/26/2004	Huntress	22-1	318.2	8	VCP Vitrified Clay Pipe	late 1970s	TBA	AMH																0	1
61st and Huntress 2004	3	6201	6141	1/26/2004	Huntress	22-1	400.4	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
62nd 2004	7	6363	6315	2/4/2004	Cactus Wren	22-8	451.3	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
62nd St / Indian Bend	2	6134	6149	6/26/2003	62nd St/ Indian Bend		91.9	8	PVC Polyvinyl Chloride	late 1980s	JOM	AMH																1	0
62nd St / Indian Bend	5	6140	South 6140	6/26/2003	62nd St		5.0	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
62nd St / Indian Bend	6	South 6140	6203	6/26/2003	62nd St		242.6	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
62nd St / Indian Bend	1	6134	6132	6/26/2003	62nd St/ Indian Bend		116.3	8	PVC Polyvinyl Chloride	late 1980s	JOM	MGO	AMH											X				6	0
62nd St / Indian Bend	3	6149	South 6149	6/26/2003	62nd St/ Indian Bend		91.9	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
62nd St / Indian Bend	4	6140	South 6149	6/26/2003	62nd St/ Indian Bend		130.5	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
65th and Cactus Wren	9	6431	6430	6/23/2003	65th St		42.7	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
65th and Cactus Wren	8	6431	6501	6/23/2003	65th St		87.4	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
65th and Cactus Wren	4	6711	6614	6/23/2003	65th St		105.1	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
65th and Cactus Wren	5	6712	6711	6/23/2003	65th St		211.5	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
65th and Cactus Wren	6	6714	6712	6/23/2003	65th St		213.7	8	VCP Vitrified Clay Pipe	late 1970s	TBA	AMH																0	1
65th and Cactus Wren	2	6601	6515	6/23/2003	65th St		219.4	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
65th and Cactus Wren	10	6500	6430	6/23/2003	Cactus Wren Pl		312.6	8	VCP Vitrified Clay Pipe	late 1970s	TBA	TBA	AMH															0	2
65th and Cactus Wren	1	6515	6501	6/23/2003	65th St		328.5	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
65th and Cactus Wren	3	6614	6601	6/23/2003	65th St		202.8	8	VCP Vitrified Clay Pipe	late 1970s	FC	AMH										X						2	0
65th and Cactus Wren	7	6501	6714	6/23/2003	65th St		190.0	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
65th St 2004	23	6505	6735 Overlap	2/5/2004	Cactus Wren Pl	22-10	26.4	8	PVC Polyvinyl Chloride	early 1980s	MGO																	0	0
65th St 2004	16	6431 West	6500 East	2/5/2004	65th St	22-10	62.5	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
65th St 2004	20	6735	6505	2/5/2004	Cactus Wren Pl	22-10	229.1	8	PVC Polyvinyl Chloride	early 1980s	MSA														X			0	4
65th St 2004	21	6735	6725	2/5/2004	Cactus Wren Pl	22-10	245.2	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
65th St 2004	19	6430 North	6445	2/5/2004	Cactus Wren Pl	22-10	69.5	8	VCP Vitrified Clay Pipe	early 1980s	AMH	RJ	AMH													X		0	3
Cactus Wren 2 2004	3	5915	6722	2/3/2004	Cactus Wren	22-6	14.4	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
Cactus Wren 2 2004	2	6722	5902	2/3/2004	Cactus Wren	22-6	35.3	8	PVC Polyvinyl Chloride	late 1980s	MSA																	0	5
Cactus Wren 2 2004	5	6051	6116	2/3/2004	Cactus Wren	22-6	191.6	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
Cactus Wren 2 2004	7	6125	6116	2/3/2004	Cactus Wren	22-6	233.4	8	PVC Polyvinyl Chloride	late 1980s	TBA	AMH																0	1
Cactus Wren 2 2004	6	6721	6051	2/3/2004	Whispering Hills	22-6	276.4	8	PVC Polyvinyl Chloride	late 1980s	MMC	AMH																0	1
Cactus Wren 2 2004	1	5902	6722	2/3/2004	Cactus Wren	22-6	434.6	8	PVC Polyvinyl Chloride	late 1980s	MSA																	0	5
Cactus Wren 2 2004	4	5915	6051	2/3/2004	Cactus Wren	22-6	468.2	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
Cactus Wren 2004	3	6600	Invergordon	2/5/2004	64th Pl	22-9	177.0	8	PVC Polyvinyl Chloride	late 1980s	JOM	MSA																1	0
Cactus Wren 2004	1	6600	6616	2/5/2004	64th Pl	22-9	111.4	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren 2004	2	6616	C/O 6700	2/5/2004	64th Pl	22-9	111.9	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren 2004	8	6467	6515	2/5/2004	Sierra Vista	22-9	116.7	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren 2004	5	6431	6516	2/5/2004	Sierra Vista	22-9	162.0	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren 2004	7	6467	6453	2/5/2004	Sierra Vista	22-9	263.2	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren 2004	6	6431	6453	2/5/2004	Sierra Vista	22-9	274.0	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren 2004	4	6600	6516	2/5/2004	64th Pl	22-9	287.2	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren 2004	9	6431 West	6431 East	2/4/2004	Cactus Wren	22-9	218.7	8	VCP Vitrified Clay Pipe	late 1980s	FC	AMH										X						2	0
Cactus Wren/ Joshua Tree/ 65th	5	6735	6632	6/24/2003	65th Pl		167.8	8	PVC Polyvinyl Chloride	early 2000s	TBA	TBA	AMH															0	2
Cactus Wren/ Joshua Tree/ 65th	6	6440	6450	6/24/2003	Joshua Tree		216.8	8	VCP Vitrified Clay Pipe	late 1970s	TBA	AMH																0	1
Cactus Wren/ Joshua Tree/ 65th	10	6431	Invergordon	6/24/2003	Cactus Wren		247.6	8	PVC Polyvinyl Chloride	early 2000s	AMH																	0	0
Cactus Wren/ Joshua Tree/ 65th	3	6600	6502	6/24/2003	Cactus Wren Pl		256.2	8	PVC Polyvinyl Chloride	early 2000s	AMH																	0	0
Cactus Wren/ Joshua Tree/ 65th	8	6418	6440	6/24/2003	Joshua Tree		268.3	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren/ Joshua Tree/ 65th	13	6145	6223	6/24/2003	Cactus Wren		389.6	8	PVC Polyvinyl Chloride	early 2000s	AMH																	0	0
Cactus Wren/ Joshua Tree/ 65th	1	North 6500	6500	6/24/2003	Cactus Wren Pl		70.2	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Cactus Wren/ Joshua Tree/ 65th	12	6223	6315	6/24/2003	Cactus Wren		480.0	8	PVC Polyvinyl Chloride	early 2000s	FL	AMH											X					2	0
Cactus Wren/ Joshua Tree/ 65th	7	6431	6450	6/24/2003	Joshua Tree		113.9	8	VCP Vitrified Clay Pipe	late 1970s	TBA	RJ	MSA													X		0	4
Cactus Wren/ Joshua Tree/ 65th	9	6431	6430	6/24/2003	Cactus Wren		216.5	8	VCP Vitrified Clay Pipe	late 1970s	TBA	AMH																0	1
Cactus Wren/ Joshua Tree/ 65th	4	6600	6735	6/24/2003	65th Pl		245.5	8	PVC Polyvinyl Chloride	early 2000s	AMH																	0	0
Cactus Wren/ Joshua Tree/ 65th	2	North 6500	6450	6/24/2003	Cactus Wren Pl		50.1	8	VCP Vitrified Clay Pipe	late 1980s	CL	RJ	MSA											X		X		2	3
Cactus Wren/ Joshua Tree/ 65th	11	6315	Invergordon	6/24/2003	Cactus Wren		449.5	8	PVC Polyvinyl Chloride	early 2000s	TBA	AMH																0	1
E. Quartz Mt Road	2	23-41-A	23-41-B	20040407	EAST QUARTZ MT. ROAD	54-1	120.4	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
E. Quartz Mt Road	1	23-42-E	23-42-F	20040407	QUARTZ RDIE. HUMMINGBIRD	54-1	129.8	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
E. Quartz Mt Road	3	23-41-C	23-41-D	20040407	EAST QUARTZ MT. ROAD	54-1	205.5	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
East Mockingbird	1	1	South	1/26/2009	6741 E Mockingbird	77965	55.4	8	VCP Vitrified Clay Pipe	early 1970s	MWL	MGO	MSA														X	0	7
Folder for 2005	46	C/O 6487 Malcomb	6463 Arryo Verde	3/18/2005	Casa Blanca QS21-43	43757A	207.13	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Folder for 2005	52	6630 Lincoln	6724 Lincoln	03/21/2005	Lincoln QS22-43	42593	361.7	8	VCP Vitrified Clay Pipe	early 1980s	ISSRH	ISSRH	ISSRH	CM	ISZ	CS	AMH							X				5	10
Folder for 2005	18	6717 Soloano	5716 Mockingbird	3/18/2005	Solano Dr QS20-43	43746A	302.09	8	VCP Vitrified Clay Pipe	early 1980s	DAGS	MMC	MMC	RBJ	AMH										X	X		0	9
Folder for 2005	26	6709 San Juan	5501 67th Pl	3/16/2005	67th Pl QS20-43	43746A	258.87	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Folder for 2005	1	6248 McDonald	5815 Sahuaro	3/15/2005	Sahuaro QS20-42	43746	299.22	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Folder for 2005	48	6460 Arryo Verde	6136 Arryo Verde	3/18/2005	Arryo Verde QS21-43	43757A	304.57	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Folder for 2005	32	68th St	68th Pl	3/17/2005	Jackrabbit QS20-44	43757	307.63	8	PVC Polyvinyl Chloride	early 1980s	AMH	AMH																0	0
Folder for 2005	22	6500 Jackrabbit	Jackrabbit/ Casa Blanca	3/18/2005	Jackrabbit QS19-43	43746A	312.38	8	PVC Polyvinyl Chloride	early 1980s	MSA																	0	5
Folder for 2005	27	6624 Kasba Cir Rear	Casa Blanca/ Jackrabbit	3/17/2005	Jackrabbit QS20-43	43757	315.55	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Folder for 2005	30	5500 Jackrabbit	67th Pl Intersection	3/17/2005	Jackrabbit QS20-43	43757	319.31	8	PVC Polyvinyl Chloride	early 1980s	ISZ	TBA	OBM	AMH														0	5
Folder for 2005	10	5627 Casa Blanca	San Miguel	3/15/2005	Casa Blanca QS20-43	43746	319.4	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Folder for 2005	57	V Vista/ 59th Pl	6301 59th Pl	03121/2005	N 59th Pl QS21-41	42593	320.39	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Folder for 2005	47	6460 Arryo Verde	Invergordon/ Arryo Verde	3/18/2005	Arryo Verde QS21-43	43757A	321.88	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Folder for 2005	37	Quail Run	5511 Quail Run Yard	3/17/2005	Jackrabbit QS20-44	43757	324.45	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0

Report Name	Inspection (Section) Number	Start MH	Stop MH	Date	Street	Tape/Media Number	Footage	Report Diameter	Material	Esimated Decade Sewer Built	Defect Code 1	Defect Code 2	Defect Code 3	Defect Code 4	Defect Code 5	Defect Code 6	Defect Code 7	Defect Code 8	Defect Code 9	Defect Code 10	CIP Lining or CIP Point Repair	Potential CIP lining or CIP Point Repair	Excavated Repair or CIP Point Repair	Re-inpect then Repair	INSPECT - FOG	INSPECT - ROOTS	INSPECT - OTHER	Struc Score	O&M Score
Folder for 2005	36	69th Pl Intersection	6995 Jackrabbit	3/17/2005	Jackrabbit QS20-44	43757	330.38	8	PVC Polyvinyl Chloride	early 1980s	ISZ	AMH																0	2
Folder for 2005	49	7026 McDonald	Eastward	3/21/2005	McDonald QS	42593	18.8	8	PVC Polyvinyl Chloride	early 1990s	RBL	MSA														X		0	5
Folder for 2005	5	Starlight/ Cameldale	5840 Starlight	3/15/2005	Starlight/ Cameldale	43746	312.1	8	PVC Polyvinyl Chloride	early 1990s	RBJ	D	TBA	D	AMH									X		X		8	5
Foothill Dr	2-1	1	2	3/8/2013	E Foothills Dr	1	186.4	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
Grant Street	13	5739 Sahuaro	5665 Sahuaro	03/14/2005	Sahuaro QS20-42	43734	402.69	8	PVC Polyvinyl Chloride	early 1990s	TBA	AMH																0	1
Grant Street	10	5306 Wilkinson	C/O	03/14/2005	Wilkinson QS19-43	43734	105.84	8	PVC Polyvinyl Chloride	early 1990s	ACO																	0	0
Grant Street	5	5168 71st Pl	Scottsdale Rd	03/14/2005	N 71st Pl QS19-44	43734	167.76	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	11	5615 Sahuaro	5539 Sahuaro	03/14/2005	Sahuaro QS20-42	43734	260.3	8	PVC Polyvinyl Chloride	early 1990s	D	LR	ISSR	AMH										X				4	3
Grant Street	1	7035 Balfur	7091 Balfur	03/14/2005	Balfur QS19-44	43734	172.71	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	4	5168 71st Pl	7181 Balfur	03/14/2005	N 71st Pl QS19-44	43734	195.76	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	12	5615 Sahuaro	5665 Sahuaro	03/14/2005	Sahuaro QS20-42	43734	398.6	8	PVC Polyvinyl Chloride	early 1990s	D	ISSR	AMH											X				4	2
Grant Street	6	5106 Wilkinson	5102 Wilkinson	03/14/2005	Wilkinson QS19-43	43734	233.74	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	3	5152 70th Way	7035 Balfur	03/14/2005	N 70th Way QS19-44	43734	236.91	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	2	7091 Balfur	7181 Balfur	03/14/2005	Balfur QS19-44	43734	258.17	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	14	5739 Sahuaro	5815 Sahuaro	03/14/2005	Sahuaro QS20-42	43734	278.65	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	7	5102 Wilkinson	5100 Wilkinson	03/14/2005	Wilkinson QS19-43	43734	398.24	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	9	5306 Wilkinson	5200 Wilkinson	03/14/2005	Wilkinson QS19-43	43734	403.88	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street	8	5106 Wilkinson	5200 Wilkinson	03/14/2005	Wilkinson QS19-43	43734	413.28	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Grant Street 2	42	6602 Casa Blanca	Northward	3/17/2005	Casa Blanca QS21-43	43757A	400.52	8	PVC Polyvinyl Chloride	early 1980s	JOM	AMH																1	0
Grant Street 2	4	NW Corner	Center of St	3/15/2005	Sahuaro QS21-42	43746	46.1	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	28	Casa Blanca/ Jackrabbit	6500 Jackrabbit Overlap	3/17/2005	Jackrabbit QS20-43	43757	53.4	8	PVC Polyvinyl Chloride	early 1980s	MSA																	0	0
Grant Street 2	17	6716 Solano Dr	5701 Solano Dr	3/16/2005	Solano Dr QS20-43	43746A	98.42	8	VCP Vitrified Clay Pipe	early 1980s	MMC	MMC	AMH															0	2
Grant Street 2	33	68th Pl	6832 Jackrabbit	3/17/2005	Jackrabbit QS20-44	43757	110.89	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	59	6237 N 59th Pl	6161 N 59th Pl	3/21/2005	N 59th Pl QS21-42	42593	126.22	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	25	San Juan/ 67th Pl	6709 San Juan	3/16/2005	67th Pl QS20-43	43746A	135.71	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	9	5801 Starlight	5757 Starlight	3/15/2005	Cameldale QS20-41	43746	146.5	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	41	Casa Blanca/ Malcomb	6602 Casa Blanca	3/17/2005	Casa Blanca QS21-43	43757A	150.85	8	PVC Polyvinyl Chloride	early 1980s	TBA	AMH																0	1
Grant Street 2	51	6724	Mockingbird	3/21/2005	Lincoln QS22-43	42593	380.8	8	VCP Vitrified Clay Pipe	early 1980s	ISSRH	ISSRH	CL	CL	TBA	AMH								X				4	5
Grant Street 2	12	5721 Casa Blanca	Solano Dr	3/15/2005	Casa Blanca QS20-43	43746	155.79	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	38	Jackrabbit/ 5511 Quail Run	7045 Jackrabbit	3/17/2005	Jackrabbit QS20-44	43757	159.7	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	35	69th Pl N/ Intersection	69th Pl S/ Intersection	3/17/2005	Jackrabbit QS20-44	43757	175.97	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	58	59th Pl/ Edward	6237 59th Pl	3/21/2005	N 59th Pl QS21-42	42593	176.86	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	7	5714 Cameldale	Cameldale/ Starlight	3/15/2005	Cameldale QS20-41	43746	489.34	8	PVC Polyvinyl Chloride	early 1980s	DAGS	AMH													X			0	2
Grant Street 2	45	6487 Malcomb	S/O 6487 Malcomb	3/18/2005	Casa Blanca QS21-43	43757A	217.82	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	8	5801 Starlight	5840 Starlight	3/15/2005	Cameldale QS20-41	43746	268.07	8	PVC Polyvinyl Chloride	early 1980s	RBL	AMH														X		0	4
Grant Street 2	3	6011 Sahuaro	McDonald NW Corner	3/15/2005	Sahuaro QS21-42	43746	270.93	8	PVC Polyvinyl Chloride	early 1980s	DAGS	AMH													X			0	2
Grant Street 2	54	6500 Lincoln	6602 Lincoln	3/21/2005	Lincoln QS22-43	42593	373.1	8	VCP Vitrified Clay Pipe	early 1980s	ISZ	CS	CM	CL	CL	ISZ	AMH				X							9	4
Grant Street 2	52	6630 Lincoln	6724 Lincoln	3/21/2005	Lincoln QS22-43	42593	381.7	8	VCP Vitrified Clay Pipe	early 1980s	ISSRH	ISSRH	ISSRH	CM	ISZ	TBA	CS	AMH						X				5	11
Grant Street 2	31	68th St/ Jackrabbit	67th Pl/ Jackrabbit	3/17/2005	Jackrabbit QS20-43	43757	329.89	8	PVC Polyvinyl Chloride	early 1980s	DAGS	TBA	OBR	MSA											X			0	9
Grant Street 2	50	7026 McDonald	Eastward	3/21/2005	McDonald QS21-44	42593	19.1	8	VCP Vitrified Clay Pipe	late 1980s	CL	RBB	TBA	MSA										X		X		2	6
Grant Street 2	39	Casa Blanca/ Malcomb	6215 Casa Blanca	3/17/2005	Casa Blanca QS21-43	43757A	346.29	8	PVC Polyvinyl Chloride	early 1980s	JOM	TBA	DAGS	AMH											X			1	3
Grant Street 2	24	S/O 6708 San Juan	San Miguel	3/16/2005	67th Pl QS20-43	43746A	130.4	8	PVC Polyvinyl Chloride	early 1980s	D	AMH												X				4	0
Grant Street 2	43	6519 Malcomb	Casa Blanca/ Malcomb	3/18/2005	Casa Blanca QS21-43	43757A	295.07	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	40	6215 Casa Blanca	Southward	3/17/2005	Casa Blanca QS21-43	43757A	301.1	8	PVC Polyvinyl Chloride	early 1980s	TBA	AMH																0	1
Grant Street 2	29	Behind 6624 Jackrabbit	5500 Jackrabbit	3/17/2005	Jackrabbit QS20-43	43757	310.11	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	60	59th Pl/ Edward	Northward	3/21/2005	N 59th Pl QS21-42	42593	334.54	8	PVC Polyvinyl Chloride	early 1980s	TBA	AMH																0	1
Grant Street 2	21	Wilkinson/ Jackrabbit	6500 Jackrabbit	3/16/2005	Jackrabbit QS19-43	43756A	338.0	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	11	5627 Casa Blanca	5721 Casa Blanca	3/15/2005	Casa Blanca QS20-43	43746	340.97	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	44	6519 Malcomb	Westward	3/18/2005	Casa Blanca QS21-43	43757A	346.41	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	20	Jackrabbit/ Wilkinson	6400 Jackrabbit	3/16/2005	Jackrabbit QS19-43	43756A	346.9	8	PVC Polyvinyl Chloride	early 1980s	TBA	TBA	ISZ	TBA	ISSRH	AMH												0	8
Grant Street 2	56	V Vista/ 59th Pl	Northward	3/21/2005	N 59th Pl QS21-42	42593	350.17	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	2	6248 McDonald	McDonald/ Sahuaro	3/15/2005	Sahuaro QS20-42	43746	351.85	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	55	V Vista/ 59th Pl	5902 Valley Vista	3/21/2005	N 59th Pl QS21-42	42593	360.65	8	PVC Polyvinyl Chloride	early 1980s	TBA	AMH																0	1
Grant Street 2	13	6630 Solano Dr	Casa Blanca	3/15/2005	Solano Dr QS20-43	43746	374.2	8	VCP Vitrified Clay Pipe	early 1980s	MMC	AMH																0	1
Grant Street 2	19	5716 Mockingbird	5800 Mockingbird	3/16/2005	Solano Dr QS20-43	43746A	343.54	8	VCP Vitrified Clay Pipe	early 1980s	DAGS	MSA													X			0	2
Grant Street 2	34	69th Pl/ Jackrabbit	68th Pl/ SO Side	3/17/2005	Jackrabbit QS20-44	43757	393.99	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
Grant Street 2	14	6630 Solano Dr	Cul-de-sac	3/15/2005	Solano Dr QS20-43	43746A	398.0	8	VCP Vitrified Clay Pipe	early 1980s	CL	AMH												X				2	0
Grant Street 2	6	Starlight/ Cameldale	5841 Starlight	3/15/2005	Starlight/ Cameldale	43746	438.01	8	PVC Polyvinyl Chloride	early 1990s	MMC	AMH																0	1
Grant Street 2	15	6701 Solano Dr	Cul-de-sac	3/16/2005	Solano Dr QS20-43	43746A	207.53	8	VCP Vitrified Clay Pipe	early 1980s	RBJ	AMH														X		0	5
Grant Street 2	16	6701 Solano Dr	6716 Solano Dr	3/16/2005	Solano Dr QS20-43	43746A	281.02	8	VCP Vitrified Clay Pipe	early 1980s	RBJ	AMH														X		0	5
Grant Street 2	53	Casa Blanca	6500 Lincoln	3/21/2005	Lincoln QS22-43	42593	156.9	8	VCP Vitrified Clay Pipe	early 1980s	CL	ISZ	CM	CL	CL	AMH								X				9	2
Grant Street 2	23	San Juan/ 67th Pl	6708 San Juan	3/16/2005	67th Pl QS20-43	43746A	380.0	8	PVC Polyvinyl Chloride	early 1980s	CS	FL	D	AMH									X					9	0
Huntress	3	6001	C/O 6000	2/2/2004	Huntress	22-4	21.6	6	VCP Vitrified Clay Pipe	late 1970s	ACO																	0	0
Huntress	2	6020	6001	2/2/2004	Huntress	22-4	73.5	6	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Huntress	1	6020	6100	2/2/2004	Huntress	22-4	107.6	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Huntress	7	6325	6311	2/2/2004	61st Pl	22-4	123.2	6	VCP Vitrified Clay Pipe	late 1970s	ACO																	0	0
Huntress	5	6301	6234	2/2/2004	Yucca	22-4	144.1	6	VCP Vitrified Clay Pipe	late 1980s	ACO																	0	0
Huntress	6	6123	6133	2/2/2004	61st Pl	22-4	160.7	6	VCP Vitrified Clay Pipe	late 1970s	ACO																	0	0
Huntress	8	6100	6417	1/30/2004	Huntress	22-4	278.6	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Huntress	4	6001	6010	2/2/2004	Huntress	22-4	281.7	6	PVC Polyvinyl Chloride	late 1970s	MSA																	0	5
Joshua Tree/ 58th Pl	13	5832	6719	2/2/2004	58th Pl	22-5	108.6	8	PVC Polyvinyl Chloride	late 1980s	MGO																	0	0
Joshua Tree/ 58th Pl	9	5739	5729	2/2/2004	Joshua Tree/ 58th Pl	22-5	154.8	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
Joshua Tree/ 58th Pl	8	5744	5739	2/2/2004	Joshua Tree/ 58th Pl	22-5	181.9	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
Joshua Tree/ 58th Pl	11	6719	5832	2/2/2004	58th Pl	22-5	196.0	8	PVC Polyvinyl Chloride	late 1980s	MSA																	0	5
Joshua Tree/ 58th Pl	14	6712	5902	2/2/2004	Cactus Wren	22-5	217.9	8	PVC Polyvinyl Chloride	late 1980s	MSA																	0	5
Joshua Tree/ 58th Pl	15	5902	6712	2/2/2004	Cactus Wren	22-5	268.0	8	PVC Polyvinyl Chloride	late 1980s	MSA																	0	5
Joshua Tree/ 58th Pl	10	5744	5832	2/2/2004	Joshua Tree/ 58th Pl	22-5	329.8	8	PVC Polyvinyl Chloride	late 1980s	TBA	AMH																0	1
Joshua Tree/ 58th Pl	12	6719	6712	2/2/2004	58th Pl	22-5	337.1	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
Lincoln Dr	2	6721	6145	6/27/2003	62nd St		421.3	8	PVC Polyvinyl Chloride	late 1980s	JOL	MMC	MMC	AMH														2	2
Lincoln Dr	1	6145	6721	6/27/2003	62nd St/ Joshua Tree		334.2	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
Lincoln Dr	3	6101	6145	6/27/2003	Cactus Wren		425.9	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
Meadowlark/ 66th/ Hummingbird	18	6412	6420	6/19/2003	Hummingbird		19.0	8	VCP Vitrified Clay Pipe	early 1970s	AJB	AMH																0	0
Meadowlark/ 66th/ Hummingbird	8	6550	66th Overlap	6/19/2003	Meadowlark/ 66th St		21.2	8	VCP Vitrified Clay Pipe	late 1990s	MGO																	0	0
Meadowlark/ 66th/ Hummingbird	5	6629	66th St	6/19/2003	Meadowlark/ 66th Pl		27.2	8	VCP Vitrified Clay Pipe	late 1990s	AMH																	0	0
Meadowlark/ 66th/ Hummingbird	17	64th Pl	6420	6/19/2003	Hummingbird		36.6	8	VCP Vitrified Clay Pipe	late 1990s	AMH																	0	0
Meadowlark/ 66th/ Hummingbird	10	6601	C/O 7126	6/19/2003	66th St		76.7	8	VCP Vitrified Clay Pipe	late 1990s	ACO																	0	0
Meadowlark/ 66th/ Hummingbird	9	6515	6550	6/19/2003	Meadowlark/ 66th St		110.6	8	VCP Vitrified Clay Pipe	late 1990s	RJ	TBA	AMH													X		0	3
Meadowlark/ 66th/ Hummingbird	15	6527	6501	6/19/2003	Hummingbird		307.9	8	VCP Vitrified Clay Pipe	late 1990s	RJ	RJ	B	RJ	AMH						X					X		5	6
Meadowlark/ 66th/ Hummingbird	14	6527	66th St	6/19/2003	Hummingbird		310.1	8	VCP Vitrified Clay Pipe	late 1990s	FC	B	AMH								X							7	0
Meadowlark/ 66th/ Hummingbird	11	6601	6655	6/19/2003	66th St		152.9	8	VCP Vitrified Clay Pipe	late 1990s	DAGS	RJ	AMH												X	X		0	5
Meadowlark/ 66th/ Hummingbird	3	6629	6659	6/19/2003	Meadowlark/ 66th Pl		285.3	8	VCP Vitrified Clay Pipe	late 1990s	TBA	B	TBA	TBA	AMH						X							5	3

Report Name	Inspection (Section) Number	Start MH	Stop MH	Date	Street	Tape/Media Number	Footage	Report Diameter	Material	Esimated Decade Sewer Built	Defect Code 1	Defect Code 2	Defect Code 3	Defect Code 4	Defect Code 5	Defect Code 6	Defect Code 7	Defect Code 8	Defect Code 9	Defect Code 10	CIP Lining or CIP Point Repair	Potential CIP lining or CIP Point Repair	Excavated Repair or CIP Point Repair	Re-inpect then Repair	INSPECT - FOG	INSPECT - ROOTS	INSPECT - OTHER	Struc Score	O&M Score
Meadowlark/ 66th/ Hummingbird	4	6629	7126	6/19/2003	Meadowlark/ 66th Pl		407.0	8	VCP Vitrified Clay Pipe	late 1990s	FC	AMH										X						2	0
Meadowlark/ 66th/ Hummingbird	1	6717	7100	6/19/2003	Meadowlark		289.4	8	VCP Vitrified Clay Pipe	late 1990s	DAGS	MSA													X			0	7
Meadowlark/ 66th/ Hummingbird	13	6601	Hummingbird	6/19/2003	66th St		229.3	8	VCP Vitrified Clay Pipe	late 1990s	TBA	AMH																0	1
Meadowlark/ 66th/ Hummingbird	7	66th St	6550	6/19/2003	Meadowlark/ 66th St		256.8	8	VCP Vitrified Clay Pipe	late 1990s	MSA																	0	5
Meadowlark/ 66th/ Hummingbird	2	6659	6717	6/19/2003	Meadowlark		302.2	8	VCP Vitrified Clay Pipe	late 1990s	TBA	TBA	AMH															0	2
Meadowlark/ 66th/ Hummingbird	16	64th Pl	6501	6/19/2003	Hummingbird		159.6	8	VCP Vitrified Clay Pipe	late 1990s	FC	AMH										X						2	0
Meadowlark/ 66th/ Hummingbird	12	6627	6655	6/19/2003	66th St		424	8	VCP Vitrified Clay Pipe	late 1990s	AMH																	0	0
Meadowlark/ 66th/ Hummingbird	6	66th St	6629 Overlap	6/19/2003	Meadowlark/ 66th St		393.4	8	VCP Vitrified Clay Pipe	late 1990s	B	TBA	RJ	MGO							X							5	3
Mockingbird and Indian Bend	2	Octillo	S. 6745	6/17/2005	Octillo	45358	87.67	8	PVC Polyvinyl Chloride	early 1990s	RP	RP	RP	JOM	RP	A												1	2
Mockingbird and Indian Bend	3	S/O Judson	6715	6/17/2005	Judson	45358	31.71	8	PVC Polyvinyl Chloride	late 1980s	RP	RP	RP	RP	A													0	2
Mockingbird and Indian Bend	4	S/O Ind Ben	Indian Bend	6/17/2005	Indian Bend	45358	201.61	8	PVC Polyvinyl Chloride	late 1990s	RP	RP																0	1
Mockingbird and Indian Bend	1	66 Place	6608	6/17/2005	66 Place	45358	236.44	8	PVC Polyvinyl Chloride	early 1990s	RP	RP	A															0	2
Morrison and 54th	11 - 5452	11	5452	2/13/2013	Morrison and 54th	1	81.2	8	VCP Vitrified Clay Pipe	early 1970s	RFB	RBL	MSA													X		0	4
Morrison and 54th	5452-11	11	5452	2/13/2013	Morrison and 54th	1	116.9	8	VCP Vitrified Clay Pipe	early 1970s	RFC	RBL	MSA													X		0	4
Morrison and 54th	5432-5426	5426	5432	2/13/2013	Morrison and 54th	1	0.5	8	VCP Vitrified Clay Pipe	early 1970s	RBC	MSA														X		0	4
Morrison and 54th	5452-5432	5452	5432	2/13/2013	Morrison and 54th	1	117.8	8	VCP Vitrified Clay Pipe	early 1970s	RFJ	AMH														X		0	2
Morrison and 54th	CL-11	11	CL	2/13/2013	Morrison and 54th	1	88.5	8	VCP Vitrified Clay Pipe	early 1970s	ACO																	0	0
Morrison and 54th	5426-5426 West	5426	5426 West	2/13/2013	Morrison and 54th	1	120.0	8	VCP Vitrified Clay Pipe	early 1970s	TBA	AMH																0	1
Morrison and 54th	5412-54th St	5412	54th St	2/13/2013	Morrison and 54th	1	136.2	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
Morrison and 54th	5412-5426 West	5426 West	5412	2/13/2013	Morrison and 54th	1	72.2	8	VCP Vitrified Clay Pipe	early 1970s	RBC	MSA													X			0	4
Naumann 2 2004	17	6201	6221	1/26/2004	Naumann	22-2	127.9	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2 2004	16	6201	C/O 6131	1/26/2004	Naumann	22-2	130.6	8	VCP Vitrified Clay Pipe	late 1970s	ACO	MGO																0	5
Naumann 2 2004	15	6201	C/O 6200	1/26/2004	Naumann	22-2	149.4	6	VCP Vitrified Clay Pipe	late 1970s	ACO	MSA																0	5
Naumann 2 2004	14	6320	C/O 6331	1/26/2004	Naumann	22-2	157.2	6	VCP Vitrified Clay Pipe	late 1970s	ACO	MSA																0	5
Naumann 2 2004	18	6221	6231	1/26/2004	Naumann	22-2	193.4	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2 2004	2	6101	6400	1/27/2004	Huntress	22-2	208.5	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2 2004	1	6101	6417	1/27/2004	Huntress	22-2	214.6	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2 2004	3	6020	6400	1/27/2004	Naumann	22-2	279.7	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2 2004	13	6311	6231	1/26/2004	Naumann	22-2	400.0	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2004	1	6101	6100	1/30/2004	61st Pl	22-3	154.1	8	VCP Vitrified Clay Pipe	late 1970s	RJ	AMH														X		0	2
Naumann 2004	2	6101	6123	1/30/2004	61st Pl	22-3	165.2	8	VCP Vitrified Clay Pipe	late 1970s	RJ	AMH														X		0	2
Naumann 2004	3	6163	6123	1/30/2004	61st Pl	22-3	111.4	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2004	3	6121	6400	1/29/2004	61st Pl	22-3	148.0	8	VCP Vitrified Clay Pipe	late 1970s	MSA																	0	5
Naumann 2004	4	6121	6323	1/29/2004	61st Pl	22-3	162.1	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2004	5	6323	6325	1/29/2004	61st Pl	22-3	165.7	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2004	1	6010	6020	1/29/2004	Naumann	22-3	175.7	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2004	2	6010	6011	1/29/2004	Naumann	22-3	181.8	8	VCP Vitrified Clay Pipe	late 1970s	RJ	AMH																0	2
Naumann 2004	5	6215	6214	1/30/2004	61st Pl	22-3	234.0	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Naumann 2004	7	6229	6325	1/30/2004	61st Pl	22-3	238.4	8	VCP Vitrified Clay Pipe	late 1970s	TBI	AMH																0	2
Naumann 2004	6	6310	6323	1/29/2004	Yucca	22-3	298.6	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
Naumann 2004	4	6163	6215	1/30/2004	61st Pl	22-3	350.0	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
Paradise Ranch	11	7101 North	7101 South	6/16/2003	Mockingbird/ Meadow Lark		16.6	8	VCP Vitrified Clay Pipe	late 1990s	JOM	AMH																1	0
Paradise Ranch	16	7010	C/O 7004	6/16/2003	70th St/ El Alba		122.1	8	PVC Polyvinyl Chloride	late 1990s	MGO	ACO																0	5
Paradise Ranch	17	7117	7181	6/18/2003	68th Pl		150.9	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
Paradise Ranch	3	6929	6962	6/18/2003	Cheney, W/O 70th St		325.6	8	PVC Polyvinyl Chloride	late 1990s	DAGS	MMC	RJ	DAGS	MGO	AMH									X	X		0	7
Paradise Ranch	18	7117	7100	6/16/2003	68th Pl		338.1	8	PVC Polyvinyl Chloride	late 1990s	DAGS	AMH													X			0	3
Paradise Ranch	6	7302	7239	6/18/2003	Mockingbird/ Avenida El Alba		155.3	8	PVC Polyvinyl Chloride	early 1990s	DAGS	DAGS	AMH												X			0	2
Paradise Ranch	14	6760 South	6743	6/18/2003	Mockingbird/ Arroyo Court		218.7	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
Paradise Ranch	13	6760 South	6760	6/18/2003	Mockingbird/ Arroyo Court		16.4	8	VCP Vitrified Clay Pipe	late 1990s	DAGS	DAGS													X			0	2
Paradise Ranch	15	6760 South	6767	6/16/2003	Mockingbird/ Arroyo Court		307.1	8	VCP Vitrified Clay Pipe	late 1990s	DAGS	DAGS	AMH												X			0	3
Paradise Ranch	12	7101 South	6760	6/18/2003	Mockingbird/ Meadow Lark		339.6	8	VCP Vitrified Clay Pipe	late 1990s	DAGS	AMH													X			0	2
Paradise Ranch	1	6988	7602	6/18/2003	70th/ Paradise Ranch		307.1	8	PVC Polyvinyl Chloride	late 1980s	TBA	AMH																0	1
Paradise Ranch	7	7239	7235	6/18/2003	Mockingbird/ Bluebird		322.1	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
Paradise Ranch	10	7100	7101	6/16/2003	Mockingbird, N/O Meadow Lark		326.6	8	PVC Polyvinyl Chloride	late 1990s	MMC	AMH																0	1
Paradise Ranch	8	7235	7201	6/16/2003	Mockingbird, S/O Bluebird		328.1	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
Paradise Ranch	2	6962	6988	6/16/2003	Paradise Ranch		347.4	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
Paradise Ranch	9	7100	7201	6/16/2003	Mockingbird, N/O Meadow Lark		352.7	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
Paradise Ranch	4	6900	6929	6/18/2003	Cheney, W/O 70th St		397.5	8	PVC Polyvinyl Chloride	late 1990s	TBA	TBA	TBA	AMH														0	3
Paradise Ranch	5	7437	6900	6/18/2003	Cheney/ Mockingbird		399.2	8	PVC Polyvinyl Chloride	late 1980s	TBA	TBA	AMH															0	2
QS 20-41	5	6	1	10/5/2009	QS 20-41	0	74.05	8	PVC Polyvinyl Chloride	late 1980s	MWL	DAGS	AMH												X			0	4
QS 20-41	4	6	7	10/5/2009	QS 20-41	0	145.38	8	PVC Polyvinyl Chloride	late 1980s	MWL	TBI	DAGS	AMH											X			0	6
QS 20-41	7	8	12	10/5/2009	QS 20-41	0	146.49	8	PVC Polyvinyl Chloride	late 1980s	MWL	DAGS	AMH												X			0	4
QS 20-41	14	9	20	10/5/2009	QS 20-41	0	238.19	8	VCP Vitrified Clay Pipe	late 1970s	MWL	MWLS	DAGS	MMC	MMC	RFJ	MWL	MWL	DSC	MSA					X			0	13
QS 20-41	13	9	21	10/5/2009	QS 20-41	0	440.37	8	VCP Vitrified Clay Pipe	late 1970s	DAGS	DAGS	AMH												X			0	2
QS 20-41	2	10	11	10/5/2009	QS 20-41	91820	313.0	8	PVC Polyvinyl Chloride	late 1990s	MWL	DAGS	D	RMJ	RMJ	TBA	SZ	AMH						X	X	X		4	13
QS 20-41	1	10	9	10/5/2009	QS 20-41	91820	433.98	8	PVC Polyvinyl Chloride	late 1990s	MWL	DAGS	RMJ	MMC	AMH										X	X		0	9
QS 20-41	3	11	12	10/5/2009	QS 20-41	91820	264.55	8	PVC Polyvinyl Chloride	late 1990s	MWL	DAGS	D	TBA	AMH									X	X			4	3
QS 20-41	10	14	13	10/5/2009	QS 20-41	0	502.71	8	PVC Polyvinyl Chloride	late 1990s	MWL	DAGS	AMH	AMH											X			0	4
QS 20-41	8	19	16	10/5/2009	QS 20-41	0	295.19	8	PVC Polyvinyl Chloride	late 1990s	MWL	DAGS	AMH												X			0	4
QS 20-41	9	16	13	10/5/2009	QS 20-41	0	51.65	8	PVC Polyvinyl Chloride	late 1980s	MWL	DAE	AMH															0	4
QS 20-41	6	7	8	10/5/2009	QS 20-41	0	169.29	8	PVC Polyvinyl Chloride	late 1980s	MWL	AMH																0	2
QS 20-41	11	14	15	10/5/2009	QS 20-41	0	224.67	8	PVC Polyvinyl Chloride	late 1980s	MWL	AMH																0	2
QS 20-41	12	15	17	10/5/2009	QS 20-41	0	280.97	8	PVC Polyvinyl Chloride	late 1990s	MWL	DAGS	AMH															0	2
QS 20-42	14-18	14	18	6/11/2012	Yucca Rd & Palo Verde	1	421.0	8	PVC Polyvinyl Chloride	late 1990s	DAE	DAGS	DAGS	AMH											X			0	5
QS 20-42	11-30	30	11	6/6/2012	Saguaro Rd & Palo Verde	1	262.3	8	PVC Polyvinyl Chloride	late 1990s	DAGS	DAGS	AMH												X			0	2
QS 20-42	7-9	7	9	6/11/2012	Saguaro Rd & Palo Verde	1	405.6	8	PVC Polyvinyl Chloride	late 1990s	JOM	DAE	JOM	AMH														2	1
QS 20-42	8-10	10	8	6/11/2012	Yucca Rd & Palo Verde	1	400.9	8	PVC Polyvinyl Chloride	late 1990s	JSM	AMH																1	0
QS 20-42	6-35	35	6	6/11/2012	Yucca Rd & Cameldale Wy	1	9.7	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	30-13	13	30	6/6/2012	Saguaro Rd & Palo Verde	1	15.8	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	31-30	30	31	6/6/2012	Saguaro Rd & Palo Verde	1	48.6	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	34-2	2	34	6/11/2012	Saguaro Rd & Jackrabbit Ln	1	65.8	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	35-8	8	35	6/11/2012	Yucca Rd & Cameldale Wy	1	156.9	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	3-4	4	58-42-3	6/11/2012	Yucca Rd & Cameldale Wy	1	195.3	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	4-6	4	6	6/11/2012	Yucca Rd & Cameldale Wy	1	237.5	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0

Report Name	Inspection (Section) Number	Start MH	Stop MH	Date	Street	Tape/Media Number	Footage	Report Diameter	Material	Esimated Decade Sewer Built	Defect Code 1	Defect Code 2	Defect Code 3	Defect Code 4	Defect Code 5	Defect Code 6	Defect Code 7	Defect Code 8	Defect Code 9	Defect Code 10	CIP Lining or CIP Point Repair	Potential CIP lining or CIP Point Repair	Excavated Repair or CIP Point Repair	Re-inpect then Repair	INSPECT - FOG	INSPECT - ROOTS	INSPECT - OTHER	Struc Score	O&M Score
QS 20-42	5-7	7	5	6/11/2012	Saguaro Rd & Palo Verde	1	264.6	8	PVC Polyvinyl Chloride	late 1990s	JSM	AMH																0	1
QS 20-42	13-15	13	15	6/6/2012	Saguaro Rd & Palo Verde	1	300.4	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	33-32	32	33	6/6/2012	Saguaro Rd & Palo Verde	1	300.5	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	32-31	31	32	6/6/2012	Saguaro Rd & Palo Verde	1	304.0	8	PVC Polyvinyl Chloride	late 1990s	TBA	AMH																0	1
QS 20-42	12-14	14	12	6/11/2012	Yucca Rd & Palo Verde	1	322.9	8	PVC Polyvinyl Chloride	late 1990s	DAZ	MCU	MSA															0	5
QS 20-42	2+ - 5+	2+	5+	7/27/2012	Saguaro Rd & Jackrabbit Ln	1	342.6	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	15-22	15	22	6/6/2012	Saguaro Rd & Palo Verde	1	352.7	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 20-42	10-12	10	12	6/11/2012	Yucca Rd & Palo Verde	1	405.8	8	PVC Polyvinyl Chloride	late 1990s	TBA	AMH																0	1
QS 20-43 and 59-51	1	20-43-E	20-43-F	3/5/2004	67th Pl/San Juan	22-1	253.4	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
QS 20-43 and 59-51	2	20-43-B	20-43-A	3/5/2004	McDonald/Casa Blanca	22-1	412.4	8	PVC Polyvinyl Chloride	early 1990s	MGO	AMH																0	4
QS 20-43 and 59-51	3	20-43-C	20-43-D	3/5/2004	McDonald/Kiva Ln	22-1	422.6	8	PVC Polyvinyl Chloride	early 1990s	DAZ	DAZ	MGO	AMH														0	4
QS 20-44	4	I	H	7/1/2005	C Light Hwy	44643	117.02	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 20-44	2	20-44-C	20-44-B	7/1/2005	C Light Hwy	44643	150.06	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 20-44	3	I	J	7/1/2005	C Light Hwy	44643	338.0	8	VCP Vitrified Clay Pipe	late 1970s	CC	AMH												X				1	0
QS 21-40 21-42 and 22-40	1	21-42-A	21-42-B	4/2/2004	E Huntress Dr	22-1	86.7	8	VCP Vitrified Clay Pipe	late 1970s	DS	OBZ	MSA															0	4
QS 21-40 21-42 and 22-40	4	22-40-A	22-40-B	4/2/2004	N Mummy Mtn Rd	22-1	93.8	8	PVC Polyvinyl Chloride	late 1970s	AMH																	0	0
QS 21-40 21-42 and 22-40	5	21-40-B	21-40-A	4/2/2004	Camelback Manor Dr	22-1	208.0	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 21-40 21-42 and 22-40	2	21-42-C	21-42-D	4/2/2004	N Yucca Rd	22-1	299.2	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 21-40 21-42 and 22-40	3	22-40-C	22-40-D	4/2/2004	N Mummy Mtn Rd	22-1	398.5	8	PVC Polyvinyl Chloride	late 1970s	FC	AMH												X				2	0
QS 21-41 21-40 22-43 23-43	8	21-40-E	21-40-F	4/7/2004	Camelback Manor Dr	30-1	300.46	8	PVC Polyvinyl Chloride	late 1990s	JOM	AMH																1	0
QS 21-41 21-40 22-43 23-43	16	23-43-G	23-43-H	4/7/2004	Meadowlark Ln	30-1	6.7	8	PVC Polyvinyl Chloride	late 1990s	DS	MSA																0	2
QS 21-41 21-40 22-43 23-43	11	22-43-B	22-43-A	4/7/2004	East Cactus Wren Rd	30-1	86.46	8	VCP Vitrified Clay Pipe	late 1990s	AMH																	0	0
QS 21-41 21-40 22-43 23-43	10	21-40-I	21-40-J	4/7/2004	Camelback Manor Dr	30-1	121.29	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 21-41 21-40 22-43 23-43	13	22-43-F	22-43-E	4/7/2004	Mockingbird Ln	30-1	164.57	10	VCP Vitrified Clay Pipe	late 1980s	MGO	MGO	AMH															0	5
QS 21-41 21-40 22-43 23-43	9	21-40-H	21-40-G	4/7/2004	Camelback Manor Dr	30-1	177.46	8	PVC Polyvinyl Chloride	late 1990s	TBA	LL	AMH															0	2
QS 21-41 21-40 22-43 23-43	5	21-40-B	21-40-C	4/5/2004	Q.S. 21-41	30-1	184.2	8	PVC Polyvinyl Chloride	late 1990s	MSA																	0	0
QS 21-41 21-40 22-43 23-43	2	21-41-B	21-41-C	4/5/2004	Q.S. 21-41	30-1	227.68	8	VCP Vitrified Clay Pipe	late 1990s	AMH																	0	0
QS 21-41 21-40 22-43 23-43	1	21-41-A	21-41-B	4/5/2004	Q.S. 21-41	30-1	227.99	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
QS 21-41 21-40 22-43 23-43	7	21-40-D	21-40-E	4/7/2004	Camelback Manor Dr	30-1	295.33	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 21-41 21-40 22-43 23-43	14	23-43-B	23-43-A	4/7/2004	Meadowlark Ln	30-1	298.75	8	VCP Vitrified Clay Pipe	late 1990s	DS	DS	DS	AMH														0	2
QS 21-41 21-40 22-43 23-43	6	21-40-B	21-40-A	4/5/2004	Q.S. 21-40	30-1	287.27	8	PVC Polyvinyl Chloride	late 1990s	RJ	AMH														X		0	4
QS 21-41 21-40 22-43 23-43	3	21-41-E	21-41-D	4/5/2004	Q.S. 21-41	30-1	384.81	8	VCP Vitrified Clay Pipe	late 1990s	RJ	FM	RJ	RJ	RJ	RJ	DS	MSA			X					X		3	8
QS 21-41 21-40 22-43 23-43	12	22-43-C	22-43-D	4/7/2004	East Cactus Wren Rd	30-1	327.94	8	VCP Vitrified Clay Pipe	late 1990s	DAGS	DS	AMH												X			0	4
QS 21-41 21-40 22-43 23-43	15	23-43-E	23-43-F	4/7/2004	Meadowlark Ln	30-1	384.91	8	PVC Polyvinyl Chloride	late 1990s	TBA	MWLS	AMH															0	3
QS 21-41 21-40 22-43 23-43	4	21-41-F	21-41-G	4/5/2004	Q.S. 21-41	30-1	436.34	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 22-42 22-41 20-44	8	20-44-A	20-44-B	4/12/2004	East McDonald Dr	54-1	382.6	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	6	22-41-G	22-41-F	4/9/2004	60th St	54-1	0	8	PVC Polyvinyl Chloride	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	9	20-44-F	20-44-E	4/12/2004	East McDonald Dr	54-1	53.9	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	14	21-44-F	21-44-G	4/12/2004	East McDonald Dr	54-1	99.2	6	PVC Polyvinyl Chloride	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	13	21-44-D	21-44-E	4/12/2004	East McDonald Dr	54-1	147.4	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	12	21-44-B	21-44-A	4/12/2004	East McDonald Dr	54-1	219.9	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	1	22-42-A	22-42-B	4/9/2004	62nd St/Joshua Tree Ln	54-1	240.7	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
QS 22-42 22-41 20-44	7	20-44-C	20-44-D	4/12/2004	East McDonald Dr	54-1	241.2	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	3	22-42-D	22-42-E	4/9/2004	64th St	54-1	269.8	8	PVC Polyvinyl Chloride	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	2	22-42-D	22-42-C	4/9/2004	64th St	54-1	278.8	8	PVC Polyvinyl Chloride	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	5	22-41-A	22-41-B	4/9/2004	60th St	54-1	300.7	8	PVC Polyvinyl Chloride	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	4	22-41-C	22-41-D	4/9/2004	60th St	54-1	305.5	8	PVC Polyvinyl Chloride	late 1970s	AMH																	0	0
QS 22-42 22-41 20-44	10	20-44-F	20-44-G	4/12/2004	East McDonald Dr	54-1	336.8	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 22-43	3	9	8	11/21/2012	E Lincoln Dr	0	375.0	8	VCP Vitrified Clay Pipe	early 1970s	MWL	AMH																0	2
QS 22-43	2	10	9	11/21/2012	E Lincoln Dr	0	376.4	8	VCP Vitrified Clay Pipe	early 1970s	MWL	MSA																0	5
QS 22-43	1	11	8	11/21/2012	E Lincoln Dr	0	382.7	8	VCP Vitrified Clay Pipe	early 1970s	MWL																	0	2
QS 22-43 23-44 21-39	9	21-39-H	21-39-G	4/9/2004	Arroyo Verde/Tatum	30-1	112.94	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 22-43 23-44 21-39	4	23-44-D	23-44-C	4/9/2004	68th Pl	30-1	149.98	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 22-43 23-44 21-39	3	23-44-G	23-44-F	4/9/2004	Mockingbird	30-1	154.51	8	PVC Polyvinyl Chloride	early 1990s	MWLS	DS	AMH															0	5
QS 22-43 23-44 21-39	6	21-39-A	21-39-B	4/9/2004	McDonald/51st Pl	30-1	288.18	8	PVC Polyvinyl Chloride	early 1990s	D	AMH												X				4	0
QS 22-43 23-44 21-39	10	21-39-H	21-39-I	4/9/2004	Arroyo Verde/Tatum	30-1	62.51	8	VCP Vitrified Clay Pipe	early 1980s	FC	AMH										X						2	0
QS 22-43 23-44 21-39	7	21-39-C	21-39-D	4/9/2004	Rovey/51st St	30-1	314.25	8	PVC Polyvinyl Chloride	early 1990s	AMH																	0	0
QS 22-43 23-44 21-39	5	23-44-D	23-44-E	4/9/2004	68th Pl	30-1	334.78	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 22-43 23-44 21-39	8	21-39-E	21-39-F	4/9/2004	Arroyo Verde/Tatum	30-1	338.31	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 22-43 23-44 21-39	1	22-43-G	22-43-H	4/9/2004	Lincoln/Invergordon	30-1	378.57	8	VCP Vitrified Clay Pipe	early 1980s	MCU	MCU	MCU	AMH														0	5
QS 22-43 23-44 21-39	2	23-44-B	23-44-A	4/9/2004	Indian Bend	30-1	396.99	8	VCP Vitrified Clay Pipe	late 1980s	MCU	AMH	MCU	AMH														0	5
QS 22-43 spring		33	51	4/14/2012	QS 22-43	4142012	496.6	8	PVC Polyvinyl Chloride	early 2000s	DAGS	MWLS	TBA	TBA	TBA	TBA	AMH								X			0	5
QS 22-43 spring		35	76	4/20/2012	QS 22-43	1	169.7	8	PVC Polyvinyl Chloride	early 2000s	DAGS	TBA	TBA	AMH											X			0	3
QS 22-43 spring		51	48	4/14/2012	QS 22-43	4142012	230.1	8	PVC Polyvinyl Chloride	early 2000s	TBA	TBA	AMH															0	1
QS 22-43 spring		WEST	48	4/20/2012	QS 22-43	1	579.8	8	PVC Polyvinyl Chloride	early 2000s	TBA	TBA	TBA	AMH														0	1
QS 23-40 21-43 10-46	5	21-43-F	21-43-G	4/12/2004	Casa Blanca/Valley Vista	30-1	17.3	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
QS 23-40 21-43 10-46	2	23-40-D	23-40-C	4/12/2004	Arroyo Rd	30-1	85.0	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 23-40 21-43 10-46	1	23-40-A	23-40-B	4/12/2004	Desert Fairways	30-1	168.5	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 23-40 21-43 10-46	3	23-40-E	23-40-F	4/12/2004	Desert Fairways	30-1	208.6	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 23-40 21-43 10-46	7	21-43-H	21-43-I	4/12/2004	Mockingbird/Lincoln	30-1	226.5	8	PVC Polyvinyl Chloride	early 1990s	MWLS	MWLS	DS	MSA														0	5
QS 23-40 21-43 10-46	6	21-43-F	21-43-E	4/12/2004	Casa Blanca/Valley Vista	30-1	235.2	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
QS 23-40 21-43 10-46	4	21-43-A	21-43-B	4/12/2004	Invergordon/Lincoln	30-1	303.3	8	VCP Vitrified Clay Pipe	late 1980s	MCU	MCU	MCU	MCU	MCU	AMH												0	5
QS 23-41 and 23-42	4	23-41-G	23-41-H	4/2/2004	E Quartz Mt	54-1	60.1	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 23-41 and 23-42	1	23-41-I	23-41-J	4/2/2004	E Glenn Dr	54-1	196.7	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 23-41 and 23-42	2	23-41-K	23-41-L	4/2/2004	N 59th Pl	54-1	240.7	8	PVC Polyvinyl Chloride	early 1980s	AMH																	0	0
QS 23-41 and 23-42	3	23-41-F	23-41-E	4/2/2004	E Quartz Mt	54-1	393.9	8	VCP Vitrified Clay Pipe	late 1970s	DAE	RF	AMH													X		0	2
QS 23-41 and 23-42	5	23-42-A	23-42-B	4/2/2004	East Cheney Dr	54-1	400.1	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 23-41 and 23-42	6	23-42-C	23-42-D	4/2/2004	East Cheney Dr	54-1	400.9	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 24-20		17	19	4/22/2013	E Morrison Ln	1	199.2	8	VCP Vitrified Clay Pipe	early 1970s	RFJ	RBL	TBA	RFJ	FH2	FM	AMH				X				X	X		4	4
QS 24-20		19	21	4/22/2013	E Morrison Ln	1	116.9	8	VCP Vitrified Clay Pipe	early 1970s	FC	RFJ	RFJ	FL	AMH							X				X		5	2
QS 24-20		20	23	4/9/2013	QS 24-40	1	95.5	8	VCP Vitrified Clay Pipe	early 1970s	RFJ	AMH														X		0	2
QS 24-20		22	23	4/9/2013	QS 24-40	1	117.8	8	VCP Vitrified Clay Pipe	late 1970s	FC	AMH										X						2	0
QS 24-20		22	21	4/9/2013	QS 24-40	1	51.7	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 24-20		17	CO	4/22/2013	E Morrison Ln	1	86.6	8	VCP Vitrified Clay Pipe	early 1970s	ACO																	0	0
QS 24-20		20	18	4/9/2013	QS 24-40	1	134.7	8	VCP Vitrified Clay Pipe	late 1970s	AMH																	0	0
QS 25-40		66 Mockingbird Ln	65 Sapphire Ln	2/13/2013	QS 25-40	1	157.5	8	PVC Polyvinyl Chloride	late 1970s	TBA	AMH																0	1
QS 25-40		Royal Palm Rd	Sapphire Ln	2/13/2013	QS 25-40	1	240.1	8	PVC Polyvinyl Chloride	late 1970s	AMH																	0	0
QS 25-43		2	25	4/14/2012	QS 25-43	4142012	241.4	8	VCP Vitrified Clay Pipe	late 1980s	DAGS	JAL	AMH										X		X			2	2
QS 25-43		3	49	4/27/2012	QS 25-43	1	461.3	10	PVC Polyvinyl Chloride	late 1980s	DAGS	AMH													X			0	2
QS 25-43		24	25	4/14/2012	QS 25-43	4142012	247.1	8	VCP Vitrified Clay Pipe	late 1980s	DAGS	AMH													X			0	2
QS 25-43		28	31	4/14/2012	QS 25-43	4142012	219.6	8	VCP Vitrified Clay Pipe	late 1980s	DAGS	AMH													X			0	2

Report Name	Inspection (Section) Number	Start MH	Stop MH	Date	Street	Tape/Media Number	Footage	Report Diameter	Material	Esimated Decade Sewer Built	Defect Code 1	Defect Code 2	Defect Code 3	Defect Code 4	Defect Code 5	Defect Code 6	Defect Code 7	Defect Code 8	Defect Code 9	Defect Code 10	CIP Lining or CIP Point Repair	Potential CIP lining or CIP Point Repair	Excavated Repair or CIP Point Repair	Re-inpect then Repair	INSPECT - FOG	INSPECT - ROOTS	INSPECT - OTHER	Struc Score	O&M Score
QS 25-43		34	2	4/14/2012	QS 25-43	4142012	401.8	8	VCP Vitrified Clay Pipe	late 1980s	DAGS	AMH													X			0	2
QS 25-43		36	40	4/14/2012	QS 25-43	4142012	114.4	10	PVC Polyvinyl Chloride	late 1980s	DAGS	AMH													X	X		0	2
QS 25-43		36	39	4/14/2012	QS 25-43	4142012	327.1	10	PVC Polyvinyl Chloride	late 1980s	DAGS	MWLS	AMH												X			0	4
QS 25-43		37	39	4/14/2012	QS 25-43	4142012	156.8	8	VCP Vitrified Clay Pipe	late 1980s	DAGS	AMH													X			0	2
QS 25-43		40	4	4/14/2012	QS 25-43	4142012	278	10	PVC Polyvinyl Chloride	late 1980s	DAGS	AMH													X			0	2
QS 25-43		45	41	4/27/2012	QS 25-43	1	493.9	10	PVC Polyvinyl Chloride	late 1980s	DAGS	AMH													X			0	2
QS 25-43		46	45	4/27/2012	QS 48-49	1	101.5	8	PVC Polyvinyl Chloride	late 1980s	DAGS	AMH													X			0	2
QS 25-43		49	46	4/27/2012	QS 25-43	1	455.2	10	PVC Polyvinyl Chloride	late 1980s	DAGS	AMH													X			0	2
QS 25-43		41	4	4/27/2012	QS 25-43	1	289.9	10	PVC Polyvinyl Chloride	late 1980s	TBA	AMH																0	1
QS 25-43 2009	2	37	31	4/9/2009	C Light Hwy	79414	323.5	8	VCP Vitrified Clay Pipe	early 1970s	MWL	AMH																0	2
QS 25-43 2009	6	22	18	4/9/2009	C Light Hwy	79414	379.78	8	VCP Vitrified Clay Pipe	early 1970s	MWL	MMC	JOM	MMC	MCU	AMH												1	4
QS 25-43 2009	8	40	36	4/9/2009	C Light Hwy	77708	115.13	10	PVC Polyvinyl Chloride	late 1980s	MWL	AMH																0	2
QS 25-43 2009	5	24	22	4/9/2009	C Light Hwy	79414	133.76	8	VCP Vitrified Clay Pipe	early 1970s	MWL	AMH																0	2
QS 25-43 2009	12	46	45	4/9/2009	C Light Hwy	77708	148.23	10	PVC Polyvinyl Chloride	late 1980s	MWL	AMH																0	2
QS 25-43 2009	4	28	24	4/9/2009	C Light Hwy	79414	254.54	8	VCP Vitrified Clay Pipe	early 1970s	MWL	AMH																0	2
QS 25-43 2009	9	40	4	4/9/2009	C Light Hwy	77708	282.68	10	PVC Polyvinyl Chloride	late 1980s	MWL	AMH																0	2
QS 25-43 2009	14	41	4	4/9/2009	C Light Hwy	77708	286.64	10	PVC Polyvinyl Chloride	late 1980s	MWL	TBA	AMH															0	3
QS 25-43 2009	7	36	39	4/9/2009	C Light Hwy	77708	328.45	8	VCP Vitrified Clay Pipe	early 1970s	MWL	AMH																0	2
QS 25-43 2009	11	49	46	4/9/2009	C Light Hwy	77708	449.23	10	PVC Polyvinyl Chloride	late 1980s	MWL	AMH																0	2
QS 25-43 2009	10	3	49	4/9/2009	C Light Hwy	77708	457.66	10	PVC Polyvinyl Chloride	late 1980s	MWL	AMH																0	2
QS 25-43 2009	13	45	41	4/9/2009	C Light Hwy	77708	489.26	10	PVC Polyvinyl Chloride	late 1980s	MWL	AMH																0	2
QS 26-40		26	21	3/16/2012	QS 26-40	12345	331.6	8	VCP Vitrified Clay Pipe	early 1970s	RFJ	RFJ	AMH													X		0	2
QS 26-40		55	7	3/16/2012	QS 26-40	12345	134.9	8	PVC Polyvinyl Chloride	early 1990s	JOM	JOM	AMH															2	0
QS 26-40		64	65	3/16/2012	QS 26-40	12345	70.4	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 26-40		29	30	3/16/2012	QS 26-40	12345	131.2	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 26-40		37	31	3/16/2012	QS 26-40	12345	178.0	8	VCP Vitrified Clay Pipe	early 1970s	TBA	AMH																0	1
QS 26-40		57	63	3/16/2012	QS 26-40	12345	215.3	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 26-40		56	57	3/16/2012	QS 26-40	12345	222.0	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 26-40		3	37	3/16/2012	N Via Serena & Tomahawk	12345	222.5	8	VCP Vitrified Clay Pipe	late 1970s	TBA	TBA	AMH															0	1
QS 26-40		55	56	3/16/2012	QS 26-40	12345	236.2	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 26-40		63	65	3/16/2012	QS 26-40	12345	237.3	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 26-40		49	3	3/16/2012	QS 26-40	12345	242.1	8	VCP Vitrified Clay Pipe	early 1970s	TBA	TBA	AMH															0	1
QS 26-40		53	49	3/16/2012	QS 26-40	12345	244.5	8	VCP Vitrified Clay Pipe	early 1970s	TBA	TBA	AMH															0	1
QS 26-40		31	21	3/16/2012	QS 26-40	12345	261.7	8	VCP Vitrified Clay Pipe	early 1970s	TBA	TBA	AMH															0	1
QS 26-40		30	26	3/16/2012	QS 26-40	12345	396.2	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 26-40		64	53	3/16/2012	QS 26-40	12345	401.7	8	VCP Vitrified Clay Pipe	early 1970s	TBA	TBA	TBA	TBA	AMH													0	1
QS 26-41		26-41-6	26-41-7	1/6/2012	Los Caballos & Double Tree	2012	64.7	8	VCP Vitrified Clay Pipe	late 1980s	AMH																	0	0
QS 26-41		26-41-14	26-41-12	1/6/2012	Los Caballos & Double Tree	2012	136.5	8	PVC Polyvinyl Chloride	late 1980s	TBA	AMH																0	1
QS 26-41		26-41-7	26-41-9	1/6/2012	Los Caballos & Double Tree	2012	184.5	8	VCP Vitrified Clay Pipe	early 1970s	AMH																	0	0
QS 26-41		26-41-21	26-41-19	1/6/2012	Los Caballos & Double Tree	2012	237.5	8	PVC Polyvinyl Chloride	late 1980s	AMH																	0	0
QS 26-41		26-41-12	26-41-28	1/6/2012	Los Caballos & Double Tree	2012	316.1	8	PVC Polyvinyl Chloride	late 1980s	DAGS	JOM	AMH												X			1	2
QS 26-41		26-41-14	26-41-17	1/6/2012	Los Caballos & Double Tree	2012	125.0	8	PVC Polyvinyl Chloride	late 1980s	DAGS	TBA	TBA	TBA	AMH										X			0	3
QS 26-41		26-41-18	26-41-23	1/6/2012	Los Caballos & Double Tree	2012	379.6	8	PVC Polyvinyl Chloride	late 1980s	DAGS	TBA	TBA	AMH											X			0	3
QS 26-41		26-41-20	26-41-18	1/6/2012	Los Caballos & Double Tree	2012	384.2	8	PVC Polyvinyl Chloride	late 1980s	DAGS	TBA	TBA	TBA	TBA	AMH									X			0	3
QS 26-41		26-41-21	26-41-20	1/6/2012	Los Caballos & Double Tree	2012	385.9	8	PVC Polyvinyl Chloride	late 1980s	DAGS	TBA	TBA	TBA	AMH										X			0	3
QS 26-41		26-41-22	26-41-23	1/6/2012	Los Caballos & Double Tree	2012	117.1	8	PVC Polyvinyl Chloride	late 1980s	DAGS	TBA	AMH												X			0	3
QS 26-41		26-41-23	26-41-39	1/6/2012	Los Caballos & Double Tree	2012	100.3	8	PVC Polyvinyl Chloride	late 1980s	DAGS	RPZ	JOL	MSA											X			0	5
QS 26-41		26-41-3	26-41-6	1/6/2012	Los Caballos & Double Tree	2012	185.1	8	VCP Vitrified Clay Pipe	early 1970s	DAGS	AMH													X			0	2
QS 26-41		26-41-21	26-41-22	1/6/2012	Los Caballos & Double Tree	2012	355.9	8	PVC Polyvinyl Chloride	late 1980s	TBA	TBA	TBA	AMH														0	1
QS 26-41		26-41-19	26-41-17	1/6/2012	Los Caballos & Double Tree	2012	359.4	8	PVC Polyvinyl Chloride	late 1980s	TBA	TBA	TBA	AMH														0	1
QS 26-44 post clean	2	26-44-B	26-44-C	7/1/2005	Q.S. 26-44	43610	155.9	8	PVC Polyvinyl Chloride	late 1980s	RMC	AMH														X		0	3
QS 26-44 post clean	1	26-44-B	26-44-A	7/1/2005	Q.S. 26-44	43610	155.5	8	PVC Polyvinyl Chloride	late 1980s	DSGV	AMH													X			0	2
QS 27-40		69	67	5/2/2012	QS 27-40	522012	409.8	8	PVC Polyvinyl Chloride	late 1990s	MGO	B	B	OBZ	TBA	DSZ	MSA						X					8	5
QS 27-40		77	76	5/2/2012	QS 27-40	522012	387.3	8	PVC Polyvinyl Chloride	late 1990s	DAGS	AMH													X			0	2
QS 27-40		68	69	5/2/2012	QS 27-40	522012	11.1	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 27-40		74	73	3/16/2012	QS 27-40	12345	20.7	8	VCP Vitrified Clay Pipe	late 1990s	AMH																	0	0
QS 27-40		71	70	3/16/2012	QS 27-40	12345	120.5	8	VCP Vitrified Clay Pipe	late 1990s	AMH																	0	0
QS 27-40		75	74	3/16/2012	QS 27-40	12345	125.0	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 27-40		70	69	3/16/2012	QS 27-40	12345	195.4	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 27-40		72	71	3/16/2012	QS 27-40	12345	239.0	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 27-40		73	72	3/16/2012	QS 27-40	12345	246.1	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 27-40		78	77	5/2/2012	QS 27-40	522012	340.0	8	VCP Vitrified Clay Pipe	late 1990s	AMH																	0	0
QS 27-40		76	75	3/16/2012	QS 27-40	12345	405.4	8	PVC Polyvinyl Chloride	late 1990s	AMH																	0	0
QS 27-42		3	48	12/8/2011	Bar-Z & Ironwood	2011	235.2	8	VCP Vitrified Clay Pipe	early 1980s	DAGS	B	FL	AMH							X				X			7	2
QS 27-42		8	3	12/7/2011	Bar-Z & Ironwood	2011	228.4	8	VCP Vitrified Clay Pipe	early 1980s	DAGS	AMH													X			0	2
QS 27-42		13	8	12/7/2011	Bar-Z & Ironwood	2011	247.9	8	VCP Vitrified Clay Pipe	early 1980s	DAGS	AMH													X			0	2
QS 27-42		18	13	12/7/2011	Bar-Z & Ironwood	2011	196.7	8	VCP Vitrified Clay Pipe	early 1980s	DAGS	AMH													X			0	2
QS 27-42		22	18	12/7/2011	Bar-Z & Ironwood	2011	218.6	8	VCP Vitrified Clay Pipe	early 1980s	FC	AMH										X						2	0
QS 27-42		25	24	12/7/2011	Bar-Z & Ironwood	2011	389.0	8	VCP Vitrified Clay Pipe	early 1980s	DSGV	AMH													X			0	2
QS 27-42		1	C/O	12/7/2011	Bar-Z & Ironwood	2011	0.1	8	VCP Vitrified Clay Pipe	early 1980s	MSA																	0	5
QS 27-42		24	23	12/7/2011	Bar-Z & Ironwood	2011	171.5	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42		27	1	12/7/2011	Bar-Z & Ironwood	2011	214.7	8	VCP Vitrified Clay Pipe	early 1980s	TBA	TBA	AMH															0	1
QS 27-42		25	22	12/7/2011	Bar-Z & Ironwood	2011	226.9	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42		26	27	12/7/2011	Bar-Z & Ironwood	2011	238.3	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42		25	26	12/7/2011	Bar-Z & Ironwood	2011	425.2	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42 2014		33	32	6/16/2014	QS 27-42		162.5	8	VCP Vitrified Clay Pipe	early 1980s	RBC	AMH														X		0	4
QS 27-42 2014		45	C/O	6/16/2014	QS 27-42		73.0	8	VCP Vitrified Clay Pipe	early 1980s	ACO																	0	0
QS 27-42 2014		40	39	6/16/2014	QS 27-42		147.3	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42 2014		39	36	6/16/2014	QS 27-42		172.7	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42 2014		45	40	6/16/2014	QS 27-42		196.0	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42 2014		36	35	6/16/2014	QS 27-42		222.4	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42 2014		32	37	6/16/2014	QS 27-42		267.5	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42 2014		37	11	6/16/2014	QS 27-42		270.0	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0
QS 27-42 2014		35	33	6/16/2014	QS 27-42		435.9	8	VCP Vitrified Clay Pipe	early 1980s	AMH																	0	0

Report Name	Inspection (Section) Number	Start MH	Stop MH	Date	Street	Tape/Media Number	Footage	Report Diameter	Material	Esimated Decade Sewer Built	Defect Code 1	Defect Code 2	Defect Code 3	Defect Code 4	Defect Code 5	Defect Code 6	Defect Code 7	Defect Code 8	Defect Code 9	Defect Code 10	CIP Lining or CIP Point Repair	Potential CIP lining or CIP Point Repair	Excavated Repair or CIP Point Repair	Re-inpect then Repair	INSPECT - FOG	INSPECT - ROOTS	INSPECT - OTHER	Struc Score	O&M Score

Technical Memorandum

Assess Structural Condition and Estimate Remaining Useful Life of Existing Collection System

Attachment B

Recommendations for Pipe Repairs and Additional Inspections

Report Name	Inspection (Section) Number	Start MH	Stop MH	Date	Street	Tape/Media Number	Footage	Report Diameter	Struc Score	O&M Score	Recommendation
Meadowlark/ 66th/ Hummingbird	3	6629	6659	6/19/2003	Meadowlark/ 66th Pl		285.3	8	5	3	CIP Lining or Point Repair
Meadowlark/ 66th/ Hummingbird	14	6527	66th St	6/19/2003	Hummingbird		310.1	8	7	0	CIP Lining or Point Repair
Grant Street 2	54	6500 Lincoln	6602 Lincoln	3/21/2005	Lincoln QS22-43	42593	373.1	8	9	4	CIP Lining or Point Repair
Meadowlark/ 66th/ Hummingbird	6	66th St	6629 Overlap	6/19/2003	Meadowlark/ 66th St		393.4	8	5	3	CIP Lining or Point Repair
QS 24-20		22	23	4/9/2013	QS 24-40	1	117.8	8	0	2	CIP Lining or Point Repair
QS 22-43 23-44 21-39	10	21-39-H	21-39-I	4/9/2004	Arroyo Verde/Tatum	30-1	62.51	8	2	0	CIP Lining or Point Repair
Meadowlark/ 66th/ Hummingbird	16	64th Pl	6501	6/19/2003	Hummingbird		159.6	8	2	0	CIP Lining or Point Repair
65th and Cactus Wren	3	6614	6601	6/23/2003	65th St		202.8	8	2	0	CIP Lining or Point Repair
QS 27-42		22	18	12/7/2011	Bar-Z & Ironwood	2011	218.6	8	2	0	CIP Lining or Point Repair
Cactus Wren 2004	9	6431 West	6431 East	2/4/2004	Cactus Wren	22-9	218.7	8	2	0	CIP Lining or Point Repair
61st and Huntress 2004	2	6121	6141	1/26/2004	61st/ Huntress	22-1	245.4	8	2	1	CIP Lining or Point Repair
Meadowlark/ 66th/ Hummingbird	4	6629	7126	6/19/2003	Meadowlark/ 66th Pl		407.0	8	2	0	CIP Lining or Point Repair
QS 27-42		3	48	12/8/2011	Bar-Z & Ironwood	2011	235.2	8	7	2	CIP Lining or Point Repair; Inspect for FOG
QS 24-20		17	19	4/22/2013	E Morrison Ln	1	199.2	8	4	4	CIP Lining or Point Repair; Inspect for FOG; Inspect for Roots
Meadowlark/ 66th/ Hummingbird	15	6527	6501	6/19/2003	Hummingbird		307.9	8	5	6	CIP Lining or Point Repair; Inspect for Roots
QS 21-41 21-40 22-43 23-43	3	21-41-E	21-41-D	4/5/2004	Q.S. 21-41	30-1	384.81	8	3	8	CIP Lining or Point Repair; Inspect for Roots
QS 24-20		19	21	4/22/2013	E Morrison Ln	1	116.9	8	5	2	CIP Lining or Point Repair; Inspect for Roots
Grant Street 2	23	San Juan/ 67th Pl	6708 San Juan	3/16/2005	67th Pl QS20-43	43746A	380.0	8	9	0	Excavated Repair or CIP Point Repair
QS 27-40		69	67	5/2/2012	QS 27-40	522012	409.8	8	8	5	Excavated Repair or CIP Point Repair
Cactus Wren/ Joshua Tree/ 65th	12	6223	6315	6/24/2003	Cactus Wren		480.0	8	2	0	Excavated Repair or CIP Point Repair
QS 25-43		2	25	4/14/2012	QS 25-43	4142012	241.4	8	2	2	Excavated Repair or CIP Point Repair; Inspect for FOG
Paradise Ranch	13	6760 South	6760	6/18/2003	Mockingbird/ Arroyo Court		16.4	8	0	2	Inspect for FOG
Morrison and 54th	5412-5426 West	5426 West	5412	2/13/2013	Morrison and 54th	1	72.2	8	0	4	Inspect for FOG
QS 20-41	5	6	1	10/5/2009	QS 20-41	0	74.05	8	0	4	Inspect for FOG
QS 26-41		26-41-23	26-41-39	1/6/2012	Los Caballos & Double Tree	2012	100.3	8	0	5	Inspect for FOG
QS 25-43		46	45	4/27/2012	QS 48-49	1	101.5	8	0	2	Inspect for FOG
QS 26-41		26-41-22	26-41-23	1/6/2012	Los Caballos & Double Tree	2012	117.1	8	0	3	Inspect for FOG
QS 26-41		26-41-14	26-41-17	1/6/2012	Los Caballos & Double Tree	2012	125.0	8	0	3	Inspect for FOG
QS 20-41	4	6	7	10/5/2009	QS 20-41	0	145.38	8	0	6	Inspect for FOG
QS 20-41	7	8	12	10/5/2009	QS 20-41	0	146.49	8	0	4	Inspect for FOG
Paradise Ranch	6	7302	7239	6/18/2003	Mockingbird/ Avenida El Alba		155.3	8	0	2	Inspect for FOG
QS 26-44 post clean	1	26-44-B	26-44-A	7/1/2005	Q.S. 26-44	43610	155.5	8	0	2	Inspect for FOG
QS 25-43		37	39	4/14/2012	QS 25-43	4142012	156.8	8	0	2	Inspect for FOG
QS 22-43 spring		35	76	4/20/2012	QS 22-43	1	169.7	8	0	3	Inspect for FOG
QS 26-41		26-41-3	26-41-6	1/6/2012	Los Caballos & Double Tree	2012	185.1	8	0	2	Inspect for FOG
QS 27-42		18	13	12/7/2011	Bar-Z & Ironwood	2011	196.7	8	0	2	Inspect for FOG
QS 25-43		28	31	4/14/2012	QS 25-43	4142012	219.6	8	0	2	Inspect for FOG
QS 27-42		8	3	12/7/2011	Bar-Z & Ironwood	2011	228.4	8	0	2	Inspect for FOG
65th St 2004	20	6735	6505	2/5/2004	Cactus Wren Pl	22-10	229.1	8	0	4	Inspect for FOG
QS 20-41	14	9	20	10/5/2009	QS 20-41	0	238.19	8	0	13	Inspect for FOG
QS 25-43		24	25	4/14/2012	QS 25-43	4142012	247.1	8	0	2	Inspect for FOG
QS 27-42		13	8	12/7/2011	Bar-Z & Ironwood	2011	247.9	8	0	2	Inspect for FOG
QS 20-42	11-30	30	11	6/6/2012	Saguaro Rd & Palo Verde	1	262.3	8	0	2	Inspect for FOG
Grant Street 2	3	6011 Sahuaro	McDonald NW Corner	3/15/2005	Sahuaro QS21-42	43746	270.93	8	0	2	Inspect for FOG
QS 25-43		40	4	4/14/2012	QS 25-43	4142012	278	10	0	2	Inspect for FOG
Meadowlark/ 66th/ Hummingbird	1	6717	7100	6/19/2003	Meadowlark		289.4	8	0	7	Inspect for FOG
QS 20-41	8	19	16	10/5/2009	QS 20-41	0	295.19	8	0	4	Inspect for FOG
Paradise Ranch	15	6760 South	6767	6/16/2003	Mockingbird/ Arroyo Court		307.1	8	0	3	Inspect for FOG
QS 26-41		26-41-12	26-41-28	1/6/2012	Los Caballos & Double Tree	2012	316.1	8	1	2	Inspect for FOG
QS 25-43		36	39	4/14/2012	QS 25-43	4142012	327.1	10	0	4	Inspect for FOG
QS 21-41 21-40 22-43 23-43	12	22-43-C	22-43-D	4/7/2004	East Cactus Wren Rd	30-1	327.94	8	0	4	Inspect for FOG
Grant Street 2	31	68th St/ Jackrabbit	67th Pl/ Jackrabbit	3/17/2005	Jackrabbit QS20-43	43757	329.89	8	0	9	Inspect for FOG
Paradise Ranch	18	7117	7100	6/16/2003	68th Pl		338.1	8	0	3	Inspect for FOG
Paradise Ranch	12	7101 South	6760	6/18/2003	Mockingbird/ Meadow Lark		339.6	8	0	2	Inspect for FOG
Grant Street 2	19	5716 Mockingbird	5800 Mockingbird	3/16/2005	Solano Dr QS20-43	43746A	343.54	8	0	2	Inspect for FOG
Grant Street 2	39	Casa Blanca/ Malcomb	6215 Casa Blanca	3/17/2005	Casa Blanca QS21-43	43757A	346.29	8	1	3	Inspect for FOG
QS 26-41		26-41-18	26-41-23	1/6/2012	Los Caballos & Double Tree	2012	379.6	8	0	3	Inspect for FOG
QS 26-41		26-41-20	26-41-18	1/6/2012	Los Caballos & Double Tree	2012	384.2	8	0	3	Inspect for FOG
QS 26-41		26-41-21	26-41-20	1/6/2012	Los Caballos & Double Tree	2012	385.9	8	0	3	Inspect for FOG
QS 27-40		77	76	5/2/2012	QS 27-40	522012	387.3	8	0	2	Inspect for FOG
QS 27-42		25	24	12/7/2011	Bar-Z & Ironwood	2011	389.0	8	0	2	Inspect for FOG
QS 25-43		34	2	4/14/2012	QS 25-43	4142012	401.8	8	0	2	Inspect for FOG
QS 20-42	14-18	14	18	6/11/2012	Yucca Rd & Palo Verde	1	421.0	8	0	5	Inspect for FOG
QS 20-41	13	9	21	10/5/2009	QS 20-41	0	440.37	8	0	2	Inspect for FOG

QS 25-43		49	46	4/27/2012	QS 25-43	1	455.2	10	0	2	Inspect for FOG
QS 25-43		3	49	4/27/2012	QS 25-43	1	461.3	10	0	2	Inspect for FOG
Grant Street 2	7	5714 Cameldale	Cameldale/ Starlight	3/15/2005	Cameldale QS20-41	43746	489.34	8	0	2	Inspect for FOG
QS 25-43		45	41	4/27/2012	QS 25-43	1	493.9	10	0	2	Inspect for FOG
QS 22-43 spring		33	51	4/14/2012	QS 22-43	4142012	496.6	8	0	5	Inspect for FOG
QS 20-41	10	14	13	10/5/2009	QS 20-41	0	502.71	8	0	4	Inspect for FOG
QS 25-43		36	40	4/14/2012	QS 25-43	4142012	114.4	10	0	2	Inspect for FOG; Inspect for Roots
Meadowlark/ 66th/ Hummingbird	11	6601	6655	6/19/2003	66th St		152.9	8	0	5	Inspect for FOG; Inspect for Roots
Folder for 2005	18	6717 Soloano	5716 Mockingbird	3/18/2005	Solano Dr QS20-43	43746A	302.09	8	0	9	Inspect for FOG; Inspect for Roots
Paradise Ranch	3	6929	6962	6/18/2003	Cheney, W/O 70th St		325.6	8	0	7	Inspect for FOG; Inspect for Roots
QS 20-41	1	10	9	10/5/2009	QS 20-41	91820	433.98	8	0	9	Inspect for FOG; Inspect for Roots
East Mockingbird	1	1	South	1/26/2009	6741 E Mockingbird	77965	55.4	8	0	7	Inspect for Other
Morrison and 54th	5432-5426	5426	5432	2/13/2013	Morrison and 54th	1	0.5	8	0	4	Inspect for Roots
Folder for 2005	49	7026 McDonald	Eastward	3/21/2005	McDonald QS	42593	18.8	8	0	5	Inspect for Roots
65th St 2004	19	6430 North	6445	2/5/2004	Cactus Wren Pl	22-10	69.5	8	0	3	Inspect for Roots
Morrison and 54th	11 - 5452	11	5452	2/13/2013	Morrison and 54th	1	81.2	8	0	4	Inspect for Roots
QS 24-20		20	23	4/9/2013	QS 24-40	1	95.5	8	0	2	Inspect for Roots
Meadowlark/ 66th/ Hummingbird	9	6515	6550	6/19/2003	Meadowlark/ 66th St		110.6	8	0	3	Inspect for Roots
Cactus Wren/ Joshua Tree/ 65th	7	6431	6450	6/24/2003	Joshua Tree		113.9	8	0	4	Inspect for Roots
Morrison and 54th	5452-11	11	5452	2/13/2013	Morrison and 54th	1	116.9	8	0	4	Inspect for Roots
Naumann 2004	1	6101	6100	1/30/2004	61st Pl	22-3	154.1	8	0	2	Inspect for Roots
QS 26-44 post clean	2	26-44-B	26-44-C	7/1/2005	Q.S. 26-44	43610	155.9	8	0	3	Inspect for Roots
QS 27-42 2014		33	32	6/16/2014	QS 27-42		162.5	8	0	4	Inspect for Roots
Naumann 2004	2	6101	6123	1/30/2004	61st Pl	22-3	165.2	8	0	2	Inspect for Roots
Grant Street 2	15	6701 Solano Dr	Cul-de-sac	3/16/2005	Solano Dr QS20-43	43746A	207.53	8	0	5	Inspect for Roots
Grant Street 2	8	5801 Starlight	5840 Starlight	3/15/2005	Cameldale QS20-41	43746	268.07	8	0	4	Inspect for Roots
Grant Street 2	16	6701 Solano Dr	6716 Solano Dr	3/16/2005	Solano Dr QS20-43	43746A	281.02	8	0	5	Inspect for Roots
QS 21-41 21-40 22-43 23-43	6	21-40-B	21-40-A	4/5/2004	Q.S. 21-40	30-1	287.27	8	0	4	Inspect for Roots
61st and Huntress 2004	10	6340	6351	1/26/2004	Huntress	22-1	321.3	8	0	3	Inspect for Roots
QS 26-40		26	21	3/16/2012	QS 26-40	12345	331.6	8	0	2	Inspect for Roots
QS 23-41 and 23-42	3	23-41-F	23-41-E	4/2/2004	E Quartz Mt	54-1	393.9	8	0	2	Inspect for Roots
Morrison and 54th	5452-5432	5452	5432	2/13/2013	Morrison and 54th	1	117.8	8	2	0	Inspect for Roots
62nd St / Indian Bend	1	6134	6132	6/26/2003	62nd St/ Indian Bend		116.3	8	6	0	Reinspect then repair
60th St 2004	15	6134	6134 West	2/3/2004	62nd/ Indian Bend	22-7	118.2	8	5	0	Reinspect then repair
Grant Street 2	24	S/O 6708 San Juan	San Miguel	3/16/2005	67th Pl QS20-43	43746A	130.4	8	4	0	Reinspect then repair
Grant Street 2	53	Casa Blanca	6500 Lincoln	3/21/2005	Lincoln QS22-43	42593	156.9	8	9	2	Reinspect then repair
Grant Street	11	5615 Sahuaro	5539 Sahuaro	03/14/2005	Sahuaro QS20-42	43734	260.3	8	4	3	Reinspect then repair
61st and Huntress 2004	8	6320	Invergordon	1/26/2004	Huntress	22-1	266.8	8	9	0	Reinspect then repair
QS 22-43 23-44 21-39	6	21-39-A	21-39-B	4/9/2004	McDonald/51st Pl	30-1	288.18	8	4	0	Reinspect then repair
QS 20-44	3	I	J	7/1/2005	C Light Hwy	44643	338.0	8	1	0	Reinspect then repair
Folder for 2005	52	6630 Lincoln	6724 Lincoln	03/21/2005	Lincoln QS22-43	42593	361.7	8	5	10	Reinspect then repair
Grant Street 2	51	6724	Mockingbird	3/21/2005	Lincoln QS22-43	42593	380.8	8	4	5	Reinspect then repair
Grant Street 2	52	6630 Lincoln	6724 Lincoln	3/21/2005	Lincoln QS22-43	42593	381.7	8	5	11	Reinspect then repair
Grant Street 2	14	6630 Solano Dr	Cul-de-sac	3/15/2005	Solano Dr QS20-43	43746A	398.0	8	2	0	Reinspect then repair
QS 21-40 21-42 and 22-40	3	22-40-C	22-40-D	4/2/2004	N Mummy Mtn Rd	22-1	398.5	8	2	0	Reinspect then repair
Grant Street	12	5615 Sahuaro	5665 Sahuaro	03/14/2005	Sahuaro QS20-42	43734	398.6	8	4	2	Reinspect then repair
QS 20-41	3	11	12	10/5/2009	QS 20-41	91820	264.55	8	4	3	Reinspect then repair; Inspect for FOG
QS 20-41	2	10	11	10/5/2009	QS 20-41	91820	313.0	8	4	13	Reinspect then repair; Inspect for FOG; Inspect for Roots
Grant Street 2	50	7026 McDonald	Eastward	3/21/2005	McDonald QS21-44	42593	19.1	8	2	6	Reinspect then repair; Inspect for Roots
Cactus Wren/ Joshua Tree/ 65th	2	North 6500	6450	6/24/2003	Cactus Wren Pl		50.1	8	2	3	Reinspect then repair; Inspect for Roots
Folder for 2005	5	Starlight/ Cameldale	5840 Starlight	3/15/2005	Starlight/ Cameldale	43746	312.1	8	8	5	Reinspect then repair; Inspect for Roots

Technical Memorandum

Assess Structural Condition and Estimate Remaining Useful Life of Existing Collection System

Attachment C

Detailed Cost Estimate

SYSTEM AND INITIAL INSPECTION INFO

	FOOTAGE	MILEAGE	COUNT OF PIPES	AVERAGE PIPE LENGTH
Pipes inspected less repeats	102,798	19.5	441	233
Total system pipes	363,895	68.9	1,561	
Percent Inspected	28%	28%		
Scale-up Factor for balance of system	2.54			

O&M RECOMMENDATIONS INFO

	FOOTAGE	COUNT
INSPECT - FOG	13,788	49
INSPECT - ROOTS	3,453	20
INSPECT - FOG AND ROOTS	1,329	5
INSPECT - CONCRETE	55	1
PIPES FOR O&M INSPECTION	18,625	75

COSTING INFO

		FOOTAGE	COUNT	UNIT PRICE	EXTENSION	NOTES
1	CIPPL	2,489	8	$ 60.00	$ 149,341.80	per foot
2	CIPPR (OR CIPPL)	1,749	9	$ 3,000.00	$ 27,000.00	per count
3	XPR (or CIPPR)	1,511	4	$ 10,000.00	$ 40,000.00	per count
4	repair footage subtotal 1	5,750	21			
5	INSPECT TO DETERMINE REPAIR	4,953	19	$ 1.25	$ 6,191.56	per foot
6	repair footage subtotal 2	10,703	40			
7	INSPECT-O&M ONLY	18,625	75	$ 1.25	$ 23,281.75	per foot
8	INITIAL REPAIR TOTAL FOOTAGE	**29,328**				
9	INSPECT TO CONFIRM PROPOSED REPAIR	5,750		$ 1.25	$ 7,186.98	equals row 4
10	PRE-CLEAN FOR REPAIR	10,703		$ 1.75	$ 18,729.95	equals row 4
10A	ROOT AND GREASE CUTTING	3,725		$ 5.00	$ 18,625.40	per foot; equals row 7 x 20% (assumed 20% of these pipes require cutting) x unit price
11	**INITIAL REPAIR TOTAL COST**				**$ 290,357.44**	
12	**CONTINGENT: ESTIMATE REPAIRS FROM ADDITIONAL INSPECTIONS ("INSPECT TO DETERMINE REPAIR)**				**$ 202,513.78**	SCALED FROM FIRST PORTION (11) BASED ON CONSTRUCTION AND CLEANING COSTS AND RELATIVE FOOTAGES
13	**TOTAL INITIAL REPAIR CONTRACT ESTIMATE (28% OF SYSTEM):**				**$ 492,871.22**	
14						
15	**INSPECT BALANCE OF SYSTEM (72%) FOR FIRST 5-YEAR INSPECTION CYCLE**	261,097		$ 1.25	**$ 326,371.26**	total footage minus previously inspected footage

16	ANNUAL INSPECTION COST FOR CYCLE 1			$ 65,274.25	row 15 divided by 5 years
17	SCALE UP REPAIRS FOOTAGE FOR BALANCE OF SYSTEM (72%)	74,490			SCALE-UP FACTOR = 2.54 (from tables above)
18	**SCALE UP REPAIRS COST FOR BALANCE OF SYSTEM (72%)**		**$1,251,845.50**		SCALE-UP FACTOR = 2.54 (from tables above)
19	TOTAL TO INSPECT AND REPAIR BALANCE (72%) OF SYSTEM		$1,578,216.76		15 +18
20	TOTAL TO INSPECT AND REPAIR FULL (100%) SYSTEM		$2,071,087.98		13 + 19
21					
22					
23	**TOTAL FOR INSPECTION PROGRAM AND REPAIR PROGRAM OVER 10-YEAR PERIOD**		**$2,071,087.98**		20 + 21
24	OVERALL ANNUAL INSPECTION AND REPAIR COST			$ 207,108.80	row 23 divided by 10 years
25	**PERCENT SYSTEM ACTUALLY REPAIRED INCLUDING INITIAL AND SUBSEQUENT REPAIR CONTRACTS**	**29%**			17 + 8 divided by total system footage

Estimated Number of Manholes In System		1,411		
Manhhole Inspection Rate		283	per year	5-year Inspection Cycle
Inspection Cost Rate	$	40	per mh	
Annual Manhole Inspection Cost	**$**	**12,489**	per year	
Manhole Failure Rate		15%		
Manholes Repaired Per Year		43		
Average Manhole Rehab Cost	$	850		
Annual Manhole Repair Cost	**$**	**36,550**		
Total Manhole Inspection and Repair Cost for a 5-year Cycle	**$**	**245,194**		

Appendix E

Diurnal Flow Analysis and Baseflows

TOWN OF PARADISE VALLEY, AZ
WASTEWATER MASTER PLAN
APPENDIX E. DIURNAL FLOW ANALYSIS AND BASEFLOWS

SUMMER BASEFLOWS (May 01 - Oct 31)

Time	Basin A		Basin C		Basin D		Basin G		Basin H		Basin J		Basin K		Basin L		Basin M		Basin N		Basin O		Basin P		Basin Q	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
0:00	0.421	0.487	0.433	0.433	0.545	0.468	0.382	0.458	0.397	0.445	0.357	0.428	0.405	0.422	0.465	0.327	0.496	0.509	0.367	0.367	0.655	0.551	0.517	0.517	0.589	0.646
1:00	0.387	0.442	0.433	0.433	0.530	0.454	0.458	0.468	0.433	0.474	0.398	0.357	0.405	0.475	0.448	0.500	0.468	0.482	0.382	0.338	0.603	0.551	0.486	0.547	0.532	0.513
2:00	0.470	0.454	0.364	0.285	0.502	0.444	0.477	0.506	0.447	0.448	0.439	0.316	0.387	0.299	0.482	0.500	0.496	0.454	0.440	0.367	0.603	0.577	0.425	0.486	0.551	0.551
3:00	0.942	0.634	0.478	0.353	0.545	0.397	0.592	0.582	0.561	0.460	0.500	0.316	0.405	0.352	0.517	0.517	0.482	0.454	0.484	0.367	0.551	0.524	0.425	0.425	0.532	0.532
4:00	1.505	0.758	1.071	0.376	0.702	0.430	0.821	0.468	0.921	0.484	0.836	0.398	1.461	0.475	1.171	0.586	1.418	0.551	1.218	0.411	0.655	0.446	0.577	0.395	0.589	0.456
5:00	1.743	1.168	1.435	0.729	1.290	0.530	2.119	0.840	1.845	0.822	1.825	0.734	2.112	0.933	1.344	0.810	2.024	0.936	1.439	0.822	1.180	0.577	1.307	0.577	1.101	0.570
6:00	1.674	1.448	1.709	1.105	1.648	0.903	1.661	1.556	1.690	1.271	1.662	0.979	1.760	1.249	1.464	1.068	1.762	1.253	1.674	1.233	1.678	0.891	1.884	0.912	1.576	0.949
7:00	1.682	1.752	1.606	1.333	1.653	1.299	1.613	1.918	1.674	1.593	1.754	1.428	1.654	1.566	1.516	1.481	1.611	1.707	1.600	1.571	1.599	1.180	1.702	1.246	1.595	1.291
8:00	1.628	1.668	1.720	1.504	1.586	1.481	1.327	2.014	1.560	1.816	1.805	1.897	1.496	1.865	1.499	1.516	1.349	1.680	1.659	1.820	1.547	1.390	1.641	1.459	1.557	1.500
9:00	1.215	1.237	1.469	1.526	1.510	1.505	1.222	2.061	1.366	1.707	1.305	1.754	1.425	1.461	1.481	1.636	1.253	1.432	1.439	1.571	1.416	1.390	1.520	1.520	1.500	1.576
10:00	1.083	1.092	1.242	1.287	1.400	1.428	1.212	1.699	1.251	1.536	1.050	1.581	1.249	1.320	1.378	1.430	1.184	1.170	1.160	1.409	1.363	1.285	1.459	1.489	1.386	1.443
11:00	1.015	1.045	1.002	1.037	1.194	1.271	1.031	1.556	1.065	1.276	1.101	1.428	0.933	1.161	1.051	1.068	0.991	0.950	1.072	1.145	1.206	1.154	1.276	1.307	1.234	1.253
12:00	0.949	1.088	1.014	1.059	1.080	1.170	0.945	1.479	0.951	1.221	0.887	1.183	0.845	1.056	1.051	0.965	0.799	1.074	0.881	1.145	1.075	1.022	1.094	1.155	1.082	1.101
13:00	0.925	1.097	1.071	1.082	0.960	1.099	0.773	1.288	0.834	1.135	0.816	0.989	0.721	0.985	1.051	0.982	0.716	1.060	0.910	1.160	1.022	0.996	0.973	1.094	0.987	1.082
14:00	0.872	1.147	0.991	0.957	0.860	0.975	0.706	1.174	0.720	1.093	0.826	1.173	0.827	1.161	1.120	1.016	0.826	1.184	1.086	1.174	0.918	1.022	0.851	1.003	0.911	1.006
15:00	1.075	1.302	1.082	1.071	0.860	0.989	0.706	1.097	0.761	1.126	0.846	1.183	0.968	1.320	1.171	0.930	0.950	1.212	0.984	1.321	0.891	1.049	0.881	1.064	0.911	1.063
16:00	1.093	1.052	1.219	1.014	0.936	1.151	0.773	1.078	0.857	1.160	0.938	1.203	0.968	1.355	1.309	1.051	1.046	1.267	1.174	1.218	0.970	1.075	0.912	1.155	0.968	1.101
17:00	1.116	1.037	1.196	0.934	0.989	1.099	0.840	1.212	0.951	1.131	1.152	1.081	1.144	1.232	1.154	0.982	1.129	1.129	1.277	1.174	0.996	1.127	1.033	1.124	1.006	1.101
18:00	1.069	1.086	1.196	0.866	1.113	1.104	1.050	1.088	1.142	1.146	1.387	1.132	1.109	1.179	1.257	0.913	1.308	1.281	1.321	1.086	1.075	1.101	1.094	1.124	1.082	1.101
19:00	1.060	1.060	1.287	0.968	1.118	1.051	1.231	1.317	1.319	1.275	1.336	1.224	1.179	1.003	1.171	1.120	1.157	1.005	1.101	1.028	1.127	1.075	1.155	1.094	1.101	1.025
20:00	0.838	0.838	1.093	1.093	1.170	1.170	0.897	0.897	1.003	1.003	1.061	1.061	1.109	1.109	0.913	0.913	0.991	0.991	0.998	0.998	1.206	1.206	1.124	1.124	1.139	1.139
21:00	0.611	0.611	0.900	0.900	1.065	1.065	0.878	0.878	0.849	0.849	0.795	0.795	0.739	0.739	0.620	0.620	0.716	0.716	0.705	0.705	1.022	1.022	0.942	0.942	1.025	1.025
22:00	0.407	0.407	0.581	0.581	0.807	0.807	0.601	0.601	0.624	0.624	0.683	0.683	0.493	0.493	0.500	0.500	0.509	0.509	0.455	0.455	0.787	0.787	0.699	0.699	0.798	0.798
23:00	0.393	0.393	0.456	0.456	0.612	0.612	0.477	0.477	0.484	0.484	0.469	0.469	0.405	0.405	0.482	0.482	0.427	0.427	0.396	0.396	0.603	0.603	0.517	0.517	0.608	0.608

WINTER BASEFLOWS (Nov 01 - Apr 30)

Time	Basin A		Basin C		Basin D		Basin G		Basin H		Basin J		Basin K		Basin L		Basin M		Basin N		Basin O		Basin P		Basin Q	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
0:00	1.065	0.931	1.068	0.952	1.012	0.956	1.174	0.894	1.125	0.890	1.072	0.874	1.169	1.079	1.045	0.884	0.890	0.868	0.881	0.708	1.018	0.905	0.864	0.836	1.141	1.129
1:00	0.857	0.904	0.810	0.760	0.725	0.850	0.963	0.866	0.976	0.859	0.891	0.764	0.892	0.862	1.182	1.153	0.666	0.658	0.642	0.707	0.913	0.876	0.804	0.827	1.044	0.996
2:00	0.611	0.709	0.672	0.713	0.500	0.626	0.713	0.829	0.722	0.721	0.570	0.634	0.699	0.723	0.945	1.035	0.409	0.467	0.481	0.518	0.798	0.789	0.729	0.754	0.822	0.849
3:00	0.463	0.472	0.494	0.542	0.433	0.476	0.534	0.643	0.536	0.594	0.366	0.472	0.578	0.649	0.614	0.719	0.360	0.420	0.282	0.375	0.645	0.636	0.673	0.673	0.709	0.699
4:00	0.460	0.441	0.400	0.476	0.434	0.450	0.459	0.543	0.501	0.524	0.341	0.532	0.438	0.502	0.492	0.573	0.506	0.506	0.275	0.372	0.530	0.555	0.658	0.665	0.594	0.576
5:00	0.440	0.473	0.457	0.482	0.429	0.411	0.522	0.577	0.470	0.463	0.486	0.610	0.553	0.575	0.463	0.523	0.581	0.547	0.342	0.419	0.572	0.577	0.699	0.687	0.624	0.600
6:00	0.348	0.365	0.497	0.479	0.438	0.400	0.561	0.604	0.461	0.477	0.460	0.563	0.438	0.481	0.492	0.481	0.430	0.405	0.352	0.466	0.577	0.593	0.693	0.724	0.636	0.628
7:00	0.452	0.372	0.513	0.421	0.468	0.412	0.522	0.536	0.444	0.415	0.304	0.309	0.444	0.449	0.484	0.465	0.454	0.396	0.261	0.279	0.494	0.533	0.693	0.717	0.611	0.613
8:00	0.931	0.443	0.803	0.450	1.288	0.487	0.708	0.497	0.528	0.365	0.669	0.362	0.628	0.459	0.647	0.482	0.771	0.580	1.012	0.251	0.554	0.490	0.731	0.687	0.638	0.652
9:00	1.483	0.724	1.756	0.787	1.690	0.894	1.556	0.633	1.166	0.519	1.490	0.617	1.209	0.675	1.091	0.594	1.499	0.997	1.878	0.609	0.953	0.548	0.960	0.693	0.918	0.650
10:00	1.682	1.084	1.548	1.100	1.693	1.259	1.500	0.987	1.649	0.927	1.653	1.018	1.424	1.090	1.464	0.888	1.841	1.521	2.063	1.452	1.483	0.844	1.188	0.870	1.416	0.959
11:00	1.558	1.487	1.675	1.480	1.610	1.697	1.390	1.380	1.695	1.326	1.697	1.387	1.600	1.309	1.581	1.344	1.932	1.750	1.486	2.074	1.577	1.338	1.476	1.136	1.433	1.241
12:00	1.729	1.686	1.612	1.704	1.465	1.722	1.435	1.532	1.705	1.574	1.645	1.754	1.506	1.475	1.550	1.589	1.809	1.887	1.482	2.106	1.542	1.527	1.483	1.373	1.417	1.428
13:00	1.580	1.592	1.287	1.760	1.388	1.496	1.416	1.548	1.597	1.578	1.523	1.731	1.369	1.478	1.477	1.528	1.512	1.516	1.411	1.816	1.510	1.490	1.499	1.331	1.327	1.380
14:00	1.313	1.343	1.154	1.541	1.195	1.322	1.287	1.337	1.421	1.480	1.298	1.468	1.199	1.337	1.349	1.405	1.382	1.411	1.247	1.500	1.403	1.392	1.535	1.248	1.261	1.228
15:00	1.065	1.197	1.112	1.307	1.036	1.161	1.167	1.287	1.256	1.295	1.128	1.355	1.280	1.286	1.225	1.300	1.205	1.203	1.115	1.373	1.289	1.237	1.469	1.114	1.097	1.102
16:00	1.018	1.175	0.906	1.270	0.884	1.101	1.074	1.103	1.124	1.133	1.011	1.301	1.038	1.199	1.136	1.205	1.034	1.091	1.026	1.055	1.176	1.116	1.349	1.057	1.103	1.068
17:00	1.001	1.104	0.822	1.097	0.830	1.068	0.977	1.041	1.016	1.044	0.938	1.226	0.984	1.204	1.009	1.105	0.932	1.099	0.832	1.071	1.107	1.062	1.227	1.010	1.014	1.052
18:00	0.931	1.009	0.832	1.152	0.925	1.159	0.941	1.062	0.899	1.018	0.890	1.192	0.937	1.282	0.926	1.041	0.942	1.061	0.832	1.247	1.022	1.075	1.071	0.994	0.958	1.044
19:00	0.996	1.081	0.899	1.242	0.957	1.278	0.963	1.085	0.905	1.080	0.929	1.250	0.976	1.212	0.892	1.061	0.982	1.139	0.935	1.314	0.975	1.081	0.985	1.005	1.032	1.190
20:00	1.081	1.132	0.994	1.182	1.089	1.218	1.002	1.162	0.966	1.152	1.090	1.250	1.125	1.189	0.927	1.091	0.970	1.162	1.054	1.443	1.005	1.122	0.997	0.999	1.105	1.098
21:00	1.151	1.093	1.113	1.137	1.204	1.198	1.077	1.178	1.081	1.127	1.119	1.187	1.173	1.149	1.012	1.159	0.976	0.994	1.092	1.330	1.082	1.116	1.031	1.010	1.071	0.963
22:00	1.132	1.034	1.170	1.082	1.274	1.134	1.118	1.110	1.154	1.079	1.223	1.137	1.123	1.123	1.019	1.113	0.981	1.000	1.440	1.448	1.103	1.090	1.001	0.932	1.135	1.056
23:00	1.126	0.963	1.279	1.200	1.122	1.006	1.134	1.086	1.145	1.005	1.186	1.058	1.255	1.120	1.049	1.088	1.060	1.012	1.115	1.224	1.063	1.030	0.899	0.881	1.185	1.070

Appendix F

Wastewater Flow Projection Details

TOWN OF PARADISE VALLEY, AZ
WASTEWATER MASTER PLAN
APPENDIX F WASTEWATER FLOW PROJECTION DETAILS

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Buildout	Totals
Dwelling Units (DU)														
Connected at Start of Year	1,963	1,963	1,987	2,011	2,053	2,095	2,170	2,244	2,318	2,392	2,466	2,508	2,550	
New Connections														
New SFR in Vacant Parcels [1]		16	16	16	16	16	16	16	16	16	16	16	97	273
Septic - Regular Conversions [2]		8	8	8	8	8	8	8	8	8	8	8	349	437
Septic - Master Plan Additions [3]				18	18	18	18	18	18	18	18	18	460	622
Five Star Development Residential [4]						33	32	32	32	32			0	161
Total DUs Connected	1,963	1,987	2,011	2,053	2,095	2,170	2,244	2,318	2,392	2,466	2,508	2,550	3,456	**3,456**
Projected DU Average Flows (gpd) [5]	420,082	425,218	430,354	439,342	448,330	464,380	480,216	496,052	511,888	527,724	536,712	545,700	739,584	
Resort Average Commercial Flow (gpd) [6]					85,500	85,500	85,500	85,500	85,500	85,500	85,500	85,500	85,500	
Basins A-O & R-S - Total Projected Average WW Flow (gpd)	420,082	425,218	430,354	439,342	533,830	549,880	565,716	581,552	597,388	613,224	622,212	631,200	825,084	
Basins P&Q - Total Projected Average WW Flow (gpd)	55,013	56,643	58,273	60,718	63,163	65,608	68,053	70,498	72,943	75,388	77,833	80,278	177,670	
GRAND TOTAL Projected WW Flow (Average)	**475,095**	**481,861**	**488,627**	**500,060**	**596,993**	**615,488**	**633,769**	**652,050**	**670,331**	**688,612**	**700,045**	**711,478**	**1,002,754**	
Projected DU Peak Flow (gpd) [7]	784,293	793,882	803,471	820,252	996,661	1,026,626	1,056,192	1,085,758	1,115,323	1,144,889	1,161,670	1,178,450	1,540,432	
Resort Peak Commercial Flow (gpd) [6]					384,800	384,800	384,800	384,800	384,800	384,800	384,800	384,800	384,800	
Basins A-O & R-S - Total Projected WW Flow (Peak)	784,293	793,882	803,471	820,252	1,381,461	1,411,426	1,440,992	1,470,558	1,500,123	1,529,689	1,546,470	1,563,250	1,925,232	
Basins P&Q - Total Projected WW Flow (Peak)	102,708	105,752	108,795	113,360	117,924	122,489	127,054	131,619	136,184	140,748	145,313	149,878	331,710	
GRAND TOTAL Projected WW Flow (Peak)	**887,001**	**899,634**	**912,266**	**933,611**	**1,499,385**	**1,533,915**	**1,568,046**	**1,602,176**	**1,636,307**	**1,670,438**	**1,691,783**	**1,713,128**	**2,256,942**	

Notes:

1. Includes lot splits and normal lot development in vacant parcels which the Town estimates at 18 per year.
2. Includes normal septic conversions which the Town estimates at 10 per year.
3. Additional septic parcels which can be connected by new pipe infrastructure. Town estimates at 20 per year.
4. Based on approved total residential units per the June 2008 Wastewater Basis of Design Report.
5. Based on per dwelling unit flow factor: 214 gpd/DU
6. Based on June 2008 Wastewater Basis of Design Report.
7. Based on peak day to average day factor: 1.867

TOWN OF PARADISE VALLEY, AZ
WASTEWATER MASTER PLAN
APPENDIX F. WASTEWATER FLOW PROJECTION DETAILS

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Buildout	Totals
Dwelling Units (DU)														
Connected at Start of Year	135	135	139	143	149	155	161	167	173	179	185	191	197	
New Connections														
New SFR in Vacant Parcels [1]		2	2	2	2	2	2	2	2	2	2	2	29	51
Septic - Regular Conversions [2]		2	2	2	2	2	2	2	2	2	2	2	100	122
Septic - Master Plan Additions [3]				2	2	2	2	2	2	2	2	2	110	128
Five Star Development Residential [4]														
Total DUs Connected	135	139	143	149	155	161	167	173	179	185	191	197	436	**436**
Projected DU Average Flows (gpd) [5]	55,013	56,643	58,273	60,718	63,163	65,608	68,053	70,498	72,943	75,388	77,833	80,278	177,670	
Resort Average Commercial Flow (gpd) [6]														
Total Projected Average WW Flow (gpd)	55,013	56,643	58,273	60,718	63,163	65,608	68,053	70,498	72,943	75,388	77,833	80,278	177,670	
Projected DU Peak Flow (gpd) [7]	102,708	105,752	108,795	113,360	117,924	122,489	127,054	131,619	136,184	140,748	145,313	149,878	331,710	
Resort Peak Commercial Flow (gpd) [6]														
Basins P&Q - Total Projected WW Flow (Peak)	102,708	105,752	108,795	113,360	117,924	122,489	127,054	131,619	136,184	140,748	145,313	149,878	331,710	

Notes:

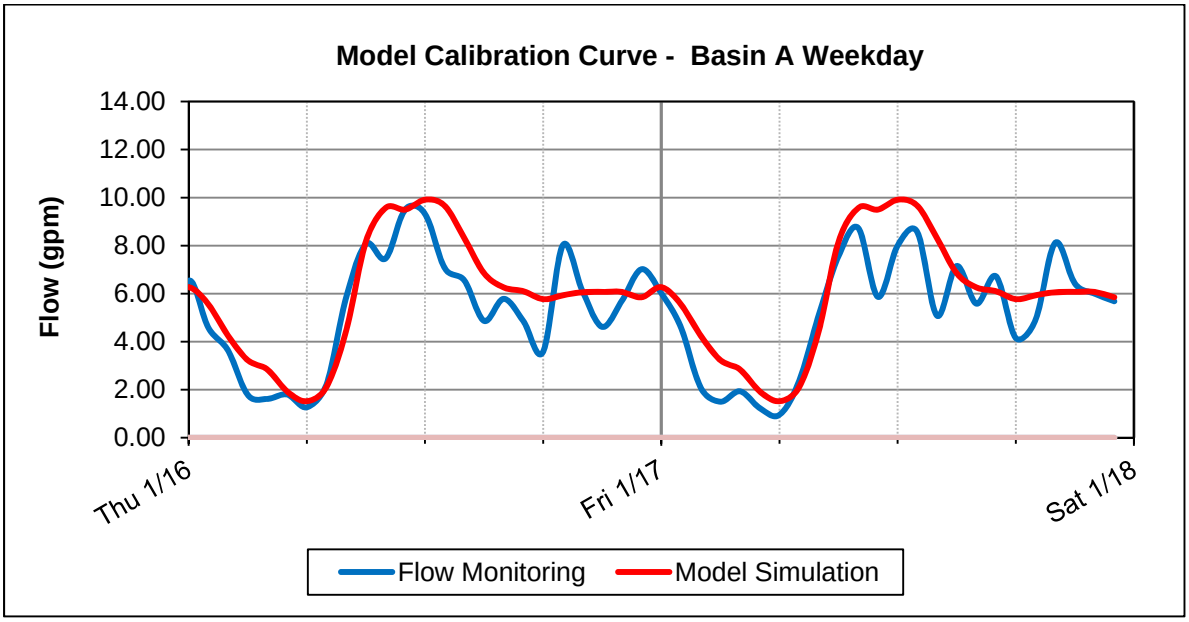
1. Includes lot splits and normal lot development in vacant parcels which the Town estimates at 18 per year.
2. Includes normal septic conversions which the Town estimates at 10 per year.
3. Additional septic parcels which can be connected by new pipe infrastructure. Town estimates at 20 per year.
4. Based on approved total residential units per the June 2008 Wastewater Basis of Design Report.
5. Based on per dwelling unit flow factor: 407.5 gpd/DU
6. Based on June 2008 Wastewater Basis of Design Report.
7. Based on peak day to average day factor: 1.867

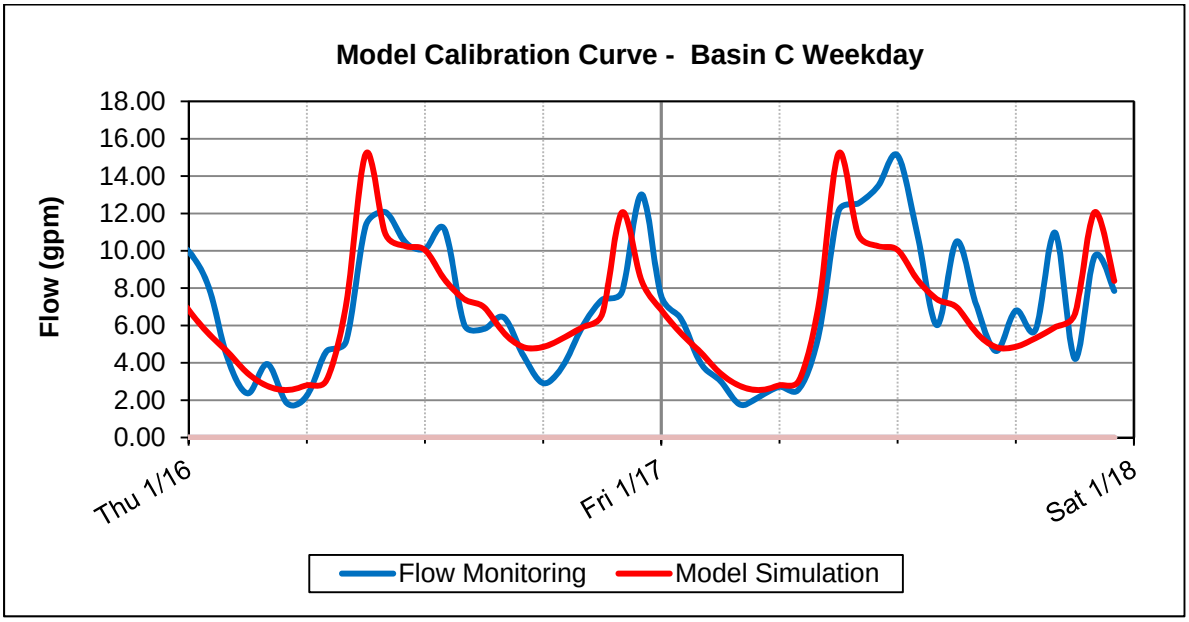
Appendix G

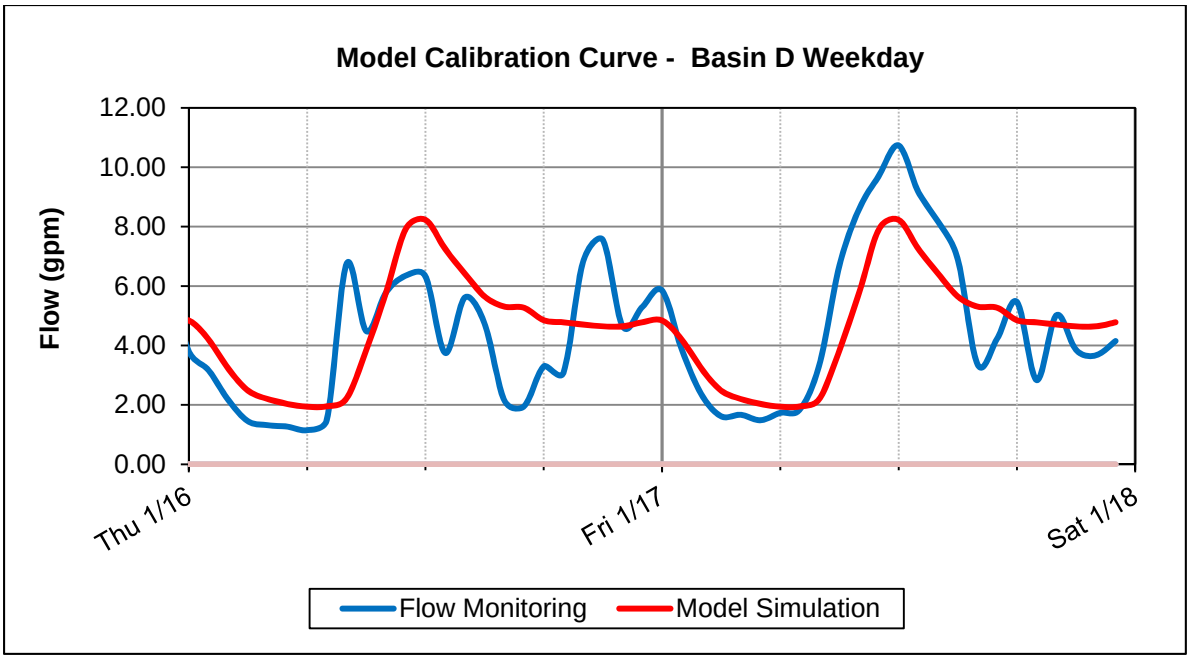
Model Calibration Results

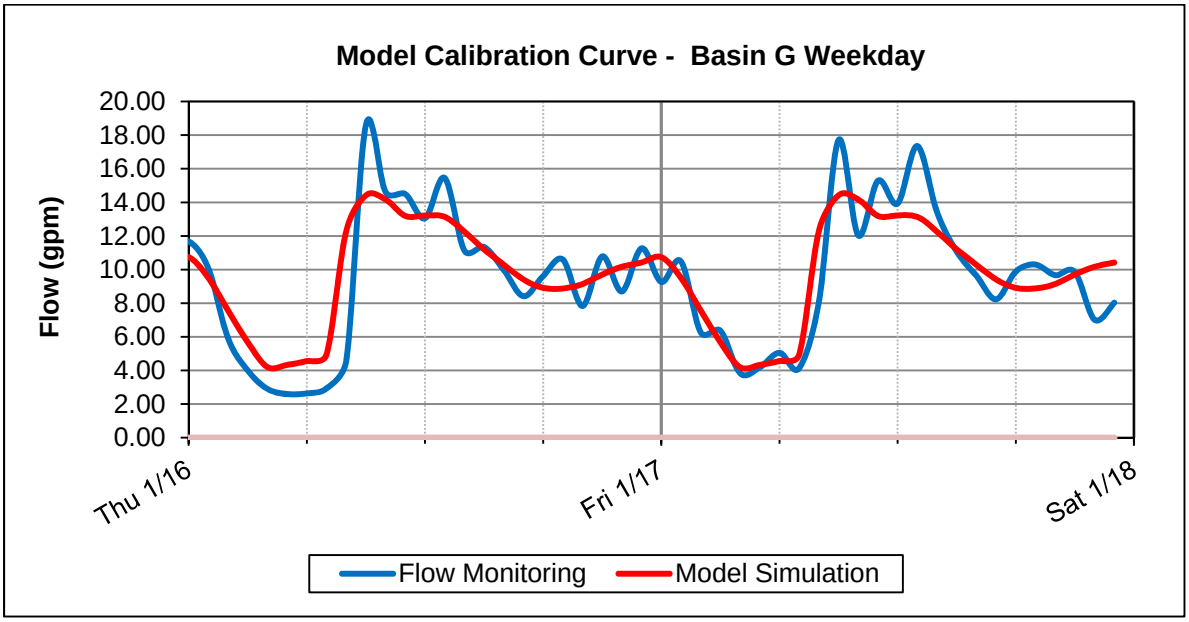
TOWN OF PARADISE VALLEY, AZ
WASTEWATER MASTER PLAN
APPENDIX G. MODEL CALIBRATION RESULTS

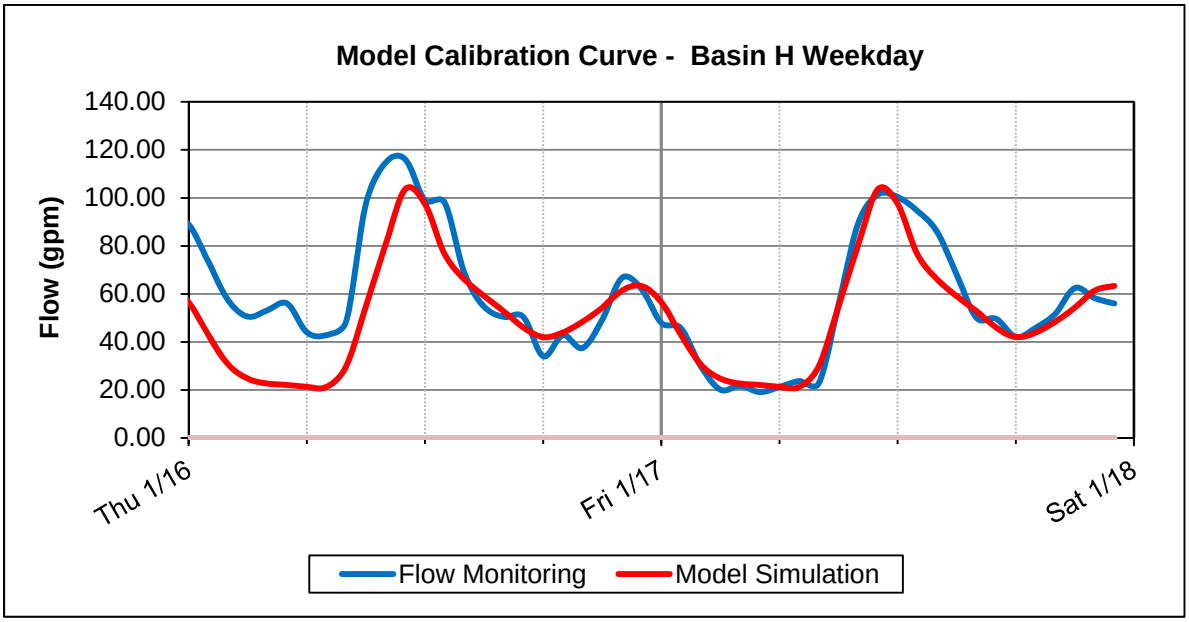
1. Weekday Flow Calibration Curves

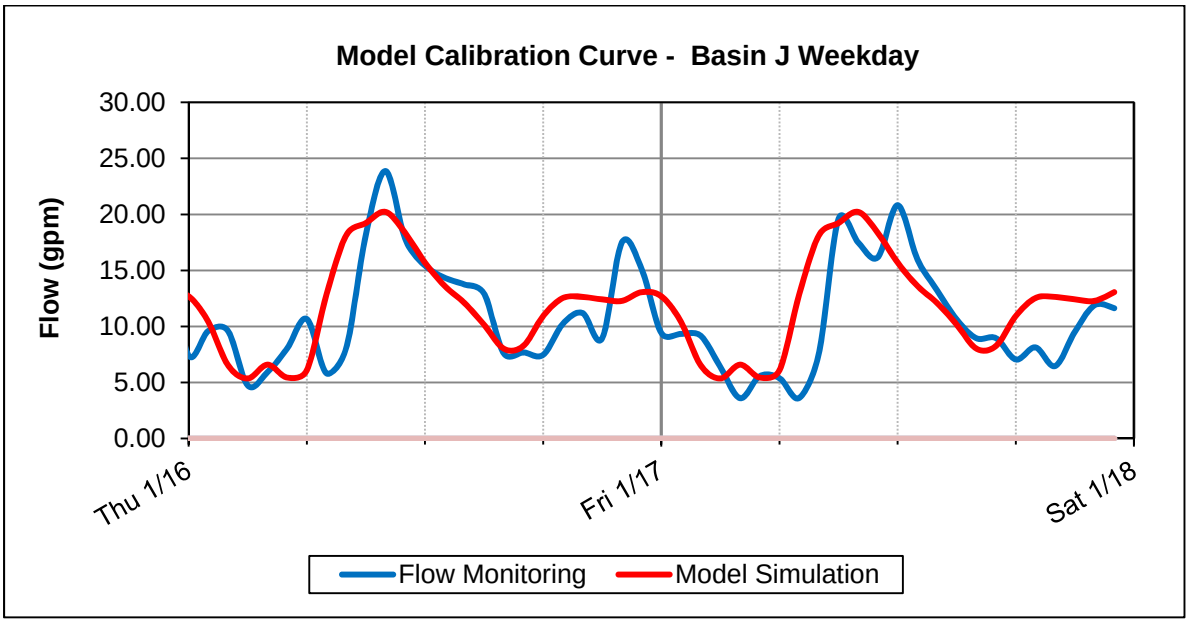


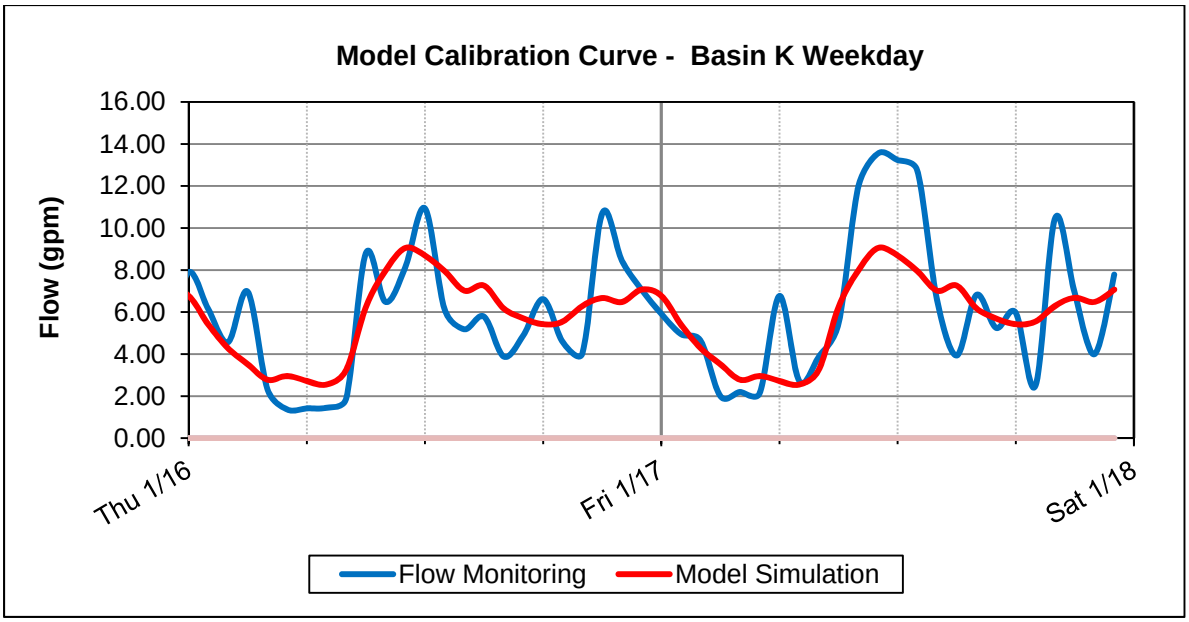


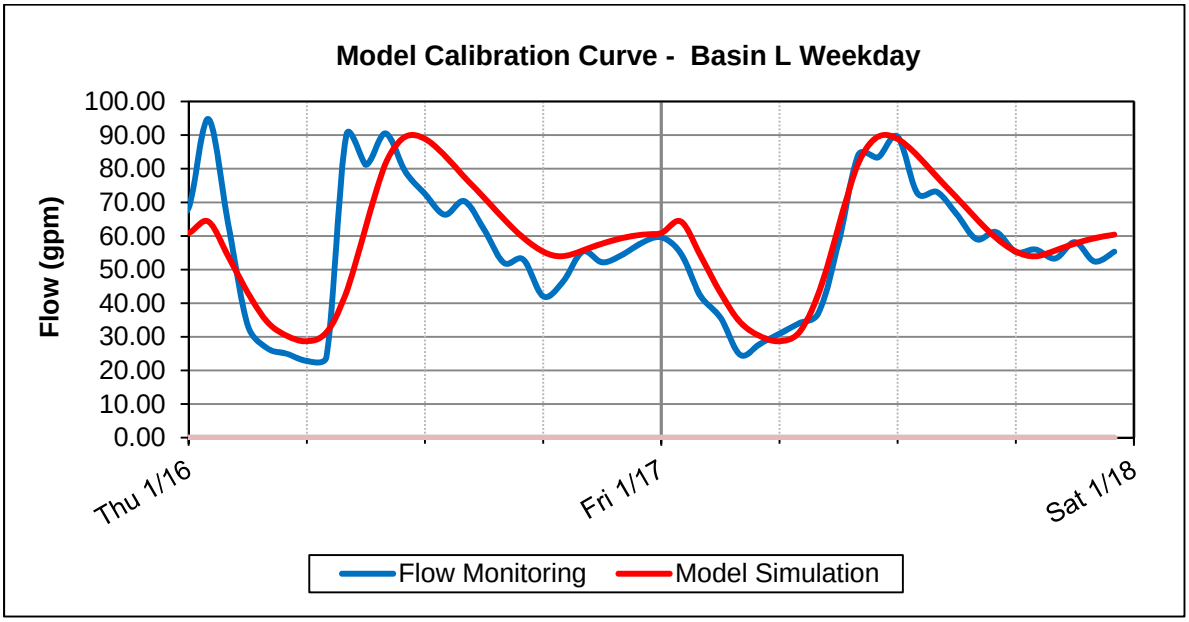

Model Calibration Curve - Basin D Weekday
Flow (gpm)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

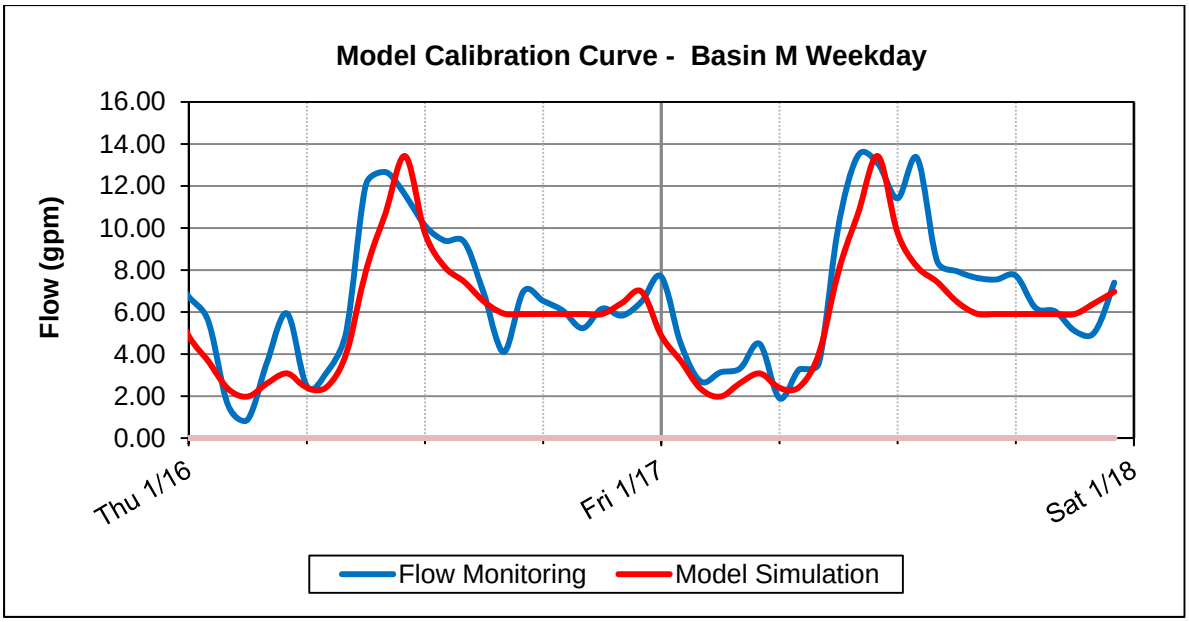

Model Calibration Curve - Basin G Weekday
Flow (gpm)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

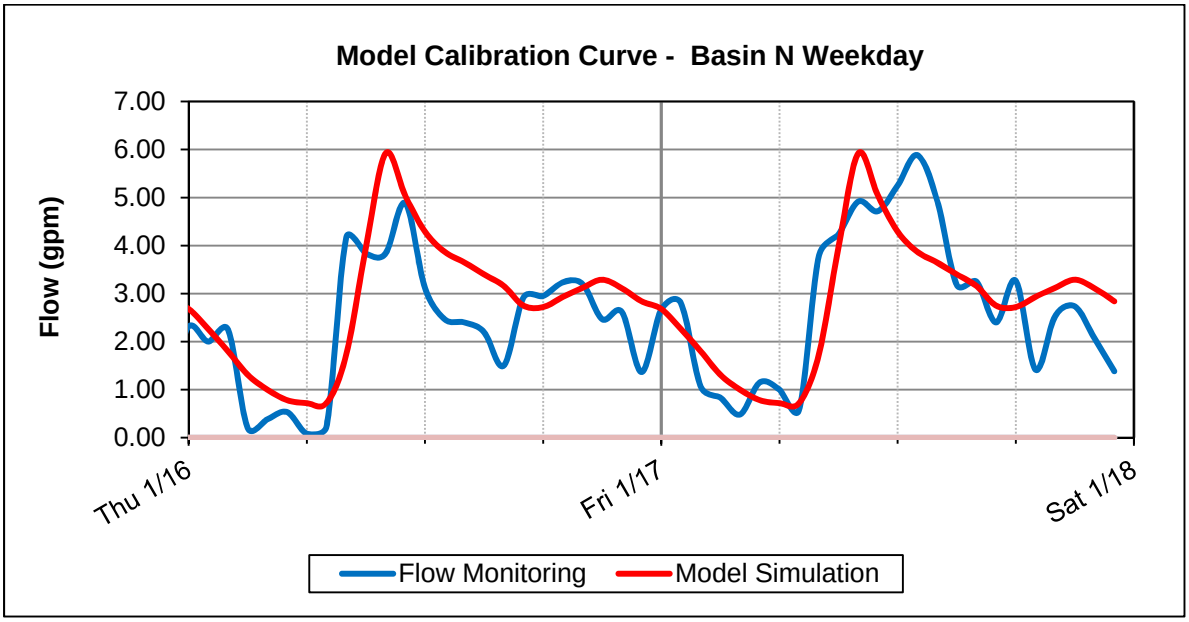

Model Calibration Curve - Basin H Weekday
Flow (gpm)
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

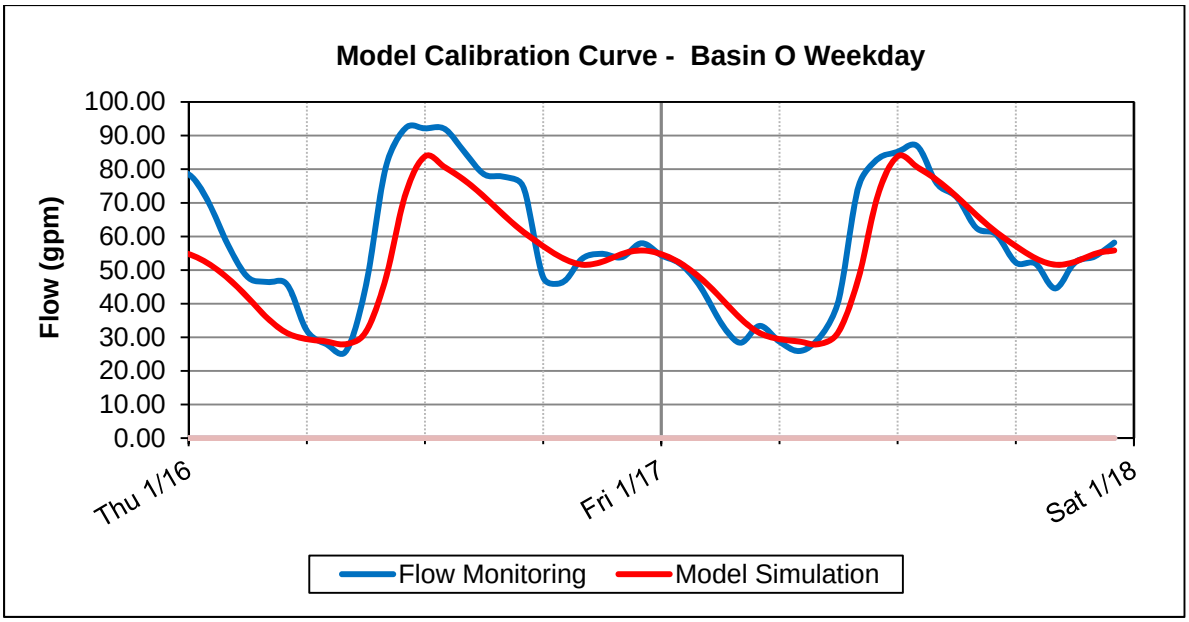

Model Calibration Curve - Basin J Weekday
Flow (gpm)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

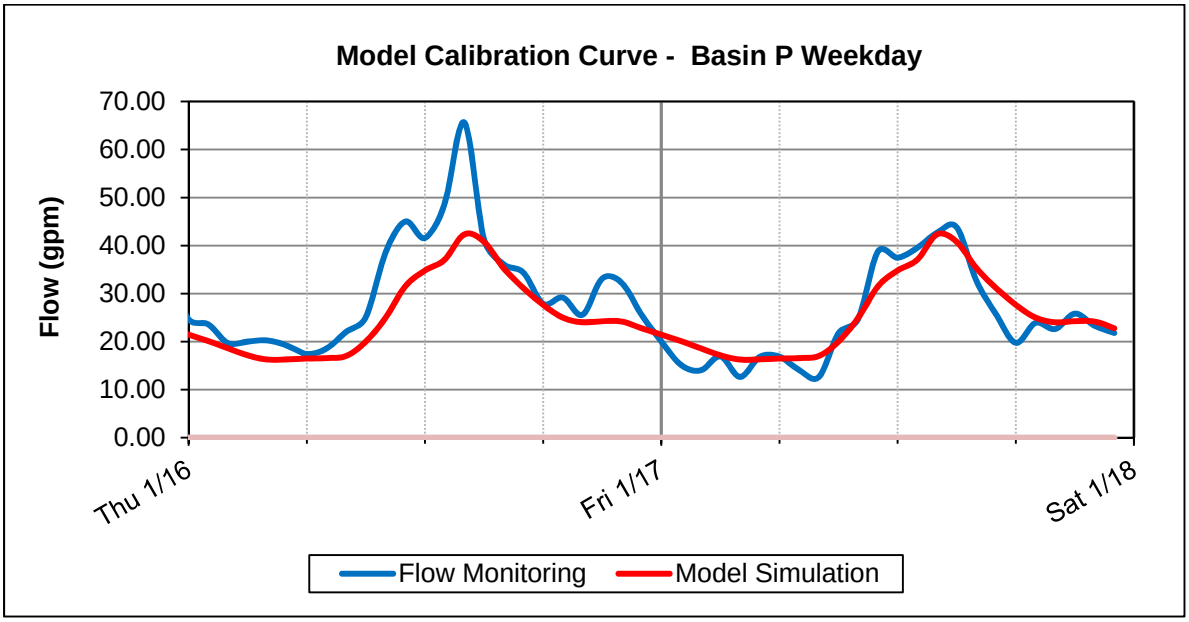

Model Calibration Curve - Basin K Weekday
Flow (gpm)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

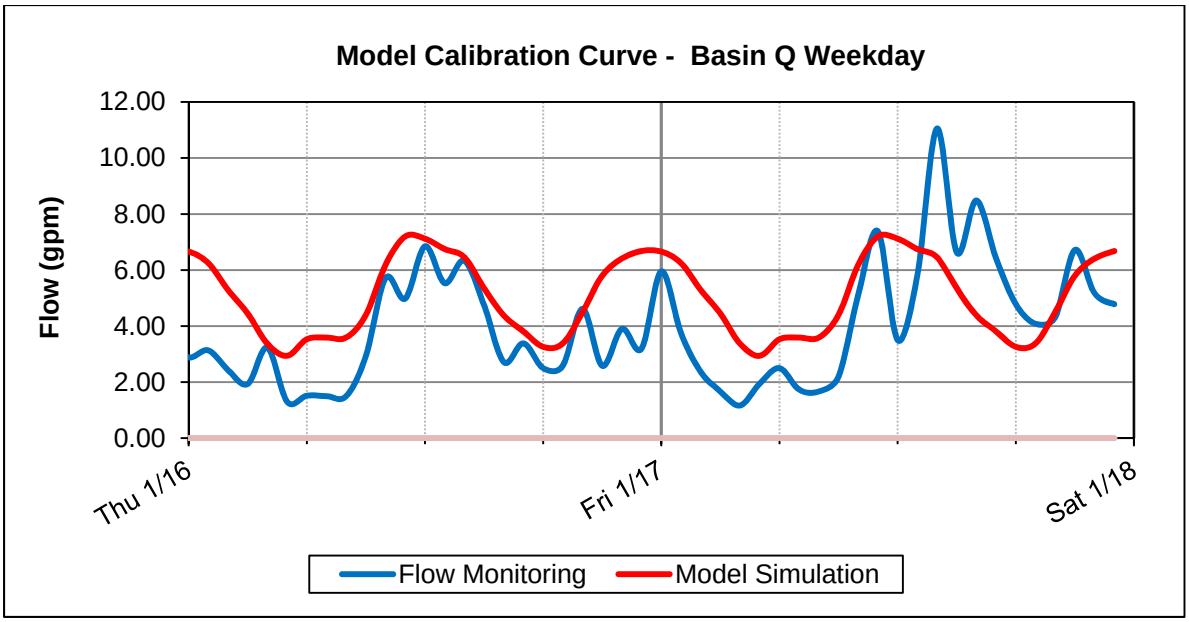

Model Calibration Curve - Basin L Weekday
Flow (gpm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation


Model Calibration Curve - Basin M Weekday
Flow (gpm)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

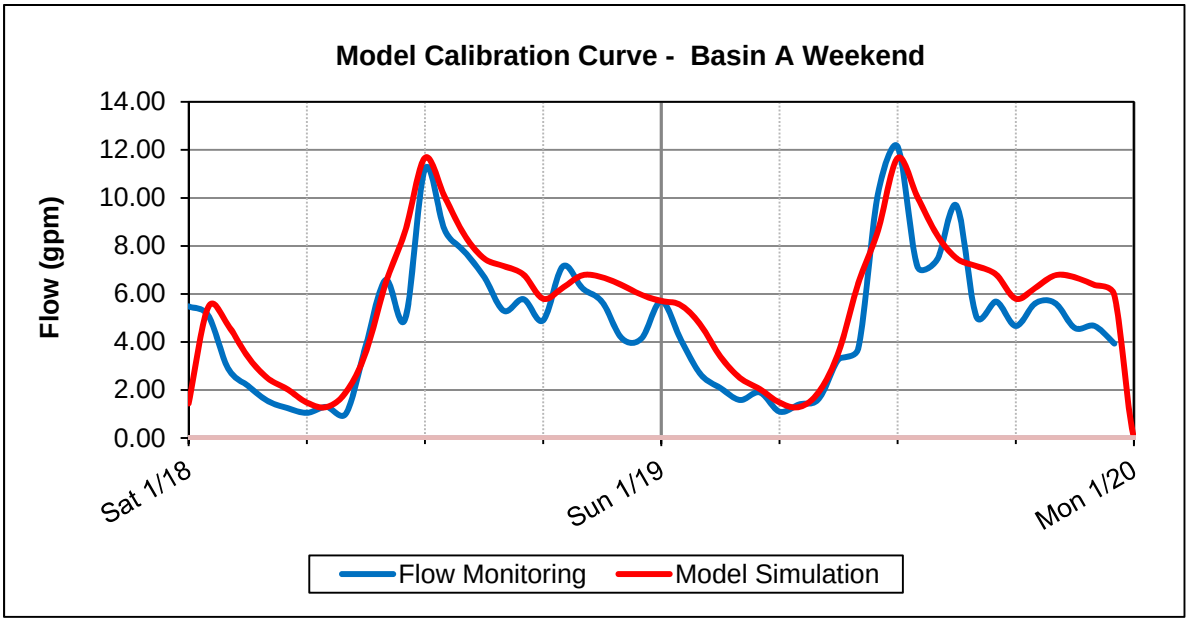

Model Calibration Curve - Basin N Weekday
Flow (gpm)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

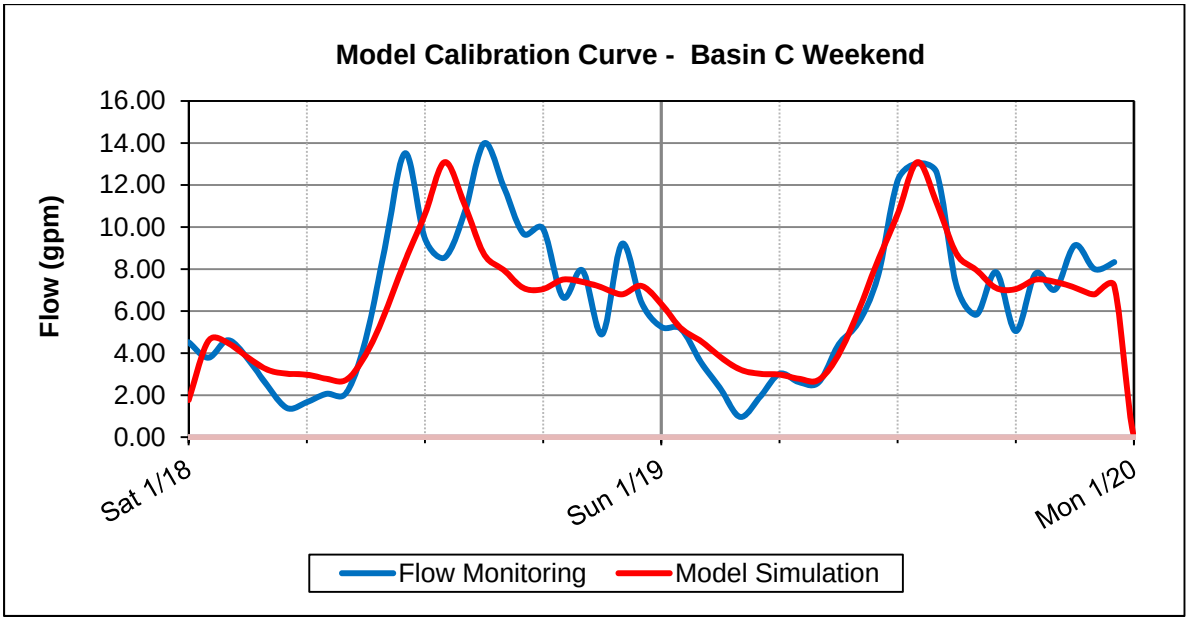

Model Calibration Curve - Basin O Weekday
Flow (gpm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

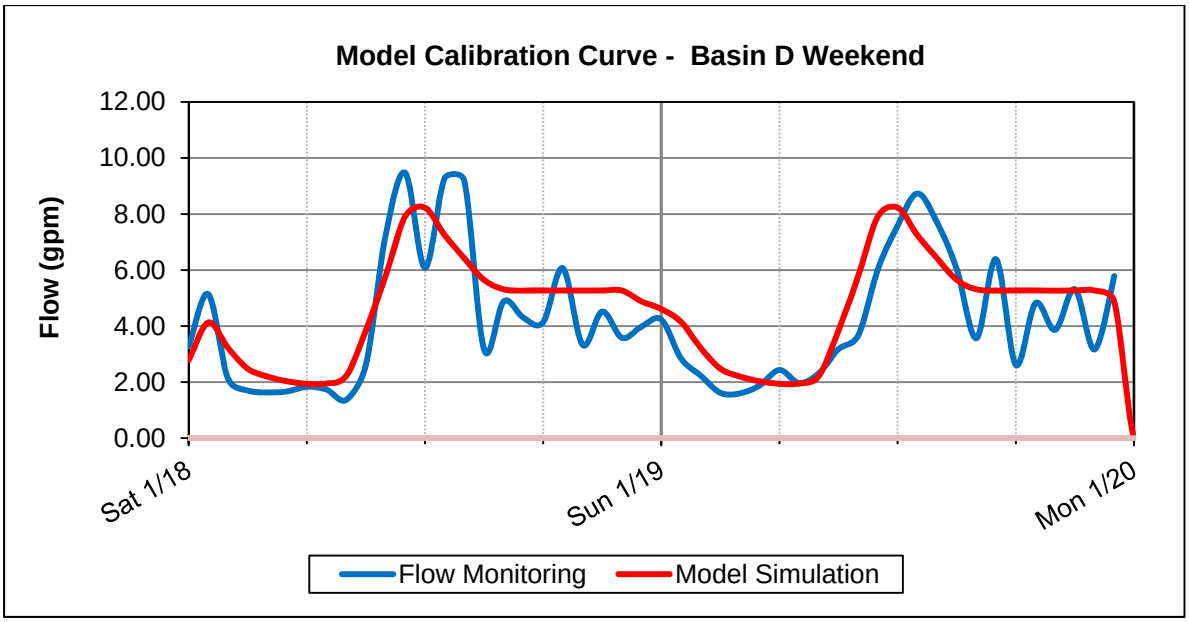

Model Calibration Curve - Basin P Weekday
Flow (gpm)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

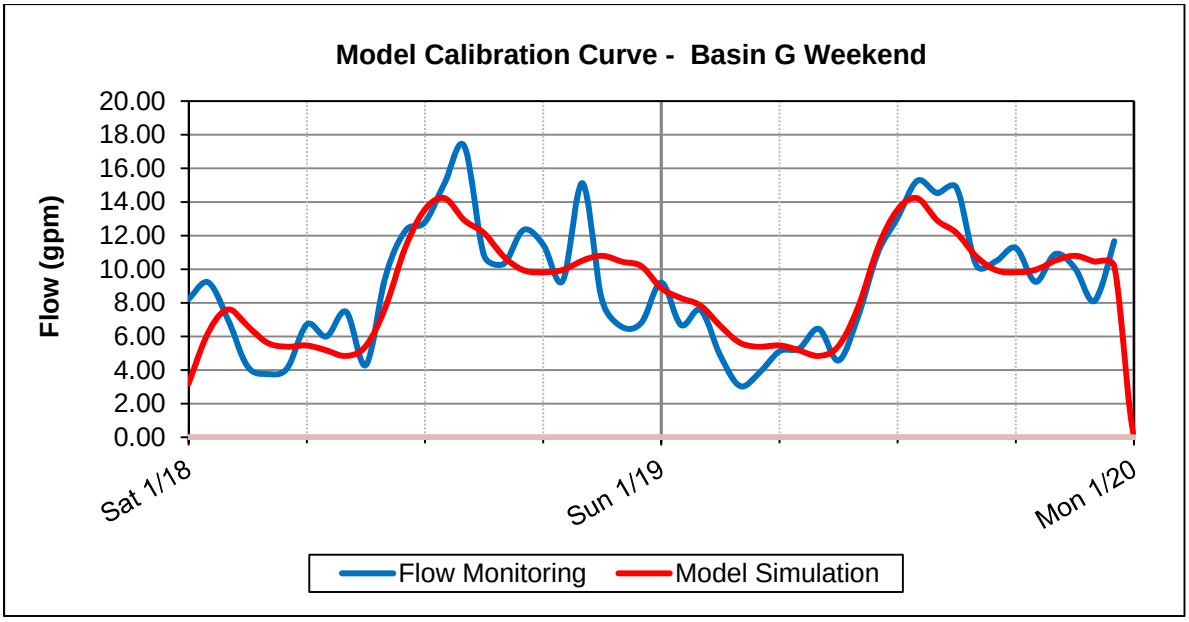

Model Calibration Curve - Basin Q Weekday
Flow (gpm)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Thu 1/16
Fri 1/17
Sat 1/18
Flow Monitoring
Model Simulation

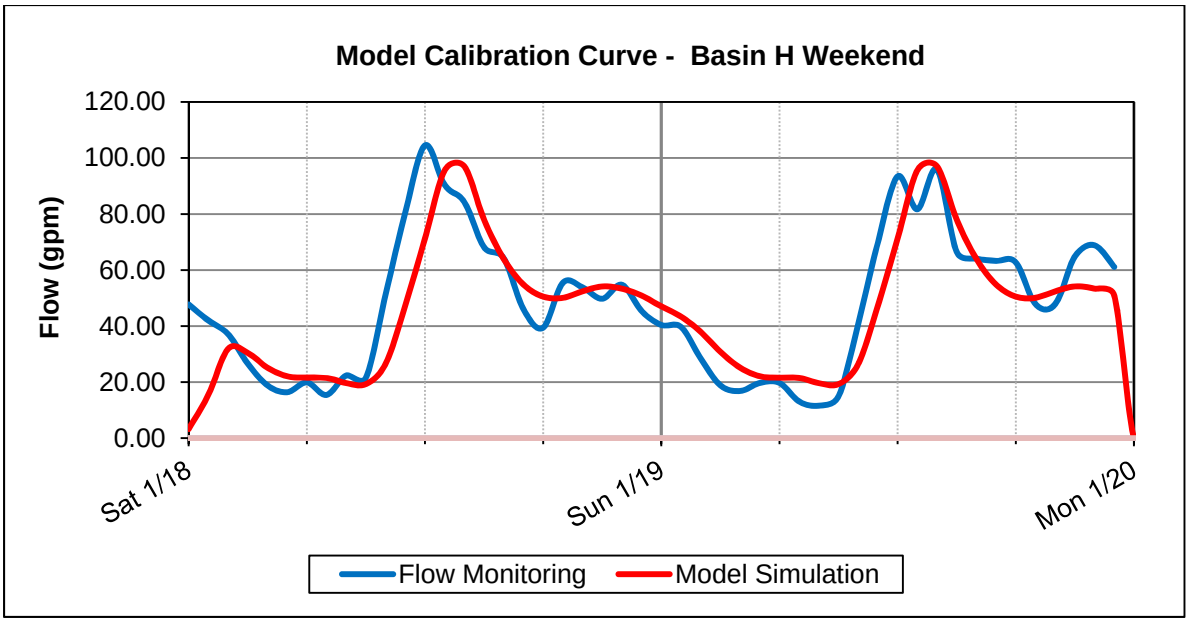
2. Weekend Flow Calibration Curves

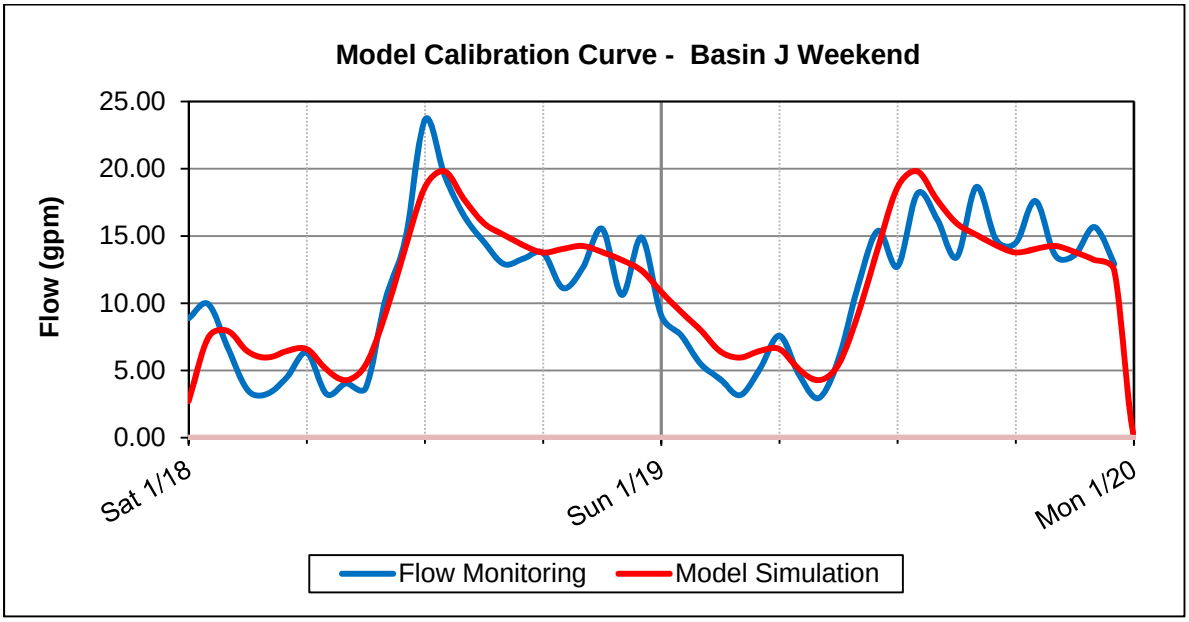


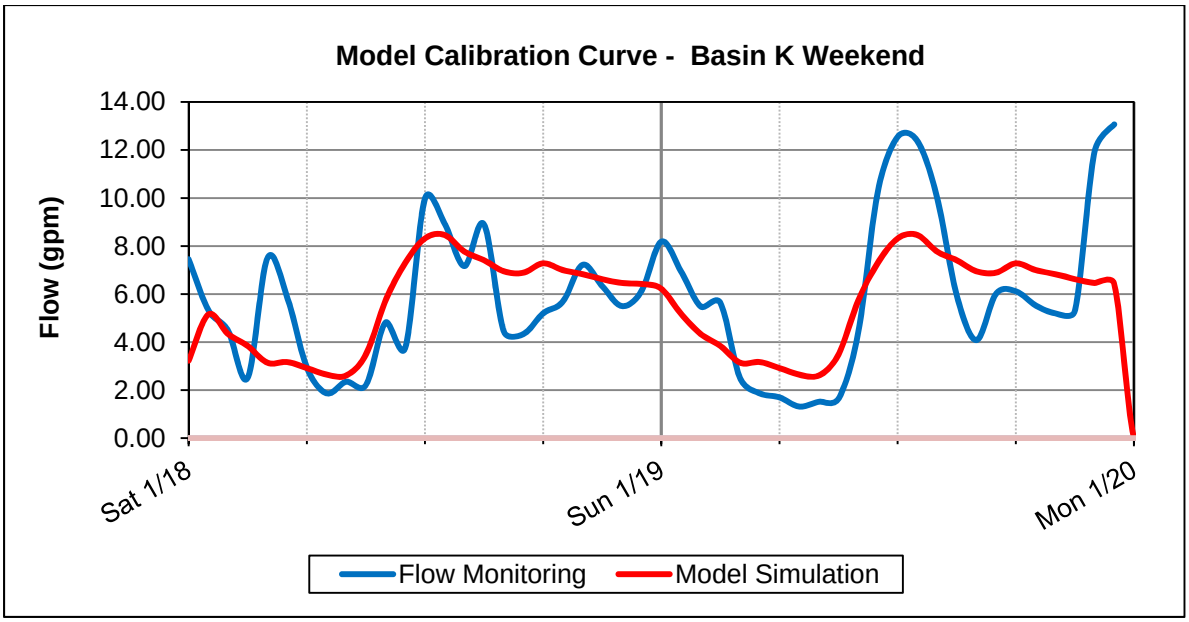


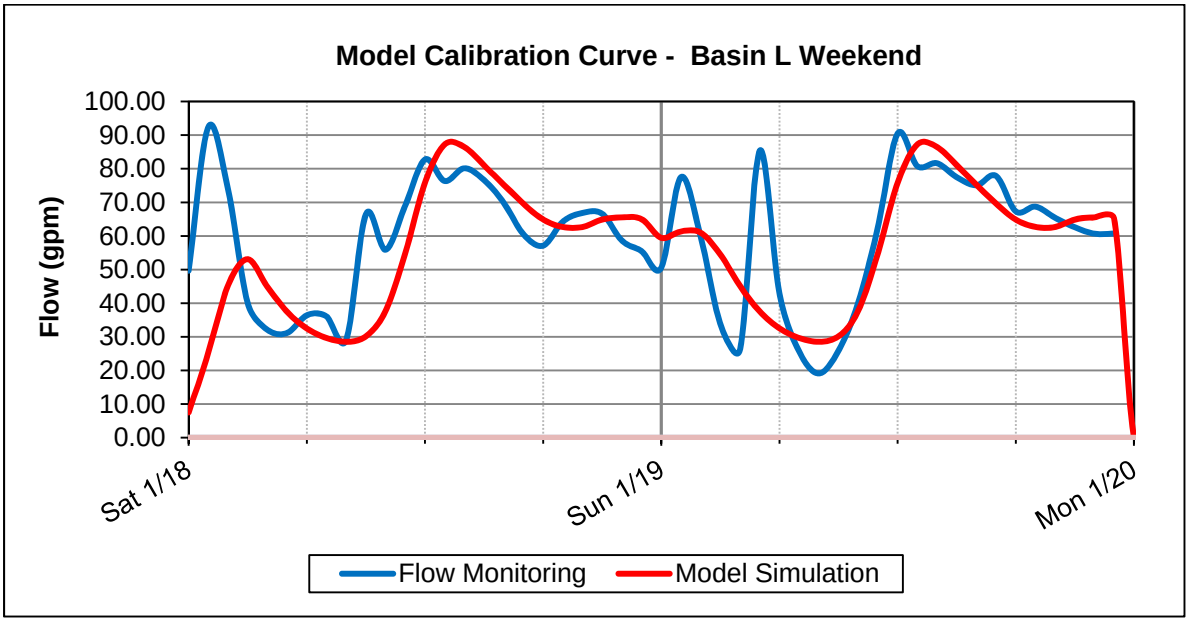

Model Calibration Curve - Basin D Weekend
Flow (gpm)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation

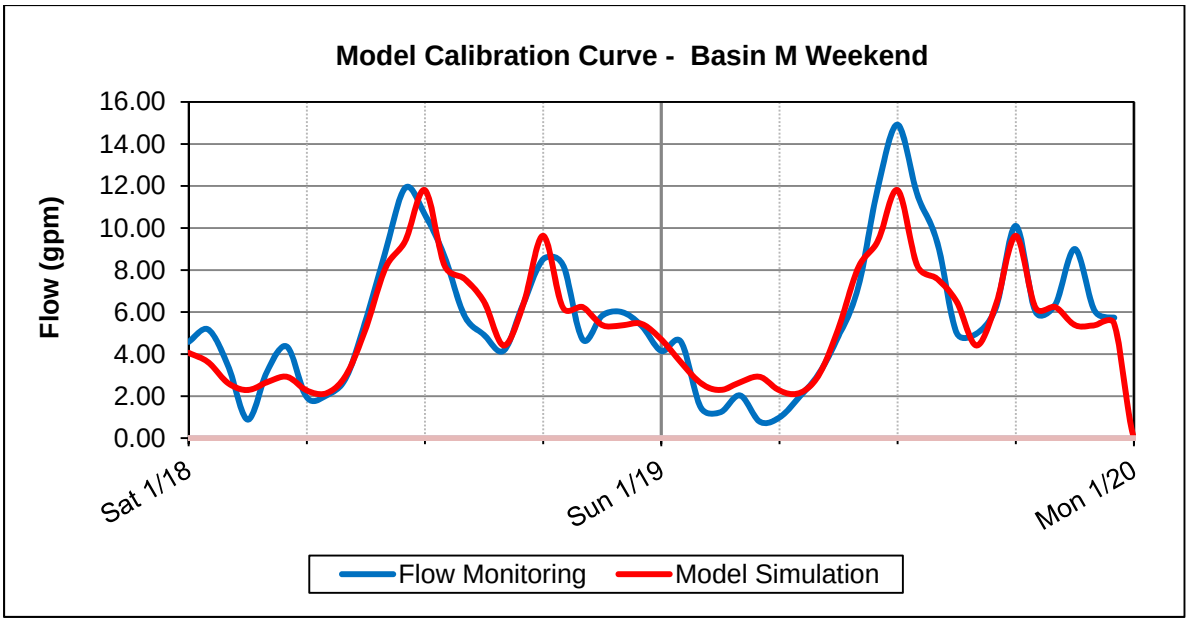

Model Calibration Curve - Basin G Weekend
Flow (gpm)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation

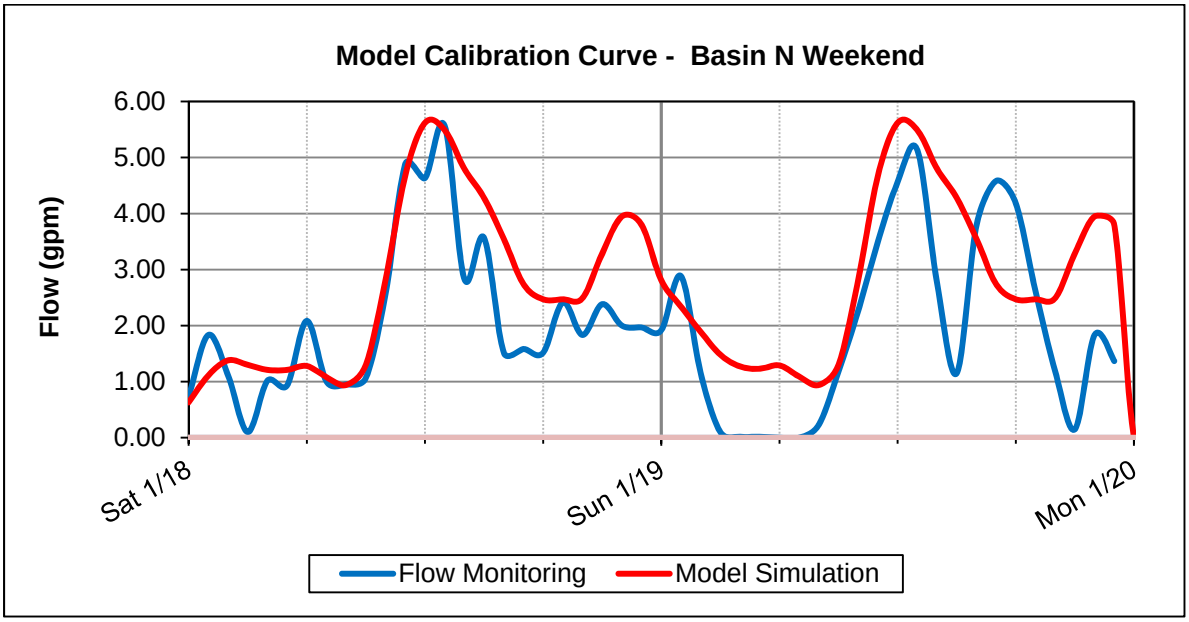

Model Calibration Curve - Basin H Weekend
Flow (gpm)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation

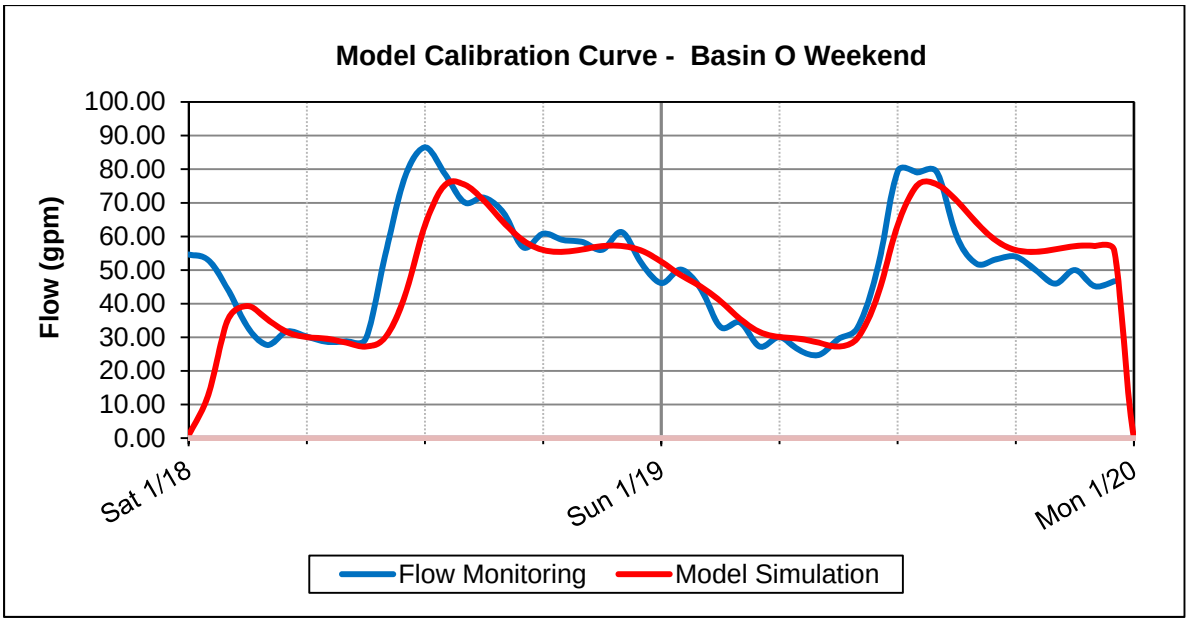

Model Calibration Curve - Basin J Weekend
Flow (gpm)
25.00
20.00
15.00
10.00
5.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation

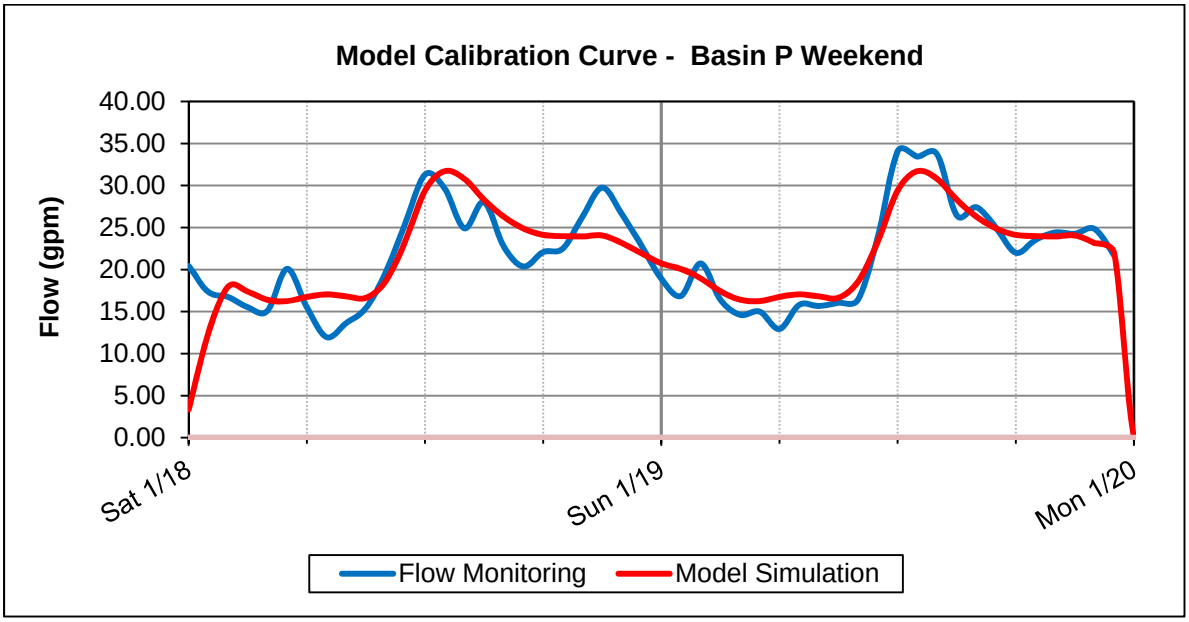

Model Calibration Curve - Basin K Weekend
Flow (gpm)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation

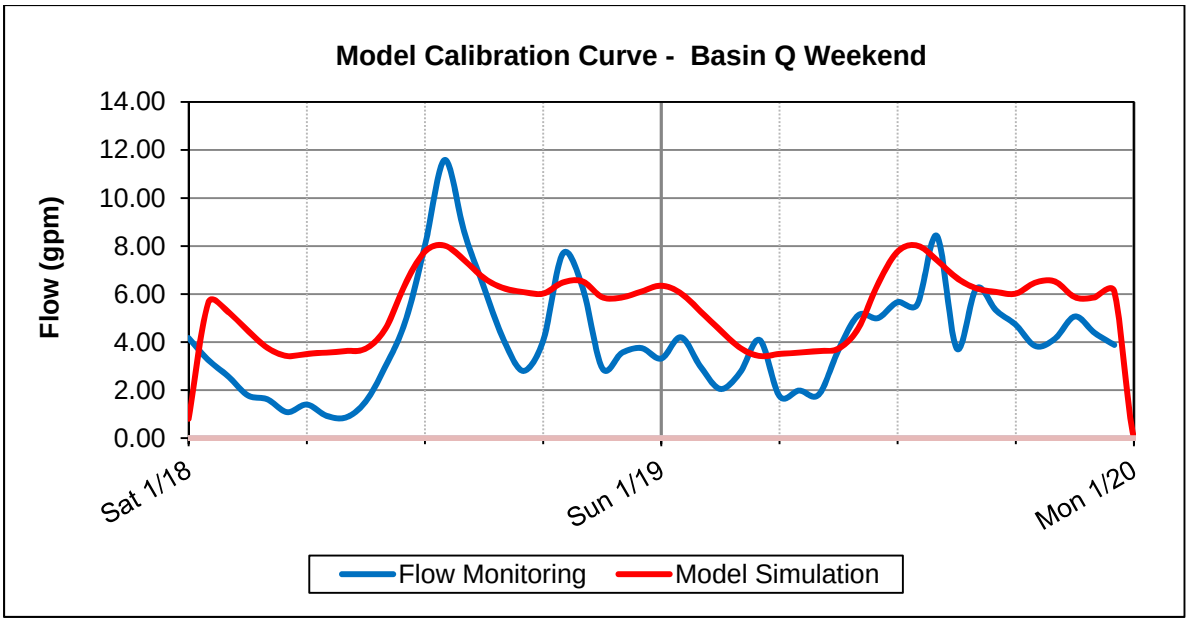

Model Calibration Curve - Basin L Weekend
Flow (gpm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation


Model Calibration Curve - Basin M Weekend
Flow (gpm)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation


Model Calibration Curve - Basin N Weekend
Flow (gpm)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation


Model Calibration Curve - Basin O Weekend
Flow (gpm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation


Model Calibration Curve - Basin P Weekend
Flow (gpm)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation


Model Calibration Curve - Basin Q Weekend
Flow (gpm)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Sat 1/18
Sun 1/19
Mon 1/20
Flow Monitoring
Model Simulation

Appendix H

Detailed Cost Estimates

TOWN OF PARADISE VALLEY, AZ
WASTEWATER MASTER PLAN
RECOMMENDED INFRASTRUCTURE (2015 - BUILDOUT)
APPENDIX H. DETAILED COST ESTIMATES

Pipe ID	Line Item Description				Cost ($)[2]	Engineering & Design ($)[3]	Contingency ($)[4]	Total Cost ($)
		Pipe Diameter	Length (LF)[1]					
1. Basin Drainage Modifications					**$ 1,438,168**	**$ 431,450**	**$ 431,450**	**$ 2,310,000**
New Pipes			**10,192**	**LF**	**$ 1,158,570**	**$ 347,571**	**$ 347,571**	**$ 1,860,000**
P-1	E Chaparral Rd from N 69th Pl to just east of N Scottsdale Rd	8-in	1,569	LF	$ 178,355	$ 53,507	$ 53,507	$ 285,400
P-2	N Scottsdale Rd from E Horseshoe Rd to E Berneil Dr	8-in	1,509	LF	$ 171,535	$ 51,460	$ 51,460	$ 274,500
P-3	Parallel to N Scottsdale Rd from N Merion Way to N Caballo Cir	8-in	914	LF	$ 103,898	$ 31,170	$ 31,170	$ 166,300
P-4	N Scottsdale Rd from E Jackrabbit Rd to E Vista Dr	8-in	1,443	LF	$ 164,032	$ 49,210	$ 49,210	$ 262,500
P-5	E Chaparral Rd from N 68th St to west of N Chiquita Ln	8-in	229	LF	$ 26,031	$ 7,809	$ 7,809	$ 41,700
P-6	E Chaparral at N Chiquita Ln goes east and west	8-in	257	LF	$ 29,214	$ 8,764	$ 8,764	$ 46,800
P-7	E Chapparal Rd east of N Chiquita Ln	8-in	249	LF	$ 28,305	$ 8,491	$ 8,491	$ 45,300
P-8	E Chaparral Rd between N Chiquita Ln to N 69th Pl	8-in	227	LF	$ 25,804	$ 7,741	$ 7,741	$ 41,300
P-9	E Chaparral Rd from N 69th Pl to N 69th Pl	8-in	208	LF	$ 23,644	$ 7,093	$ 7,093	$ 37,900
P-10	E Fanfol Dr from N 68th Pl to N 68th St; N 68th St from Fanfol Dr to E Caron Dr; West on E Caron Dr	8-in	991	LF	$ 112,651	$ 33,795	$ 33,795	$ 180,300
P-11	N Scottsdale Rd from E Sunnyvale Rd to E Horseshoe Rd; West along E Horseshoe Rd	8-in	1,257	LF	$ 142,889	$ 42,867	$ 42,867	$ 228,700
P-12	N Scottsdale from E McCormick Pky goes south; small portion from N Scottsdale Dr to E Cheney Dr	8-in	1,339	LF	$ 152,210	$ 45,663	$ 45,663	$ 243,600
Regrade Existing 8-in Pipe			**792**	**LF**	**$ 90,030**	**$ 27,009**	**$ 27,009**	**$ 145,000**
P-13	E Caron Dr from N 68th St going west	8-in	792	LF	$ 90,030	$ 27,009	$ 27,009	$ 145,000
Upsize 8-in to 12-in Pipe			**1,446**	**LF**	**$ 189,568**	**$ 56,870**	**$ 56,870**	**$ 304,000**
P-14	N Scottsdale Rd from E Bronco Dr to E Paradise Canyon Rd; E Cheney Dr at N Scottsdale Rd	12-in	1,261	LF	$ 165,314	$ 49,594	$ 49,594	$ 265,000
P-15	E Chaparral Rd from N 68th St to N 69th Pl	12-in	185	LF	$ 24,253	$ 7,276	$ 7,276	$ 39,000
2. System Improvements			**2,199**	**LF**	**$ 288,284**	**$ 86,485**	**$ 86,485**	**$ 462,000**
P-16	N 70th St from E Northern Ave to south of E Foothill Dr	12-in	730	LF	$ 95,701	$ 28,710	$ 28,710	$ 154,000
P-17	E Northern Ave from N 70th St to N Scottsdale Rd	12-in	1,469	LF	$ 192,583	$ 57,775	$ 57,775	$ 309,000

Pipe ID		Line Item Description			Cost ($)[2]	Engineering & Design ($)[3]	Contingency ($)[4]	Total Cost ($)
		Pipe Diameter	Length (LF)[1]					
3. Master Plan Additions					**$ 14,235,450**	**$ 4,270,635**	**$ 4,270,635**	**$ 22,780,000**
Basin 1			**56,039**	**LF**	**$ 6,370,202**	**$ 1,911,061**	**$ 1,911,061**	**$ 10,200,000**
P-18	E Road Runner Rd goes north before N Las Brisas Ln continues east to E Desert Vista Rd and goes south	8-in	1,323	LF	$ 150,391	$ 45,117	$ 45,117	$ 241,000
P-19	E Road Runner Rd east of N Las Brisas Ln to N Shadown Mountain Rd, goes south on N Shadow Mountain Rd	8-in	1,062	LF	$ 120,722	$ 36,217	$ 36,217	$ 194,000
P-20	N 64th Pl from E Berneil Ln goes north to end	8-in	150	LF	$ 17,051	$ 5,115	$ 5,115	$ 28,000
P-21	E Desert Jewel Dr from east of N Ridgeview Dr to east of N Arroyo Rd	8-in	1,387	LF	$ 157,666	$ 47,300	$ 47,300	$ 253,000
P-22	N Ridgeview Dr from E Crestview Dr to E Desert Jewel Dr	8-in	434	LF	$ 49,335	$ 14,800	$ 14,800	$ 79,000
P-23	N Arroyo Rd from E Desert Jewel Dr to E Crestview Dr, goes west on E Crestview Dr	8-in	1,555	LF	$ 176,764	$ 53,029	$ 53,029	$ 283,000
P-24	N 70th St north of road end	8-in	250	LF	$ 28,419	$ 8,526	$ 8,526	$ 46,000
P-25	N 64th Pl at E Berneil Ln	8-in	157	LF	$ 17,847	$ 5,354	$ 5,354	$ 29,000
P-26	N Ironwood Dr goes north from E Fanfol Dr	8-in	131	LF	$ 14,891	$ 4,467	$ 4,467	$ 24,000
P-27	E Donna Ln west of N Morning Glory Rd	8-in	240	LF	$ 27,282	$ 8,185	$ 8,185	$ 44,000
P-28	N Morning Glory Rd south of E Berneil Ln	8-in	82	LF	$ 9,321	$ 2,796	$ 2,796	$ 15,000
P-29	N 57th St from E Doubletree Ranch Rd to E Horseshoe Rd, from E Horseshoe Rd goes east to end	8-in	677	LF	$ 76,958	$ 23,087	$ 23,087	$ 124,000
P-30	E Via del Cieto going north, west of N Via la Serena Ln	8-in	105	LF	$ 11,936	$ 3,581	$ 3,581	$ 20,000
P-31	E Orchid Ln from N 49th St west until end	8-in	573	LF	$ 65,135	$ 19,541	$ 19,541	$ 105,000
P-32	E Sunter Dr from E Mockingbird Ln to E Caide del Sol Dr, E Caide del Sol Dr to N 48th Pl, N 48th Pl south to end	8-in	1,254	LF	$ 142,548	$ 42,764	$ 42,764	$ 229,000
P-33	E Caballo Dr goes south, east of E Via Los Ranchos	8-in	150	LF	$ 17,051	$ 5,115	$ 5,115	$ 28,000
P-34	N Avenida del Sol from south of E Via Buena Via goes north	8-in	306	LF	$ 34,784	$ 10,435	$ 10,435	$ 56,000
P-35	N Shadow Mountain Rd from N Las Brisas Ln goes to south of E Road Runner Rd	8-in	1,393	LF	$ 158,348	$ 47,505	$ 47,505	$ 254,000
P-36	N 54th St goes south from E Royal Palm Rd, new line branches off to the east	8-in	848	LF	$ 96,396	$ 28,919	$ 28,919	$ 155,000
P-37	N tatum Blvd from E Foothill Dr goes south	8-in	665	LF	$ 75,594	$ 22,678	$ 22,678	$ 121,000
P-38	N 65th St south of E Horseshoe Dr	8-in	210	LF	$ 23,872	$ 7,161	$ 7,161	$ 39,000
P-39	N Mohave Cir goes north from E Mohave Pl	8-in	242	LF	$ 27,509	$ 8,253	$ 8,253	$ 45,000
P-40	E Fanfol Dr from N 68th St goes west; N68th Pl from end to E Fanfol Dr	8-in	1,315	LF	$ 149,482	$ 44,845	$ 44,845	$ 240,000
P-41	E Doubletree Ranch Rd from N 56th St to N 55th St	8-in	626	LF	$ 71,160	$ 21,348	$ 21,348	$ 114,000
P-42	New road from E Road Runner Rd, goes north parallel to N Shadown Mountain Rd	8-in	1,344	LF	$ 152,778	$ 45,834	$ 45,834	$ 245,000
P-43	E Royal Palm Rd from N 54th St to N 53rd St	8-in	953	LF	$ 108,332	$ 32,500	$ 32,500	$ 174,000
P-44	E Sapphire Ln from N 54th St goes west to end	8-in	288	LF	$ 32,738	$ 9,821	$ 9,821	$ 53,000
P-45	N Lillian Ln from E Mockingbird Ln to E Charles Dr, E Charles Dr to N Waterman Ln	8-in	1,322	LF	$ 150,278	$ 45,083	$ 45,083	$ 241,000
P-46	N 53rd St between E Royal Palm Rd and E Mockingbird Ln	8-in	750	LF	$ 85,256	$ 25,577	$ 25,577	$ 137,000
P-47	E Mockingbird Ln from N Lauretta Ln to N Charles Dr, goes south on N Charles Dr	8-in	1,203	LF	$ 136,750	$ 41,025	$ 41,025	$ 219,000
P-48	N 51st St from E Sky Desert Ln to E Mockingbird Ln, E Sky Desert Ln goes west until end	8-in	1,058	LF	$ 120,268	$ 36,080	$ 36,080	$ 193,000
P-49	E Moonlight Way from N Tatum Blvd to N Moonlight Ln, goes north on N Moonlight Ln	8-in	1,567	LF	$ 178,128	$ 53,438	$ 53,438	$ 286,000
P-50	E Crystal Ln from N Tatum Ln goes west; goes north on E Sparkling Ln	8-in	1,096	LF	$ 124,587	$ 37,376	$ 37,376	$ 200,000
P-51	E Sparkling Ln from noth of E Crystal Ln goes west to E Crystal Ln	8-in	1,234	LF	$ 140,274	$ 42,082	$ 42,082	$ 225,000

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		Pipe Diameter	Length (LF)[1]					
P-52	E Crystal Ln from west of E Sparkling Ln goes west to E Sparking Ln	8-in	1,337	LF	$ 151,983	$ 45,595	$ 45,595	$ 244,000
P-53	N Tatum Blvd from E Desert Fairways Dr to E Moonlight Way	8-in	1,479	LF	$ 168,124	$ 50,437	$ 50,437	$ 269,000
P-54	E Road Runner Rd from west of N Tatum Blvd to N 50th St, goes north on N 50th St	8-in	1,486	LF	$ 168,920	$ 50,676	$ 50,676	$ 271,000
P-55	N Las Brisas Ln from E Cheney Dr to E Desert Vista Rd, E Paradise Canyon Rd from N Las Brisas Ln goes east to end	8-in	1,505	LF	$ 171,080	$ 51,324	$ 51,324	$ 274,000
P-56	E Moonlight Way from N Moonlight Ln goes east	8-in	1,077	LF	$ 122,427	$ 36,728	$ 36,728	$ 196,000
P-57	E Bar-Z Ln from end to N 66th Pl, goes south on N 66th Pl	8-in	802	LF	$ 91,167	$ 27,350	$ 27,350	$ 146,000
P-58	E Fanfol Dr from N Invergordon goes east	8-in	483	LF	$ 54,905	$ 16,471	$ 16,471	$ 88,000
P-59	E Fanfol Dr from N Invergordon goes east	8-in	455	LF	$ 51,722	$ 15,517	$ 15,517	$ 83,000
P-60	E Fanfol Dr from N Invergordon goes east	8-in	182	LF	$ 20,689	$ 6,207	$ 6,207	$ 34,000
P-61	N 53rd Pl from E Sanna St to N 52nd Pl, goes north on N 52nd Pl, goes south on N 53rd St	8-in	1,653	LF	$ 187,904	$ 56,371	$ 56,371	$ 301,000
P-62	E Berneil Dr from east of N 70th St, goes north on N 70th St	8-in	449	LF	$ 51,040	$ 15,312	$ 15,312	$ 82,000
P-63	E Horseshoe Rd from N 56th St goes east	8-in	361	LF	$ 41,036	$ 12,311	$ 12,311	$ 66,000
P-64	E Doubletree Ranch Rd from N Foothill Manor Dr to N Martingale Rd, goes north and south along N Martingale Rd	8-in	1,807	LF	$ 205,410	$ 61,623	$ 61,623	$ 329,000
P-65	N 52nd St from E Doubletree Rd goes north	8-in	839	LF	$ 95,373	$ 28,612	$ 28,612	$ 153,000
P-66	N Lauretta Ln from E Mockingbird Ln to N Charles Rd, goes southwest along N Charles Rd	8-in	1,907	LF	$ 216,777	$ 65,033	$ 65,033	$ 347,000
P-67	N 52nd St from E Tomahawk Trl to E Orchid Ln, goes west along E Orchid Ln	8-in	1,266	LF	$ 143,912	$ 43,174	$ 43,174	$ 231,000
P-68	N Poco Calle from E Butler goes south	8-in	384	LF	$ 43,651	$ 13,095	$ 13,095	$ 70,000
P-69	E Mockingbird Ln from N Lauretta to E Sunset Dr	8-in	1,270	LF	$ 144,367	$ 43,310	$ 43,310	$ 231,000
P-70	E Horseshoe Rd from N Tatum Blvd to N Martingate Rd	8-in	1,433	LF	$ 162,895	$ 48,869	$ 48,869	$ 261,000
P-71	E Tamahawk Trl to N Tatum Blvd, goes north on N Tatum Blvd	8-in	1,310	LF	$ 148,914	$ 44,674	$ 44,674	$ 239,000
P-72	E Orchid Ln from west of N 52nd St to N 50th Pl, goes south on N 50th Pl	8-in	312	LF	$ 35,466	$ 10,640	$ 10,640	$ 57,000
P-73	N Tatum Blvd from E Horseshoe Rd goes south	8-in	372	LF	$ 42,287	$ 12,686	$ 12,686	$ 68,000
P-74	N Las Brisas Ln from E Road Runner Rd to E Desert Vista Rd, goes east on E Desert Vista Rd	8-in	1,167	LF	$ 132,658	$ 39,797	$ 39,797	$ 213,000
P-75	N 56th St from end to E Royal Palm Rd goes west along E Royal Rd	8-in	994	LF	$ 112,992	$ 33,898	$ 33,898	$ 181,000
P-78	E Horseshoe Rd between N 66th Pl and N Scottsdale Rd	8-in	1,344	LF	$ 152,778	$ 45,834	$ 45,834	$ 245,000
P-79	E Sunnyvale Rd from N Scottsdale Rd goes west	8-in	1,667	LF	$ 189,495	$ 56,849	$ 56,849	$ 304,000
P-80	N Shadown Mountain Rd from E Road Runned Rd to E Desert Park Ln, E Desert Park Ln from N Shadow Mountain Rd to N 50th St	8-in	1,525	LF	$ 173,354	$ 52,006	$ 52,006	$ 278,000
P-81	E Road Runner Rd from N Shadow Mountain Rd to N 50th St	8-in	1,223	LF	$ 139,024	$ 41,707	$ 41,707	$ 223,000
Basin 2			**875**	**LF**	**$ 99,465**	**$ 29,840**	**$ 29,840**	**$ 160,000**
P-82	E Horseshoe Rd west of 66th Pl, goes south along new road towards E Sunnyvale Rd	8-in	875	LF	$ 99,465	$ 29,840	$ 29,840	$ 160,000
Basin 3			**15,718**	**LF**	**$ 1,786,735**	**$ 536,020**	**$ 536,020**	**$ 2,860,000**
P-83	E Hummingbord Ln between N 69th Pl and N 71st St	8-in	138	LF	$ 15,687	$ 4,706	$ 4,706	$ 26,000
P-84	N Invergordon Rd from E Catesby Rd to E Cheney Dr, goes west along E Cheyney Dr and north along N Invergordon Rd	8-in	806	LF	$ 91,622	$ 27,486	$ 27,486	$ 147,000
P-85	E Ironwood Dr from end to N Mohave Rd, goes north along N Mohave Rd	8-in	895	LF	$ 101,739	$ 30,522	$ 30,522	$ 163,000
P-86	N 66th St from E Ironwood Dr to E Mockingbird Ln	8-in	339	LF	$ 38,536	$ 11,561	$ 11,561	$ 62,000
P-87	N 58th Pl from E Mockingbird Ln goes north	8-in	253	LF	$ 28,760	$ 8,628	$ 8,628	$ 47,000

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		Pipe Diameter	Length (LF)[1]					
P-88	N 69th St from E Ironwood Dr to E Northern Ave	8-in	247	LF	$ 28,078	$ 8,423	$ 8,423	$ 45,000
P-89	E Belmont Cir from end to N Mockingbird Ln, goes south	8-in	593	LF	$ 67,409	$ 20,223	$ 20,223	$ 108,000
P-90	N 58th Pl from E Caballo Dr to N 58th Pl side street, N 59th Pl from E Caballo Dr to E Caballo Ln	8-in	1,337	LF	$ 151,983	$ 45,595	$ 45,595	$ 244,000
P-91	E Caballo Ln from N 59th Pl to west of N 58th Pl, N 58th Pl from E Caballo Dr south to end	8-in	1,204	LF	$ 136,864	$ 41,059	$ 41,059	$ 219,000
P-92	E Cholla Dr between N 65th St and N 66th St	8-in	420	LF	$ 47,743	$ 14,323	$ 14,323	$ 77,000
P-93	E Catesby Rd from N Invergordon west to end	8-in	975	LF	$ 110,833	$ 33,250	$ 33,250	$ 178,000
P-94	N 62nd St from end goes north towards E Cheney Dr	8-in	208	LF	$ 23,644	$ 7,093	$ 7,093	$ 38,000
P-95	N Ironwood Dr from N Hummingbird Ln goes south, N Hummingbird Ln between N Ironwood Dr and N Foothill Dr S	8-in	1,997	LF	$ 227,008	$ 68,102	$ 68,102	$ 364,000
P-96	E Hummingbird Ln between E Cheney Dr and E Cholla Dr	8-in	1,067	LF	$ 121,291	$ 36,387	$ 36,387	$ 195,000
P-97	N Ironwood Dr from E Cholla Dr goes north, E Cholla Dr from N Ironwood Dr goes west	8-in	1,331	LF	$ 151,301	$ 45,390	$ 45,390	$ 243,000
P-98	N Calle Caballeros between E Stallion Rd and E Mockingbird Ln	8-in	618	LF	$ 70,251	$ 21,075	$ 21,075	$ 113,000
P-99	N Ironwood Dr from N Hummingbird Ln to E Northern Ave, E Northern Ave from N Ironwood Dr to N Invergordon Pl	8-in	1,254	LF	$ 142,548	$ 42,764	$ 42,764	$ 229,000
P-100	N Invergordon Pl from end to N Mockingbrid Ln; N Mockingbord Ln from N Invergordon Pl to just east of 65th St	8-in	1,249	LF	$ 141,979	$ 42,594	$ 42,594	$ 228,000
P-101	Hummingbird Ln from E Quartz Mountain Rd southeast along road	8-in	787	LF	$ 89,462	$ 26,839	$ 26,839	$ 144,000
Basin 4			**23,408**	**LF**	**$ 2,660,891**	**$ 798,267**	**$ 798,267**	**$ 4,260,000**
P-102	Horseshoe Ln from 69th Pl to N Mocking Bird Ln; north along Horseshoe Ln	8-in	1,336	LF	$ 151,869	$ 45,561	$ 45,561	$ 243,000
P-103	E Ocotillo Rd east of N Mockingbird Ln	8-in	179	LF	$ 20,348	$ 6,104	$ 6,104	$ 33,000
P-104	E Joshua Tree Ln from N 63rd Pl to N Invergordon Rd; heads north along N Invergordon Rd	8-in	714	LF	$ 81,164	$ 24,349	$ 24,349	$ 130,000
P-105	E Cactus Wren Rd from N 63rd Pl goes east	8-in	113	LF	$ 12,845	$ 3,854	$ 3,854	$ 21,000
P-106	E Joshua Tree Ln from end to N 62nd St; south along N 62nd St	8-in	746	LF	$ 84,801	$ 25,440	$ 25,440	$ 136,000
P-107	N 62nd St between E Indian Bend Rd and E Joshua Tree Ln, goes south then east	8-in	455	LF	$ 51,722	$ 15,517	$ 15,517	$ 83,000
P-108	E Arroyo Ct from end to N Mockingbird Ln	8-in	221	LF	$ 25,122	$ 7,537	$ 7,537	$ 41,000
P-109	N 66th St from E Meadowlark Ln south to end	8-in	343	LF	$ 38,990	$ 11,697	$ 11,697	$ 63,000
P-110	N Mocking Bird Ln from E Bluebird Ln goes south	8-in	326	LF	$ 37,058	$ 11,117	$ 11,117	$ 60,000
P-111	E 61st Pl from end to N 61st Pl	8-in	269	LF	$ 30,578	$ 9,174	$ 9,174	$ 49,000
P-112	E Stella Ln from end to N 59th Pl	8-in	750	LF	$ 85,256	$ 25,577	$ 25,577	$ 137,000
P-113	N 59th Pl goes south from E Valley Vista Ln	8-in	136	LF	$ 15,460	$ 4,638	$ 4,638	$ 25,000
P-114	N Mocking bird Ln from E Solcito Ln to E Malcomb Dr; west along E Malcomb Dr	8-in	1,291	LF	$ 146,754	$ 44,026	$ 44,026	$ 235,000
P-115	E Nauman Dr west of N 61st Pl	8-in	107	LF	$ 12,163	$ 3,649	$ 3,649	$ 20,000
P-116	N 61st Pl north of E Nauman Dr	8-in	103	LF	$ 11,708	$ 3,513	$ 3,513	$ 19,000
P-117	N Yucca Rd west of N 61st Pl	8-in	90	LF	$ 10,231	$ 3,069	$ 3,069	$ 17,000
P-118	E Bluebird Ln goes west from end	8-in	573	LF	$ 65,135	$ 19,541	$ 19,541	$ 105,000
P-119	E Glen Dr to N 59th Pl, goes east towards N 57th Pl	8-in	2,043	LF	$ 232,237	$ 69,671	$ 69,671	$ 372,000
P-120	E Indian Bend Rd from N 57th Pl to N 59th Pl	8-in	1,448	LF	$ 164,601	$ 49,380	$ 49,380	$ 264,000
P-121	N 61st St from end to E Lincoln Dr, E Lincoln Dr to N 61st Pl, N 61st Pl to end	8-in	1,255	LF	$ 142,661	$ 42,798	$ 42,798	$ 229,000
P-122	E Lincoln Dr from N 61st Pl east of N White Wing Rd; N White Wing Rd from E Lincoln Dr to end	8-in	1,274	LF	$ 144,821	$ 43,446	$ 43,446	$ 232,000
P-123	E Lincoln Dr west of N 63rd Pl to N Invergordon Rd; N 63rd Pl from E Lincoln Dr to end	8-in	1,146	LF	$ 130,271	$ 39,081	$ 39,081	$ 209,000
P-124	N 60th St from E Lincoln Dr to E Redwing Rd; E Redwing Rd from N 60th St to end	8-in	1,280	LF	$ 145,503	$ 43,651	$ 43,651	$ 233,000

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		Pipe Diameter	Length (LF)[1]					
P-125	E Joshua Tree Ln from N 62nd St to E Cactus Wren Rd	8-in	962	LF	$ 109,355	$ 32,806	$ 32,806	$ 175,000
P-126	East of E Indian Bend Rd before N 66th Pl	8-in	532	LF	$ 60,475	$ 18,142	$ 18,142	$ 97,000
P-127	E Hummingbird Ln goes west to N 61st Pl, continues west	8-in	1,683	LF	$ 191,314	$ 57,394	$ 57,394	$ 307,000
P-128	N Invergordon Pl from E Kelm Dr to E Malcomb Dr, continues north	8-in	1,363	LF	$ 154,938	$ 46,481	$ 46,481	$ 248,000
P-129	E Lincoln Dr from N 61st St to N 59th St, N 59th St from E Lincoln Dr to end	8-in	1,416	LF	$ 160,963	$ 48,289	$ 48,289	$ 258,000
P-130	E Kelm Dr from N Invergordon Rd to 62nd Pl, goes west until end	8-in	1,254	LF	$ 142,548	$ 42,764	$ 42,764	$ 229,000
Basin 5			**3,211**	**LF**	**$ 365,009**	**$ 109,503**	**$ 109,503**	**$ 590,000**
P-131	E San Miguel Ave goes west from N Casa Blanca Dr	8-in	152	LF	$ 17,279	$ 5,184	$ 5,184	$ 28,000
P-132	N Kiva Ln from E McDonald Dr to end	8-in	451	LF	$ 51,267	$ 15,380	$ 15,380	$ 83,000
P-133	N Invergordon Rd from E McDonald Dr to south of E Badgett Ln	8-in	1,698	LF	$ 193,019	$ 57,906	$ 57,906	$ 309,000
P-134	N Casa Blanca Dr from E McDonald Dr goes north	8-in	509	LF	$ 57,860	$ 17,358	$ 17,358	$ 93,000
P-135	N 64th Pl from E McDonals Dr until end	8-in	401	LF	$ 45,583	$ 13,675	$ 13,675	$ 73,000
Basin 6			**25,979**	**LF**	**$ 2,953,148**	**$ 885,944**	**$ 885,944**	**$ 4,730,000**
P-136	N Quail Run Pl from E Vista Dr to E Vermont Ave; E Vermont Ave goes west	8-in	1,010	LF	$ 114,811	$ 34,443	$ 34,443	$ 184,000
P-137	N Quail Run Rd from E Jackrabbit Rd to E San Miguel Ave; E San Miguel Ave from N Quail Run Rd to N 70th Pl	8-in	1,417	LF	$ 161,077	$ 48,323	$ 48,323	$ 258,000
P-138	N 69th Pl from E Jackrabbit Rd to E Montebello Ave; goes east along E Montebello Ave	8-in	1,707	LF	$ 194,042	$ 58,213	$ 58,213	$ 311,000
P-139	N Wilkinson Rd goes south to E Chaparral Rd, E Chaparral Rd from N Wilkinson Rd to N 69th St, goes north along N 69th St	8-in	1,313	LF	$ 149,255	$ 44,776	$ 44,776	$ 239,000
P-140	N 66th St from E Chaparral Rd goes north	8-in	336	LF	$ 38,195	$ 11,458	$ 11,458	$ 62,000
P-141	N Casa Blanca Rd south of E Jackrabbit Rd to north of E Chaparral Rd	8-in	1,819	LF	$ 206,774	$ 62,032	$ 62,032	$ 331,000
P-142	N 66th St north of E Chaparral Rd	8-in	197	LF	$ 22,394	$ 6,718	$ 6,718	$ 36,000
P-143	E Chaparral Rd from N Wilkinson Rd to N Invergordon Rd; N Invergordon Rd from E Chaparral Rd to E Staghorn Rd	8-in	1,447	LF	$ 164,487	$ 49,346	$ 49,346	$ 264,000
P-144	N 68th St from E Vermont Ave to E Jackrabbit Rd, E Jackrabbit Rd north to E San Juan Ave	8-in	1,136	LF	$ 129,134	$ 38,740	$ 38,740	$ 207,000
P-145	N 66th St north of E Chaparral Rd	8-in	197	LF	$ 22,394	$ 6,718	$ 6,718	$ 36,000
P-146	N Kasba Cir E from N Tamanar Way to E Kasbar Cir N	8-in	1,889	LF	$ 214,731	$ 64,419	$ 64,419	$ 344,000
P-147	N Invergordon Rd from E Sage Dr to south of E Vista Dr	8-in	1,342	LF	$ 152,551	$ 45,765	$ 45,765	$ 245,000
P-148	N Tamanar Way from E Kasba Cir S to end	8-in	1,470	LF	$ 167,101	$ 50,130	$ 50,130	$ 268,000
P-149	E Kasba Cir S from N Tamanar Way to N Kasbar Cir W, N Kasbar Cir W to E Fez Way, E Fez Way to end	8-in	1,400	LF	$ 159,144	$ 47,743	$ 47,743	$ 255,000
P-150	N 70th Pl from end goes north to E Vermont Ave	8-in	1,306	LF	$ 148,459	$ 44,538	$ 44,538	$ 238,000
P-151	E Vista Rd from N 70th Pl to N 69th Pl, N 69th Pl to south of E Jackrabbit Rd	8-in	1,725	LF	$ 196,088	$ 58,827	$ 58,827	$ 314,000
P-152	N 69th Pl from E Orange Blossom Dr to E Orange Blossom Ln, E Orange Blossom Ln to E Vista Dr	8-in	1,055	LF	$ 119,927	$ 35,978	$ 35,978	$ 192,000
P-153	E Vermont Ave from N 68th St to N 68th Pl, N 68th Pl to E Jackrabbit Rd	8-in	1,067	LF	$ 121,291	$ 36,387	$ 36,387	$ 195,000
P-154	E Vista Dr from N 69th Pl to N 68th St, N 68th St goes north	8-in	1,231	LF	$ 139,933	$ 41,980	$ 41,980	$ 224,000
P-155	N 69th Pl from E Chaparral Rd to E Orange Blossom Dr, from E orange Blossom Dr goes west to end, from E Pasadena Ave goes west to end	8-in	1,312	LF	$ 149,141	$ 44,742	$ 44,742	$ 239,000
P-156	N 68th Pl from E Jackrabbit Rd E Montabello Ave, goes east on E San Migueal Ave	8-in	1,603	LF	$ 182,220	$ 54,666	$ 54,666	$ 292,000

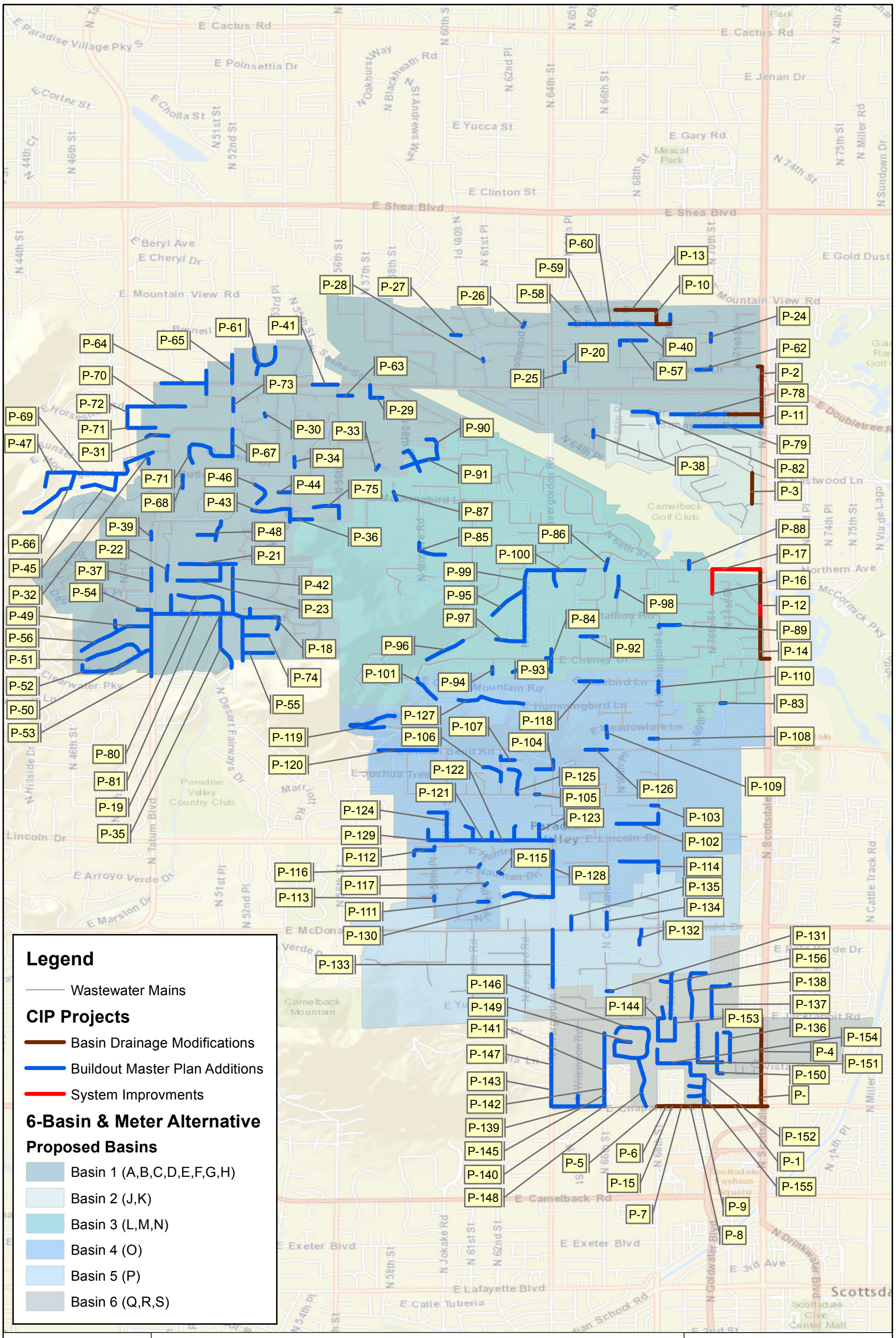
Pipe ID	Line Item Description		Cost ($)[2]	Engineering & Design ($)[3]	Contingency ($)[4]	Total Cost ($)
	Pipe Diameter	Length (LF)[1]				

RECOMMENDED INFRASTRUCTURE TOTAL	Construction Cost ($)	Engineering & Design ($)	Contingency ($)	Total Cost ($)
	$ 15,961,901	$ 4,788,570	$ 4,788,570	**$ 25,600,000**

ID	Location	Year	Capacity		Unit Cost ($/gpd)	Total Cost
4. Wastewater Treatment Capacity			**686,649**	**gpd**		**$ 7,950,000**
-	-	2017	579,778	gpd	$ 11.57	$ 6,710,000
-	-	2021	106,871	gpd	$ 11.57	$ 1,240,000

RECOMMENDED GRAND TOTAL	Total Cost
	$ 33,550,000

Notes:
(1) For pricing purposes, length of pipe rounded up to the nearest whole foot
(2) February 2015 Costs (ENR CCI = 9962)
(3) Assuming 30% Engineering & Design Allowance
(4) Assuming 30% Contingency



TOWN OF PARADISE VALLEY, ARIZONA
WASTEWATER PLANNING SERVICES

Recommended Capital Improvement Projects

ARCADIS

March 2015
Appendix H