City of Clovis

Recycled Water Master Plan

February 2017

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City of Clovis
Clovis, CA

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Abbreviations

AACE	American Association of Cost Engineers
ac	acre
AF	Acre-feet
AFY	Acre-feet per year
AGR	Agricultural supply, including irrigation and stock watering (AGR)
BOD	Biochemical Oxygen Demand
Caltrans	California Department of Transportation
CCMC	Clovis Community Medical Center
CEC	Constituents of Emerging Concern
cfs	cubic feet per second
City	City of Clovis
COLD	Cold, freshwater habitat
CSUF	California State University, Fresno
CWA	Clean Water Act
CWC	California Water Code
DAU	Detailed Analysis Unit
DDW	SWRCB, Division of Drinking Water
EPA	Environmental Protection Agency
ET	Evapotranspiration Rate
FMFCD	Fresno Metropolitan Flood Control District
fps	feet per second
ft	feet
gpm	gallons per minute
GRRP	Groundwater Replenishment Reuse Project
GWR	Groundwater Recharge
HSC	Health and Safety Code
in	inches
IND	Industrial Service Suply
IWD	International Water District
kft	thousand feet
LF	linear feet
LS	lump sum

MGD .... Million Gallons per Day
mi .... mile
MIGR .... Migration of aquatic organisms, warm and cold
MUN .... Municipal and domestic supply
NPDES .... National Pollution Discharge Elimination Systems
PRO .... Industrial process supply
psi .... pounds per square inch
RARE .... Rare, Threatened, or Endangered Species
REC-1 .... Water contact recreation, including canoeing and rafting
REC-2 .... Non-contact water recreation
RWC .... Recycled Municipal Wastewater Contribution
RWQCB .... Regional Water Quality Control Board
SDWA .... Safe Drinking Water Act
SJBP .... San Joaquin Basin Plan
SPWN .... Spawning, reproduction, and/or early development, warm
SR .... State Route
SRWP .... SWRCB Recycled Water Policy
ST/WRF .... Sewage Treatment/Water Reuse Facility
SWRCB .... State Water Resources Control Board
TLBP .... Tulare Lake Basin Plan
TSS .... Total Suspended Solids
WARM .... Warm freshwater habitat
WDR .... Waste Discharge Requirements
WILD .... Wildlife Habitat

Executive Summary

Introduction

The City of Clovis (Clovis) is located in northeastern Fresno County, California and incorporated in 1912. Historically, Clovis has relied primarily upon groundwater to meet urban demand but, as it has grown, reliance on other water sources such as surface water has grown as well. Due to the impact of a five-year drought throughout the state, the scarcity of water supplies has resulted in significant motivation to continue investment in the use of recycled water to meet water demands.

Clovis constructed a Sewage Treatment/Water Reuse Facility (Reuse Facility, ST/WRF) in 2008, which began operation in 2009. The Reuse Facility is located north of Ashlan Avenue between Thompson and McCall Avenues and was constructed to handle 2.8 million gallons per day (MGD) in its first phase with an ultimate treatment capacity of 8.4 MGD. Recycled water produced by the Reuse Facility complies with Title 22 standards (California Code of Regulations). Permitted use of the recycle water supply includes many unrestricted uses such as irrigation, impounding, cooling, and commercial/industrial applications. Currently, recycled water primary uses are landscaped areas adjacent to the recycled water transmission main.

As part of the Clovis General Plan Update process, Clovis is identifying potential users of recycled water and required infrastructure for delivery of recycled water. The General Plan encompasses an area of approximately 74 square miles and is depicted on **Figure ES-1.** The boundary for that area is generally formed by Willow Avenue on the west, Copper Avenue on the north, Academy Avenue on the east, and by Ashlan and Shields Avenues to the south.

Goals

The purpose of the Clovis Recycled Water Master Plan Update is to evaluate current recycled water use, identify additional market opportunities as defined in the adopted General Plan, and produce an implementation plan incorporating recycled water as a significant portion of the Clovis' water supply. Specific goals are as follows:

- Identify users that can replace potable water use with recycle water
- Identify potential for use (recharge) when demand is less than supply
- Plan future recycled water infrastructure and produce project level capital costs and develop an implementation plan

The efficient use of surface water and groundwater resources is critical to maintaining sustainability of communities throughout the Central Valley. To help alleviate potable water demands placed on these supplies, recycled water is a key source of supply many communities, including Clovis, utilize to enhance management of local water resources.

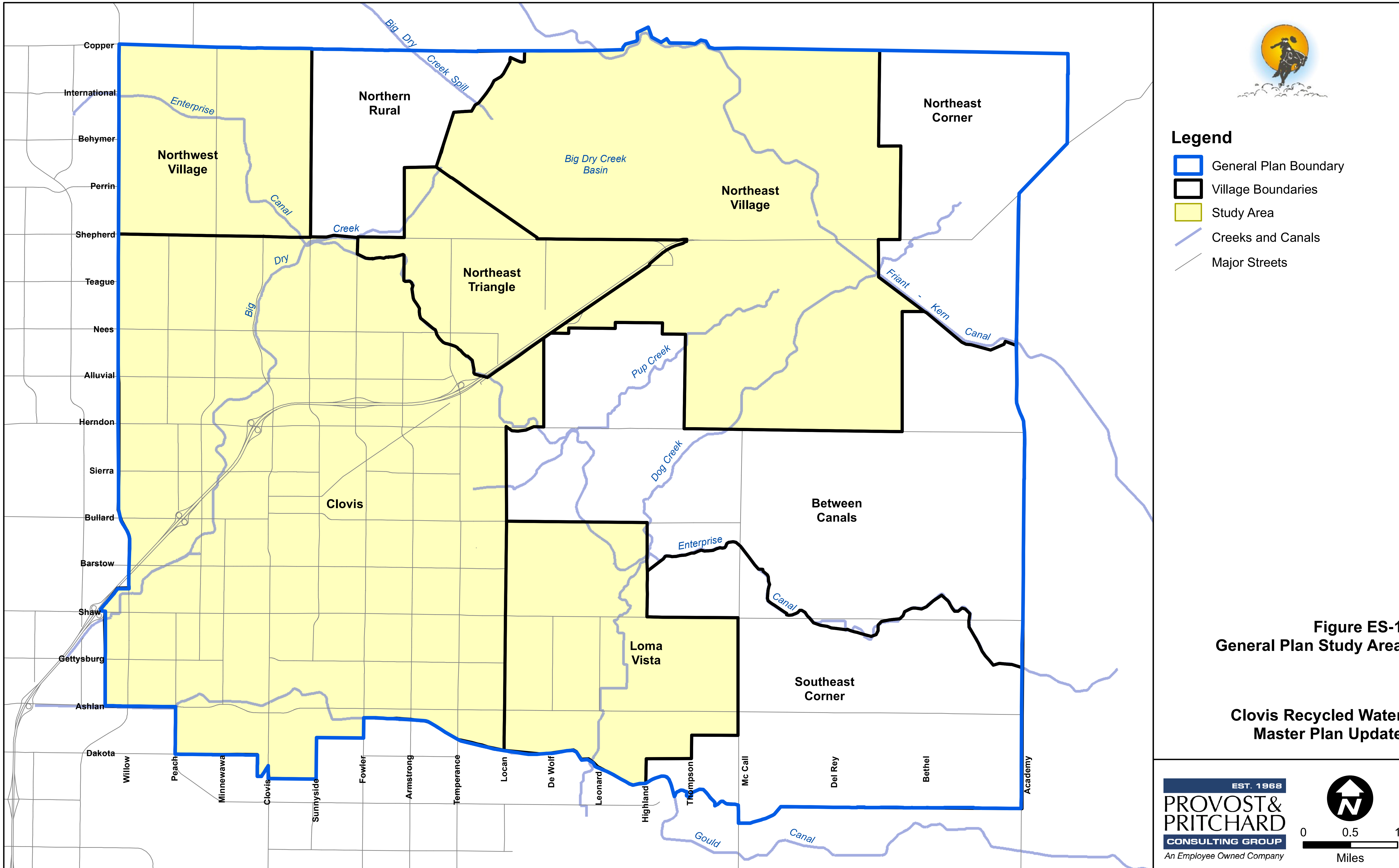

Figure ES-1
General Plan Study Area

Clovis Recycled Water Master Plan Update

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Regulatory Requirements

The ST/WRF is currently regulated by the Central Valley Regional Water Quality Control Board (RWQCB) under Waste Discharge Requirements (WDR) Order R5-2014-0005, NPDES No. CA0085235. Permitted discharges from the ST/WRF include 1) Fancher Creek, 2) Big Dry Creek and 3) groundwater underlying recycled water use sites (REC-001). Recycling specifications outlined for point REC-001, including compliance with all Title 22 regulations, generally pertain to landscape irrigation use, specifically regarding allowable concentrations of constituents of concern, irrigation practices, and protection of drinking water supplies.

The California Legislature recently updated the primary water regulations within the California Code of Regulations, including Title 17 and Title 22. This update includes significant adjustment to the permitted uses of recycled water, including regulatory requirements for groundwater recharge projects employing non-potable water. Overall, state regulations promote use of reclaimed (recycled) water to shift the demand from municipal drinking water supplies and improve overdraft conditions through recharge efforts. As such, it is recommended that the WDR for the Facility be updated to permit discharge to defined recharge facilities within Clovis city boundaries.

Existing Recycled Water System

The existing recycled water system includes a sewage treatment and water reuse facility (ST/WRF) and dedicated recycled water lines that run North and South along the eastern edge of the City. **Figure ES-2** displays the existing recycle water facilities.

Phase 1 of the ST/WRF was designed for an average daily flow of 2.8 MGD, equating to an annual average treatment capacity of about 3,100 acre-feet per year (AFY). Although this is the maximum amount of recycled water available through Phase 2 planned facility expansions, shown in Phases 3 and 5, will not occur until increased capacity is required.

Table ES-1: Treatment Capacity in Phases 1 through 5

Phase	Startup	Treatment Capacity		
		Average Day (MGD)	Average Day (cfs)	Annual Average (AF)
1	2008	2.8	4.3	3,100
3	2025-2030	5.6	8.7	6,300
5	2035-2042	8.4	13.0	9,400

Notes:
1. Startup dates are estimated based on the sewage treatment needs of Clovis.

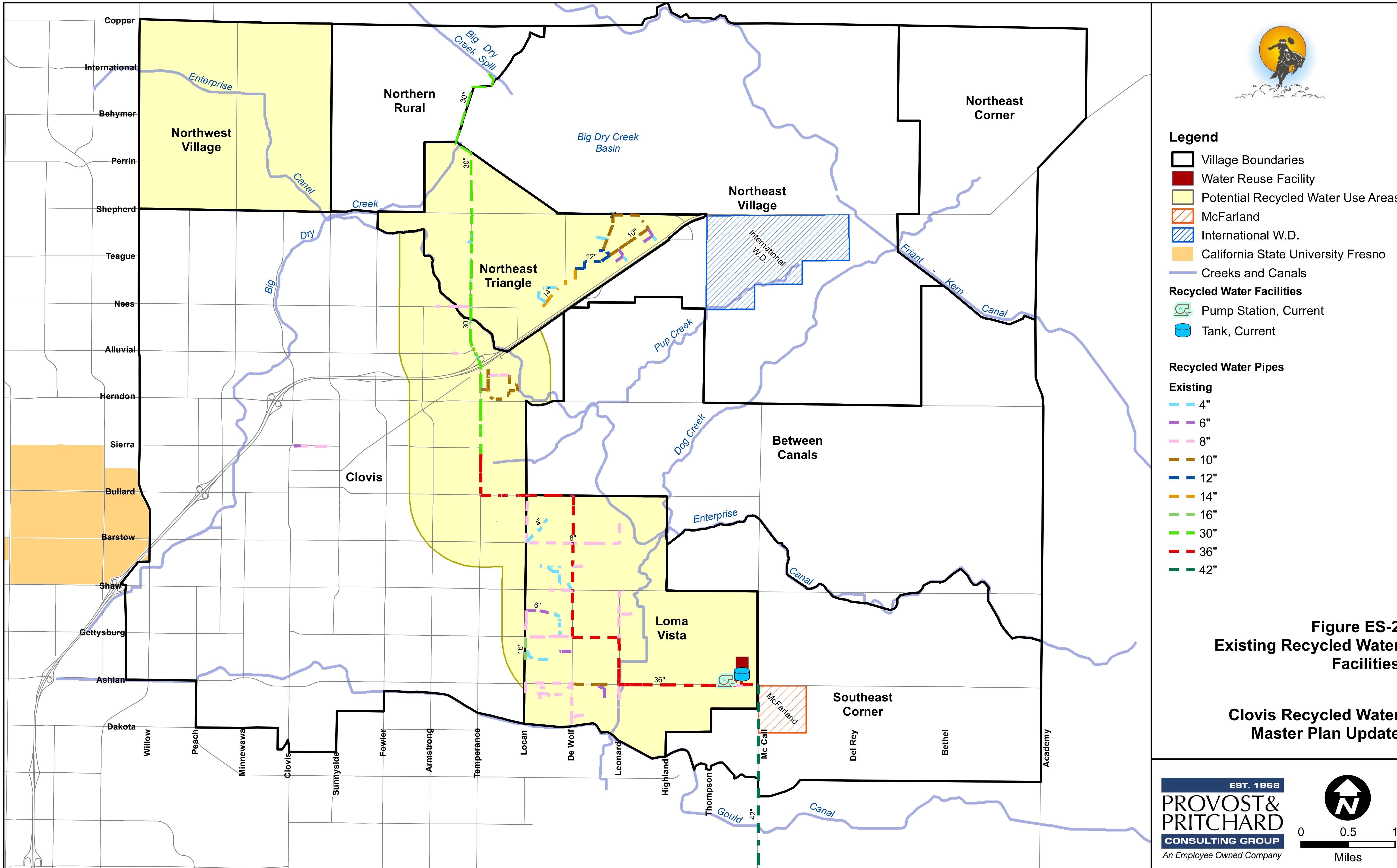

Figure ES-2
Existing Recycled Water Facilities

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The ST/WRF relies upon a combination of filtration and disinfection unit processes to produce high quality effluent complying with water quality requirements for disinfected tertiary water. Recycled water produced by the ST/WRF is permitted for use in landscape and agricultural irrigation, industrial processing and cooling, decorative water features, recharge, and commercial toilet flushing.

Recycled water use in 2015 was primarily concentrated within a service area immediately adjacent to existing recycled water pipes and along State Route 168. In 2015, this service area encompassed approximately one hundred seventy-eight (178) acres along the corridor of the transmission main heading northeasterly from the ST/WRF towards Big Dry Creek Reservoir. **Figure ES-3** shows the approximate limits of the recycled water service area in 2015.

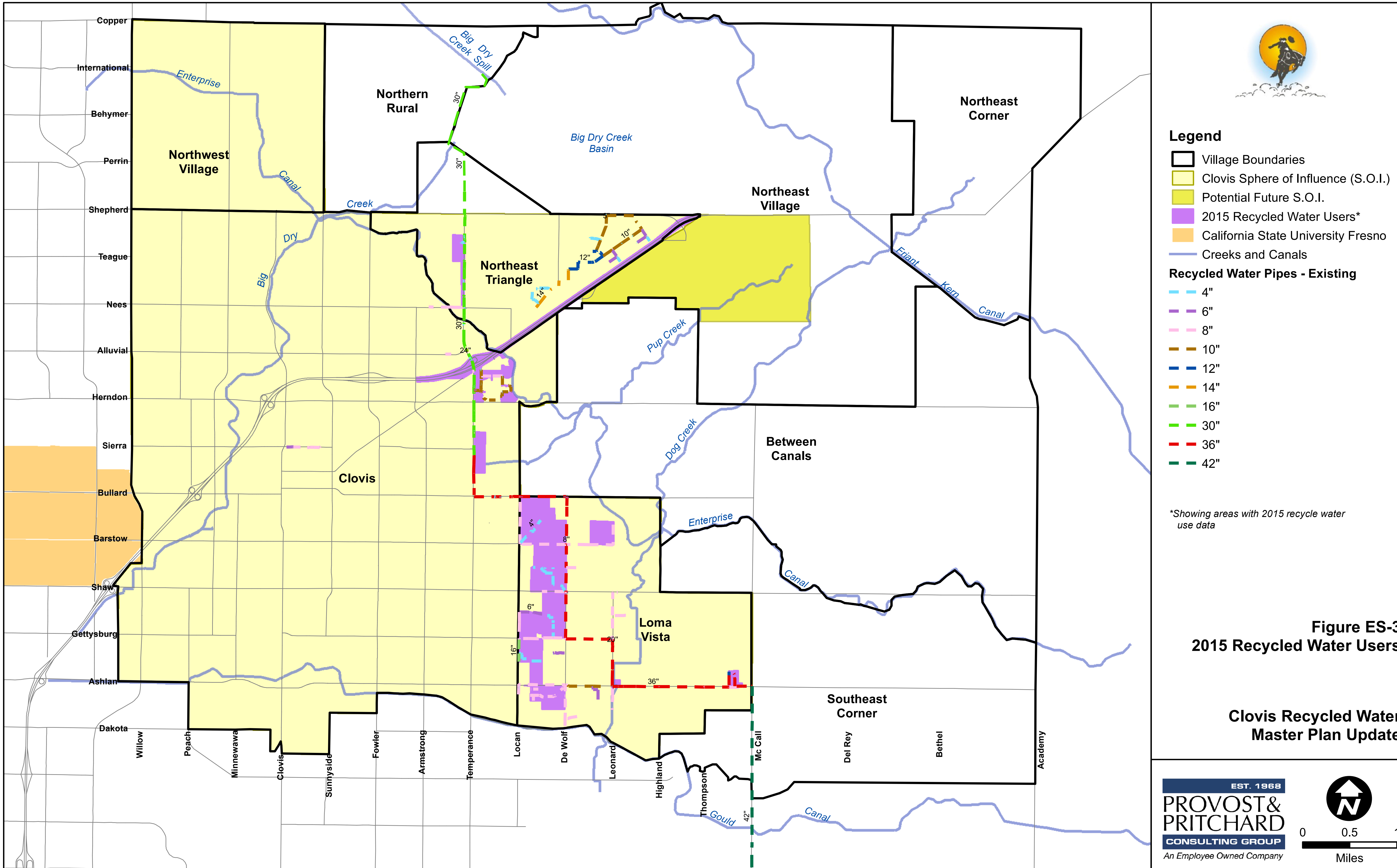

Figure ES-3
2015 Recycled Water Users

Clovis Recycled Water Master Plan Update

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In 2015, the ST/WRF generated about 1,870 acre-feet with existing customers using nearly 396 acre-feet and the remainder, 1,474 acre-feet, discharged to Fancher Creek. The discharge to Fancher Creek is outside the plan area and is lost as a resource to the City. In 2015, the existing customer class consisted of twenty-four (24) water use areas. **Figure ES-4** shows a visual breakdown of recycled water use between existing customers and Fancher Creek.

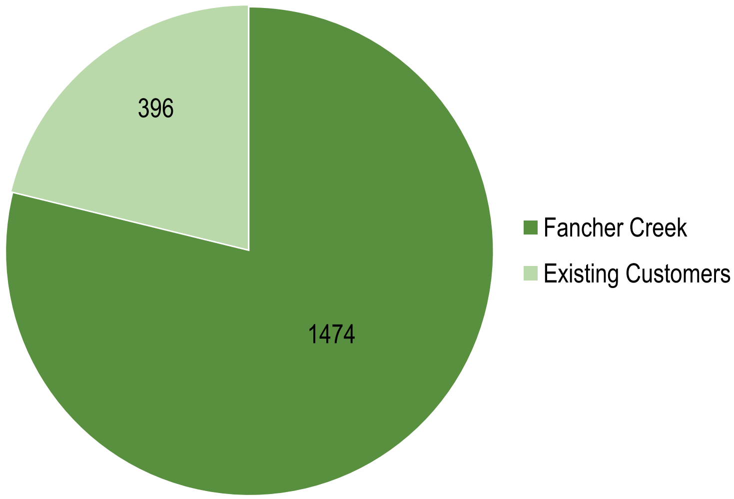

Figure ES-4: Pie Chart of 2015 Recycled Water Uses

Recycled water demand has an inherit variability, controlled by its end use, that must be considered as part of a master planning process. Systems where outdoor landscaping is the primary use of recycled water, such as Clovis follow a pattern similar to an evapotranspiration (ET) rate for grass, with the highest demand month occurring in July, generally. **Figure ES-5** shows the monthly variability in recycled water use for these customers along with monthly ET for grass.

Potential Recycled Water Use Evaluation

Potential recycled water use evaluation included outreach to the local community to identify large users of water. The entities shown in **Figure ES-6** indicate the potential users of recycled water in Clovis regardless of economic feasibility. Users vary from a pocket park or school with limited recycled water use to the Reagan Educational Complex, which is already set up with a dual plumbing system. Areas with the greatest potential for recycled water use include: users within the following regions: a ¾-mile buffer of the existing recycled water transmission main, Northeast Triangle, Northwest Village, and Loma Vista.

The entities listed in **Table ES-2** were contacted and discussions occurred to measure interest in the use of recycle water to replace potable water. All of the entities are interested in obtaining recycle water supplies. With demand outstripping supplies it is clear that the City must determine the priority of the recycle water delivery projects. Some entities have surface supplies that may be exchanged with the City should recycle supplies be made available.

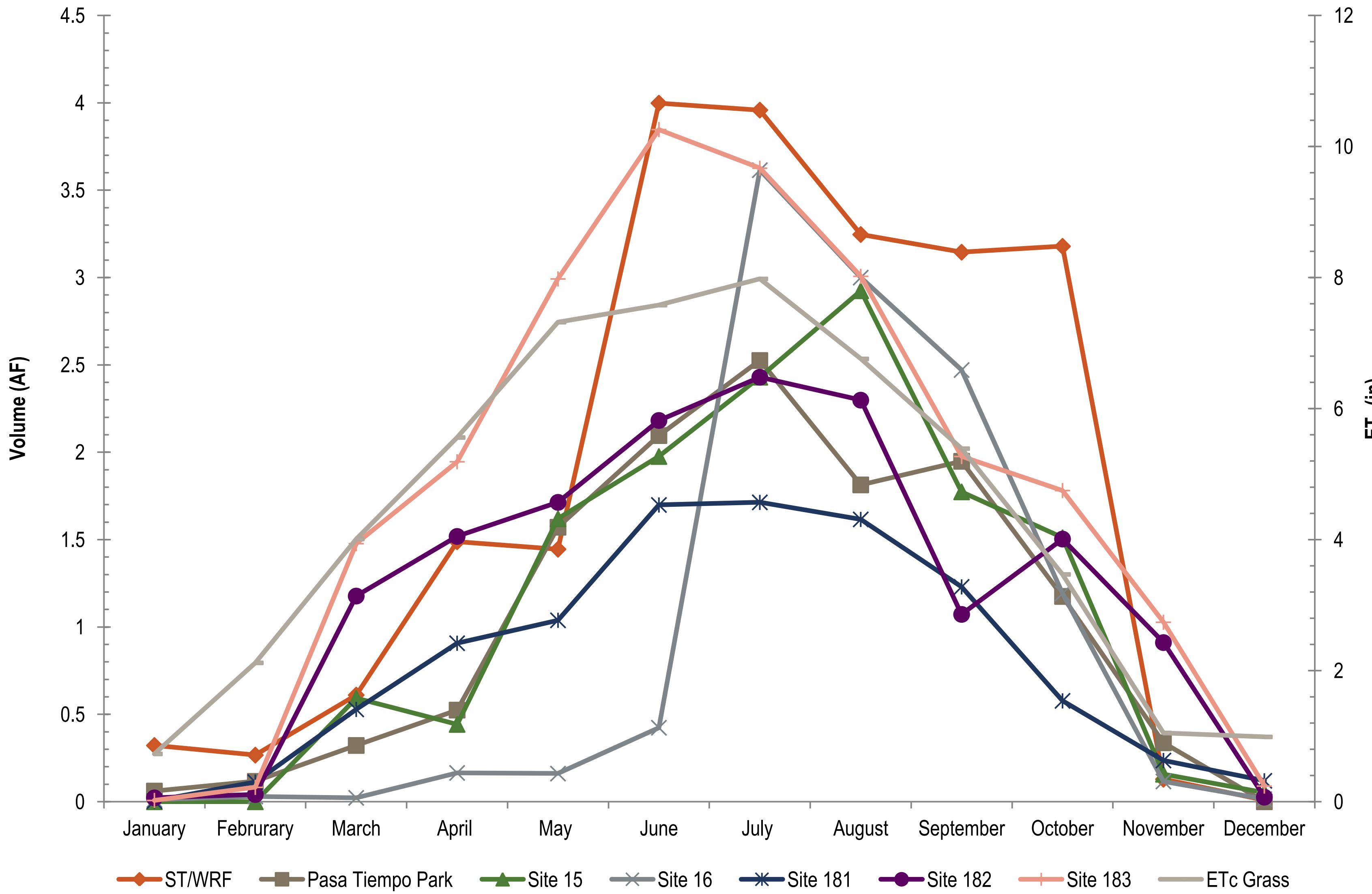

Figure ES-5: Monthly Recycled Water Use by Large Customers in 2015

Figure ES-6 displays all the potential users of recycled water in Clovis regardless of economic feasibility. Users vary from a pocket park or school with limited recycled water use to the Reagan Educational Complex, which is already set up with a dual plumbing system. Areas with the greatest potential for recycled water use include: users within the following regions: a ¾-mile buffer of the existing recycled water transmission main, Northeast Triangle, Northwest Village, and Loma Vista.

Table ES-2: Summary Potential Recycled Water Users

Recycled Water Site ID Near Term	Recycled Water User	Potential Demand (AFY)	Evaluation Explanation
N/A	Regional Agriculture	Varies; depends on end users	About 1,800 acres surrounding recycled water infrastructure is agriculture. Recycled water can be efficiently delivered to on-farm irrigation systems; water delivery would be depend on individual agreements between Clovis and regional growers
N/A	International Water District	1,500-3,600	704 acres of permanent crops could employ recycled water; recycled water pipelines would need to be constructed to connect to District conveyances and the general plan currently designates the area for future industrial uses.
CI--49	CSUF	3,200	Recycled Water delivery would require FID conveyance and may be exchanged for surface water rights. Potential recharge opportunities on east side of campus.
CI-15	Marion Recharge	2,700	Efficiently filling recharge cells requires a large flow rate, a dedicated recycled water line would need to be constructed along the Nees alignment or the Shepherd/Sunnyside alignment.
NT-26, CI-24	Caltrans (SR 168)	300	Caltrans has a length of SR 168 currently plumbed for recycled water delivery, with additional systems to be completed.
CI-26, 27	Clovis Community Medical Center	190	On site landscaping currently receives recycled water, additional development may expand demand and use as cooling water at onsite utilities is being considered
CI-30	Clovis Cemetery	90	Clovis cemetery is a large landscaped facility near the Marion Recharge and SR 168. There may be opportunity to use FID Clovis W. Branch No. 521 for connection with the Temperance Conveyance pipeline.
LV-23	ST/WRF	20	On site recycled water use is limited. The water treatment facility will expand to Phase 2 and subsequently Phase 3, increasing demand for onsite irrigation and capacity for RW disposal however that may be offset by decreases due to a solar project at the facility.
Varies	City Parks	Varies by site	Supplying recycled water to parks adjacent to pipelines provides cost effective irrigation, but non adjacent park areas do not provide a cost effective use of recycled water
Varies	Clovis Unified Schools	Varies by school	Clovis Unified schools adjacent to the RW conveyance facilities and large footprint schools produce a significant demand for recycled water. Retrofitting of plumbing required at existing schools.

Capital Improvement Program

As Clovis embarks on urbanization in growth areas beyond the current city limit it will expand utilization of alternative water supplies, such as recycled water. To better utilize recycled water of the ST/WRF in the near term, expansion of the system into the northeast triangle, NW Village and Loma Vista is needed. Longer term, at buildout, construction of additional infrastructure is required throughout the City. Major distribution infrastructure required to deliver this water will typically consist of 10- to 30-inch diameter pipes and transmission mains with pump stations at strategic locations.

As identified in the Potential Recycled Water Use, there are five main areas considered viable for recycled water use (see **Figure ES-7**). These five areas are referred to as:

- Northwest Village: Full CIP Buildout
- Clovis: Limited to ¾ Mile buffer area, Marion Recharge, Clovis Cemetery, CSUF connection
- Northeast Triangle: Full CIP Buildout
- Loma Vista: Full CIP Buildout
- Northeast Village: Full CIP Buildout

The backbone infrastructure necessary for conveying recycled water to these five areas are shown in **Figure ES-8**. Pipelines represent the prominent facility type within the buildout configuration of the potential recycled water infrastructure system; total length of pipe is approximately fifty-one (51) miles. The total cost of the proposed recycled water system is about $29.2 million with capital cost in the five (5) service areas varying from a low of about $2.6 million for the Clovis area to a high of $8.5 million for the Northwest Village.

Table ES-3: Preliminary Opinion of Probable Construction Costs

Area	Total Pipe Length	Capital Cost
Northwest Village	68,890 LF	$8.3M
Clovis	33,800 LF	$2.6M[1]
Northeast Triangle	42,520 LF	$5.8M
Loma Vista	74,220 LF	$7.2M
Northeast Village	32,420 LF	$3.7M

Notes:
1. Includes conversion of FID canal system as a line item but cost is unknown at this time and therefore not included in the total cost.
2. Anticipated capital costs shown to the nearest tenth (1/10th) of a million dollars.
3. Infrastructure cost for the Northwest Village includes a 3,000 gpm booster pump station.
4. Infrastructure cost for the Northeast Triangle includes a 3,000 gpm booster pump station and backbone infrastructure to serve the Northeast Triangle and Northeast Village.

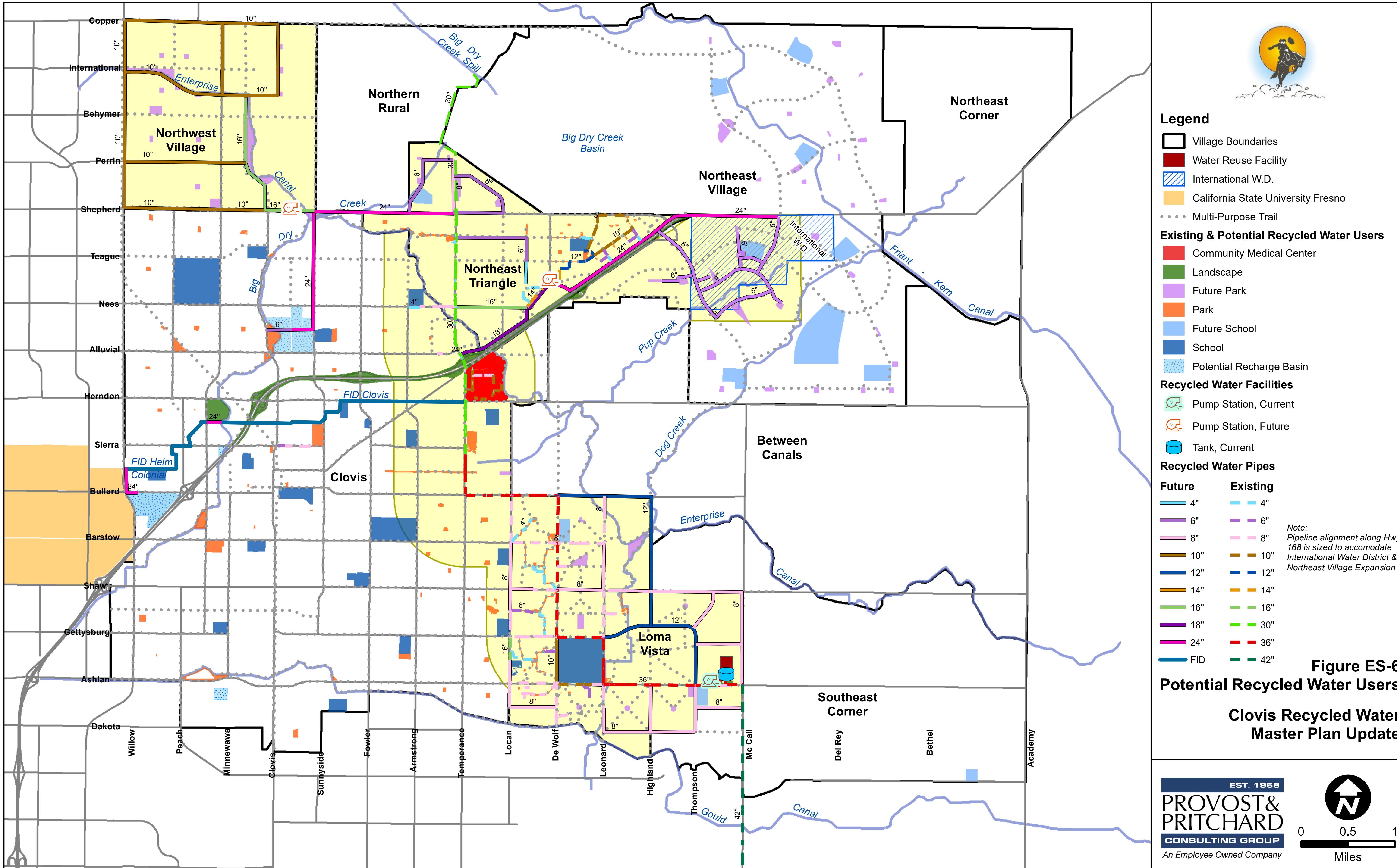

Figure ES-6
Potential Recycled Water Users

Clovis Recycled Water Master Plan Update

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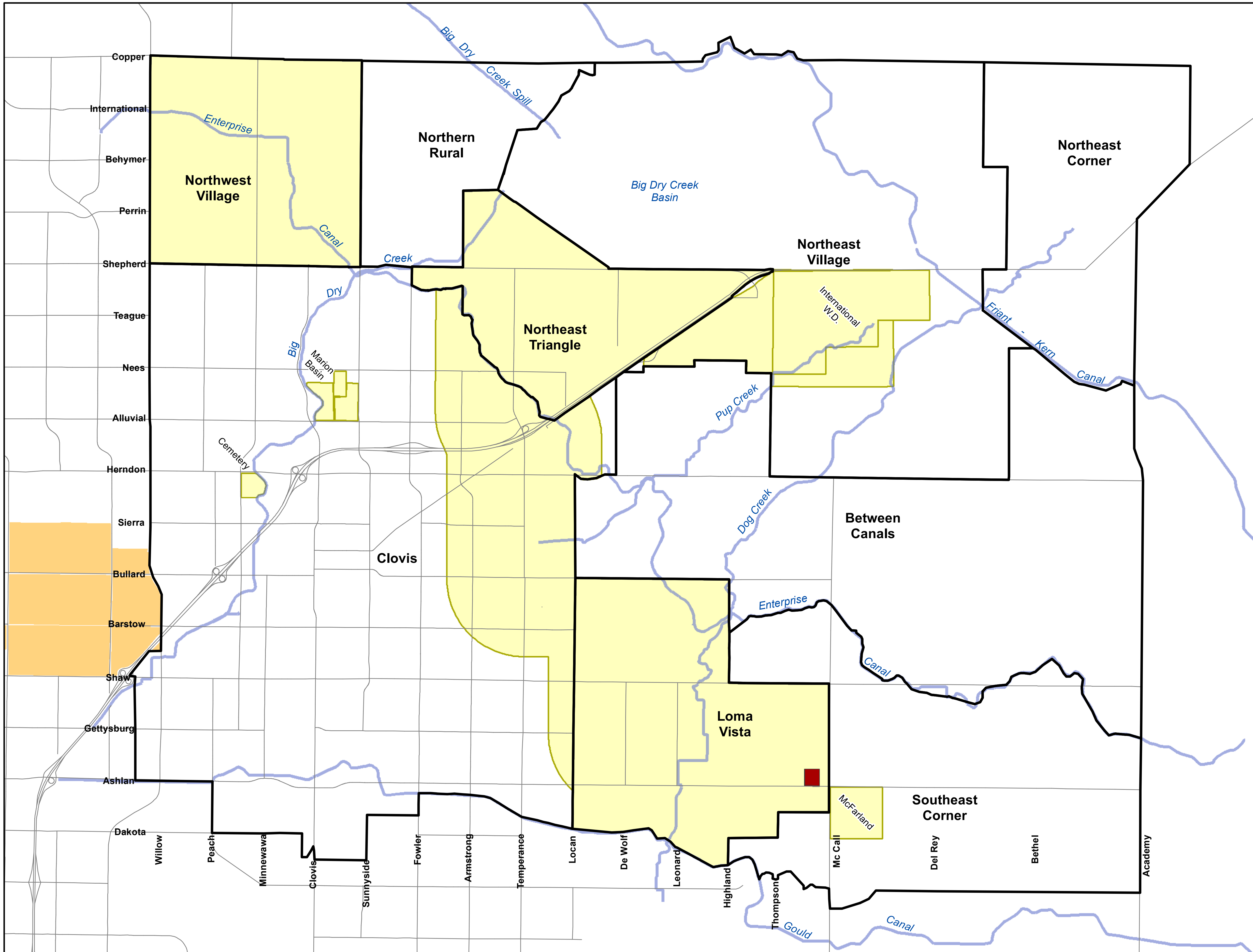

Legend

- Village Boundaries
- Potential Recycled Water Use Areas
- Water Reuse Facility
- California State University Fresno
- Creeks and Canals

Figure ES-7
Recycled Water Use Areas

Clovis Recycled Water
Master Plan Update

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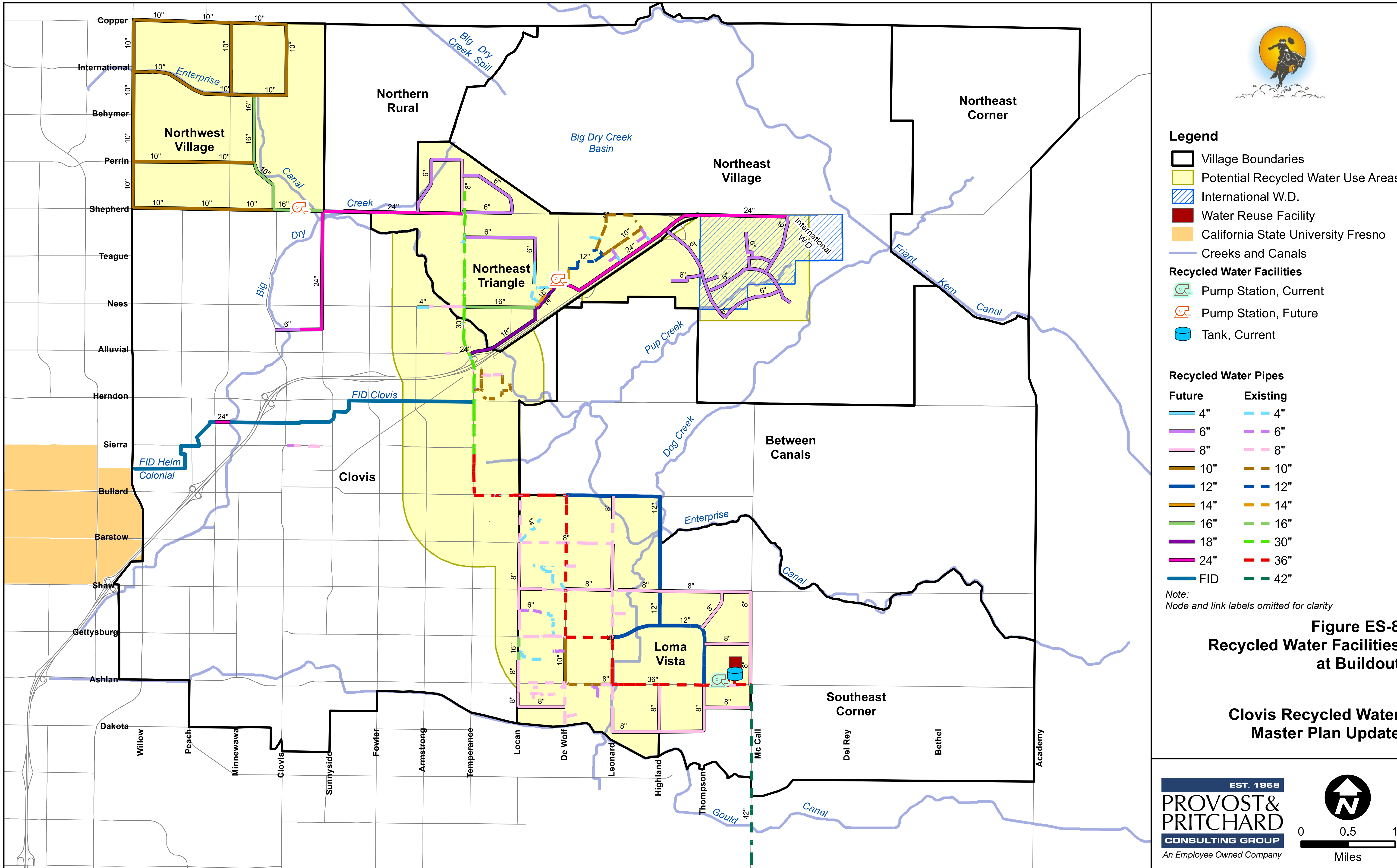

Figure ES-8
Recycled Water Facilities at Buildout
Clovis Recycled Water Master Plan Update
Legend
Village Boundaries
Potential Recycled Water Use Areas
International W.D.
Water Reuse Facility
California State University Fresno
Creeks and Canals
Recycled Water Facilities
Pump Station, Current
Pump Station, Future
Tank, Current
Recycled Water Pipes
Future
Existing
4"
6"
8"
10"
12"
14"
16"
18"
24"
FID
30"
36"
42"
Note:
Node and link labels omitted for clarity
Northwest Village
Northern Rural
Northeast Village
Northeast Corner
Northeast Triangle
Clovis
Between Canals
Loma Vista
Southeast Corner
Big Dry Creek Spill
Big Dry Creek Basin
Enterprise Canal
Big Dry Creek
Friant - Kern Canal
Pup Creek
Dog Creek
FID Clovis
FID Helm Colonial
Gould Canal
International W.D.
Copper
International
Behymer
Perrin
Shepherd
Teague
Nees
Alluvial
Herndon
Sierra
Bullard
Barstow
Shaw
Gettysburg
Ashlan
Dakota
Willow
Peach
Minnewawa
Clovis
Sunnyside
Fowler
Armstrong
Temperance
Locan
De Wolf
Leonard
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Capital Improvement Program Phasing

The capital improvements will be constructed in phases based on the location of existing facilities, new growth areas, demands, and availability of recycled water from the ST/WRF. For the purposes of this capital improvement program, improvements were divided into five (5) phases (see **Figure ES-9**) and are summarized below in **Table ES-4.** The CIP for each phase was analyzed by timeline, service area, capital cost, total potential annual demand of users in service area, and the potential water capacity of the ST/WRF on an annual basis. Costs range from a low of $1.5 Million for Phase 3 up to $11.2 Million for Phase 4, with phase demands ranging from 1400 AFY (Phase 1) to 7200 AFY (Phase 4). The cost doesn't include plant expansion. Those costs are included in the Sewer Master Plan. The total estimated demand for each phase is shown in comparison to ST/WRF capacity; note that there will not be available capacity to meet all potential demands in each phase.

Table ES-4: Potential Recycled Water Use Evaluation by Phase

Phase	Period	Major Service Area	Capital Cost by Phase	Total Cumulative Demand Estimate	Total ST/WRF Capacity Estimate
1	2015 to 2020	¾ Mile, Northwest Village	$6.9 Million	1,400 AFY	2,100 AFY[1]
2	2020 to 2025	Northwest Village, Northeast Village, Marion Recharge	$15.6 Million	4,300 AFY[6]	3,100 AFY[2]
3	2025 to 2030	Northwest Village, Loma Vista	$1.2 Million	5,800 AFY[7]	5,500 AFY[3]
4	2030 to 2035	International Water District, CSUF	$3.9 Million	13,000 AFY[8]	6,300 AFY[4]
5	2045 to Buildout			13,000 AFY[9]	9,400 AFY[5]

Notes:
1. Current capacity of the ST/WRF is constrained by the flow available to the facility.
2. Assumed use of full capacity of current facility by 2025.
3. Assumed ST/WRF expansion to 6,300 AFY in Phase 3 but not fully utilized until Phase 4.
4. Assumed use of Phase 3 capacity expansion by 2035.
5. Assumed plan capacity increase by 2042.
6. Estimated demand increase of 2,900 AFY in Phase 2.
7. Estimated demand increase of 1,500 AFY in Phase 3.
8. Estimated demand increase of 3,600 AFY in Phase 4.
9. Estimated demand increase of 3,600 AFY in Phase 5.

The four phases were designated to primarily meet the needs of the ¾ mile market, Northwest Village, Loma Vista, Northeast Triangle, Northeast Village and provide connection to large users including Marion Recharge, International Water District, and California State University Fresno (CSUF). The CIP for each phase was analyzed by village of implementation, sizing, alignment, quantity, and cost.

It is critical to evaluate the ability of the ST/WRF to meet recycle water demand on a consistent basis annually. Assuming that all users employ recycle water supplies for landscape irrigation the total demand will follow the water requirements due to evapotranspiration rates, with high demands in the summer and low demands in the winter. As such, the maximum demand month, July, is used to define the maximum recycle water service area, irrigated landscape area, of the ST/WRF based on the daily production for each phase. The analysis in **Table ES-5** indicates the maximum acreage that can be served annually with reliable recycle water deliveries, namely about 370 in Phase 1 up to nearly 1,670 acres in Phase 5 of the ST/WRF capacity defined above.

Table ES-5: Potential Recycled Water Use Evaluation by Acreage

Phase	Period	Total Potential Demand Area[1] (acres)	ST/WRF Max Service Area- July Demands[2] (acres)
1	2015 to 2020	470	370
2	2020 to 2025	530[3]	560
3	2025 to 2030	700	970
4	2030 to 2035	3,010	1,110
5	2045 to Buildout	-	1,670

Notes:
1. Total Potential Demand Area is based on when service is available to each potential user, not when supply is available based on ST/WRF expansions
2. Calculated using the landscape irrigation unit demand for the month of July: 0.48 AF/acre and the AF produced by the ST/WRF in July. This value is based on supply available with ST/WRF expansions.
3. Excludes Marion Recharge acreage as it is considered a 'sink' rather than a demand and has no unit demand

Based on the above assumption, the total annual service area demand and potable water offset potential is limited to the area for which the plant capacity may supply the maximum demand month for landscape irrigation, July. As such, annually there is additional, excess, recycle water produced in the winter above the demands of landscape. This excess annual recycle water would be available for discharge to facilities such as Marion Recharge to benefit groundwater sustainability efforts and allow an additional beneficial use for recycle water. An evaluation of annual plant capacity of recycle water, service area demand, excess recycle water to Marion Recharge, and the remaining recycle water to the Fancher Creek or Diversion Channel outfalls is presented in **Table ES-6.**

Table ES-6: Potential Recycled Water Use Evaluation by Delivery

Phase	Period	ST/WRF Capacity Estimate (AFY)	ST/WRF Service Area Demand (AFY)[1]	Excess RW to Marion Recharge (AFY)[2]	Excess RW to Outfall (AFY)
1	2015 to 2020	2,100	1,400	-	700
2	2020 to 2025	3,100	1,600	1,500	-
3	2025 to 2030	5,500	3,100	2,000	400
4	2030 to 2035	6,300	10,300	-	-
5	2045 to Buildout	9,400	10,300	-	-

Notes:
1. Service Area Demand from Table ES-4 is reduced by 2,700 AFY to account for potential Marion Recharge in Phases 2 through 5
2. Maximum deliveries to Marion Recharge defined as the available capacity above average Kings River deliveries, about 2,000 AF

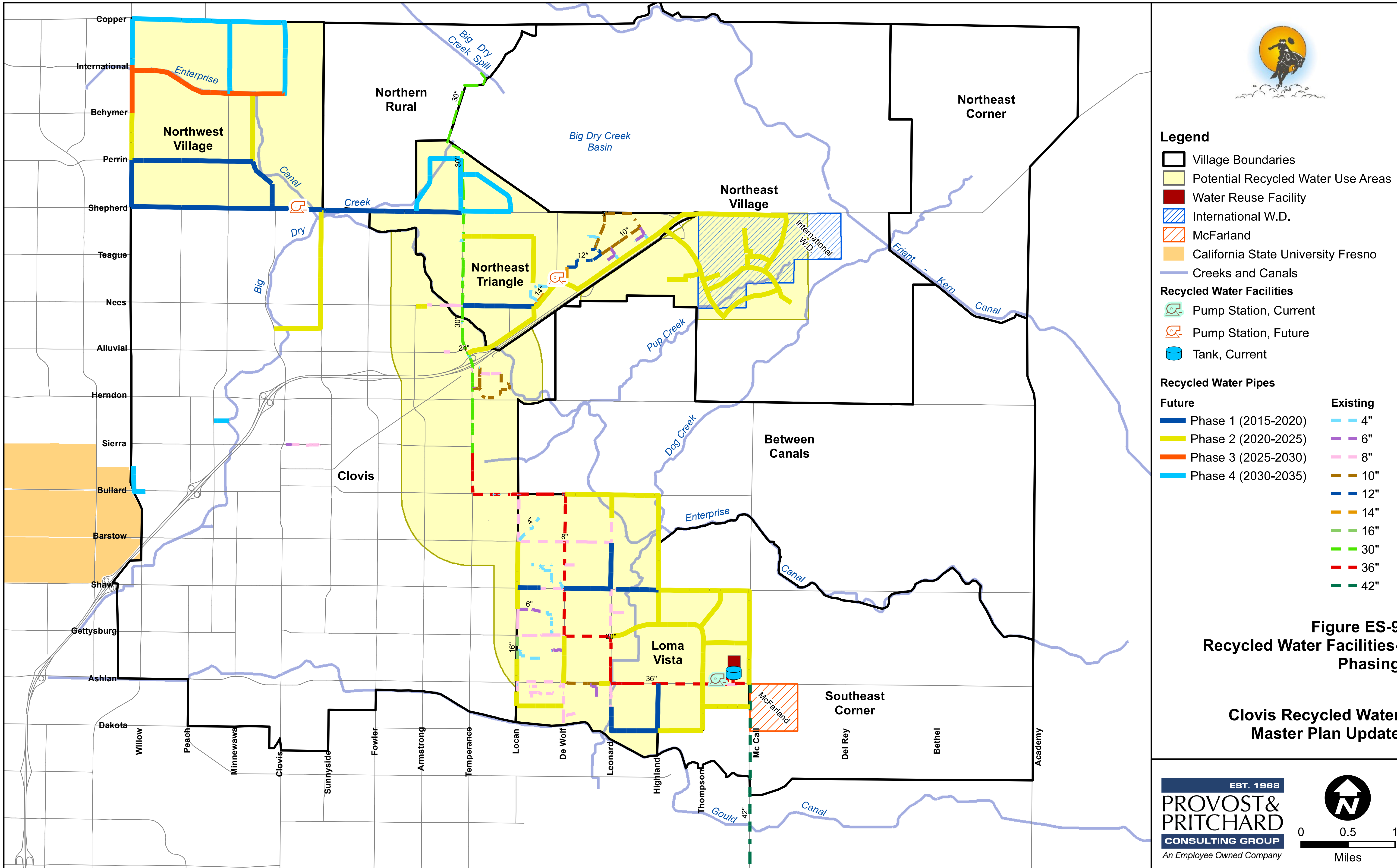

Figure ES-9 Recycled Water Facilities-Phasing

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1 Introduction

The City of Clovis (Clovis) is located in northeastern Fresno County, California and was incorporated in 1912. Historically, Clovis has relied primarily upon groundwater to meet urban demand but, as it has grown, reliance on other water sources such as surface water has grown as well. Clovis constructed a Sewage Treatment/Water Reuse Facility (Reuse Facility, ST/WRF) in 2008, which began operation in 2009. The Reuse Facility is located north of Ashlan Avenue between Thompson and McCall Avenues and was constructed to handle 2.8 million gallons per day (MGD) in its first phase with an ultimate treatment capacity of 8.4 MGD. Recycled water produced by the Reuse Facility complies with Title 22 standards (California Code of Regulations), which means permitted uses of this source of supply includes many unrestricted uses such as irrigation, impounding, cooling, and commercial/industrial applications. Currently, recycled water primary uses are landscaped areas adjacent to the recycled water transmission main.

Due to the impact of a four-year drought throughout the state, the scarcity of water supplies has resulted in significant motivation to continue investment in the use of recycled water to meet water demands. Significant changes to regulatory requirements have been made to facilitate the use of recycled water to meet a variety of water demands, including landscape irrigation, groundwater recharge, commercial and industrial non-potable uses.

This section provides a general overview of key components associated with preparation of this Recycled Water Master Plan Update. Plan components include the following five (5) items: purpose and goals, study area, previous studies, plan organization, and assumptions and limitations. Results from hydraulic models runs for existing and buildout conditions of the recycled water system are included in Appendix A.

1.1 Purpose and Goals

The purpose of the Clovis Recycled Water Master Plan Update is to evaluate current recycled water use, identify additional market opportunities as defined in the adopted General Plan, and produce an implementation plan to further incorporate recycled water as a significant portion of the Clovis' water supply. This evaluation includes the analysis of current and future user demands which can be met by recycled water, permitting requirements for recycled water use, identification of the required infrastructure for recycled water deliveries, and development of project level costs for implementing identified infrastructure. To efficiently incorporate recycled water into Clovis' water use portfolio, the implementation timeline has been broken into phases and the planning area, as identified in the General Plan, was segmented into nine subareas.
The specific goals are as follows:

- Identify and summarize existing and potential future recycled water demands;
- Identify constraints associated with certain recycled water users and recycled water demand types, including market assessment and regulatory considerations;
- Evaluate existing recycled water infrastructure and potential capacity for deliveries;
- Identify regulatory requirements for the use of recycled water in various markets;
- Provide a hydraulic model of the existing and future recycled water distribution system;

- Plan future recycled water infrastructure and identify project level capital costs; and
- Produce a phased implementation plan (Capital Improvements Program) for defined users and required infrastructure.

The efficient use of surface water and groundwater resources is critical to maintaining sustainability of communities throughout the Central Valley. To help alleviate potable water demands placed on these supplies, recycled water is a key source of supply many communities, including Clovis, utilize to enhance management of local water resources.

1.2 Study Area

As part of the Clovis General Plan Update process, Clovis is identifying potential users of recycled water and required infrastructure for delivery of recycled water. The General Plan encompasses an area of approximately 74 square miles and is depicted on **Figure 1.2-1**.

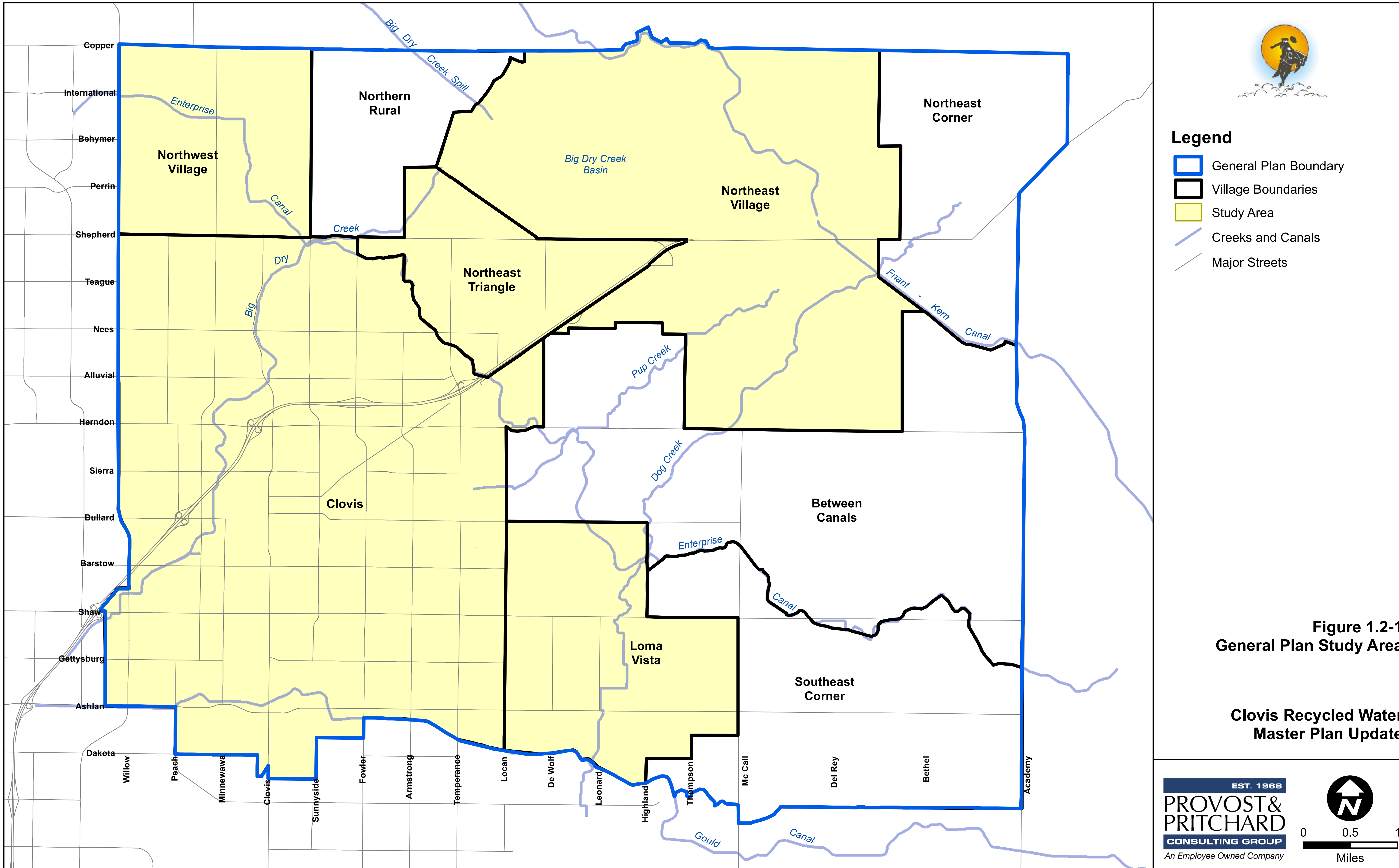

Figure 1.2-1
General Plan Study Area

Clovis Recycled Water Master Plan Update

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1.3 Goals

The purpose of the Clovis Recycled Water Master Plan Update is to evaluate current recycled water use, identify additional market opportunities as defined in the adopted General Plan, and produce an implementation plan incorporating recycled water as a significant portion of the Clovis' water supply. Specific goals are as follows:

- Identify users that can replace potable water use with recycle water
- Identify potential for use (recharge) when demand is less than supply
- Plan future recycled water infrastructure and produce project level capital costs and develop an implementation plan

The efficient use of surface water and groundwater resources is critical to maintaining sustainability of communities throughout the Central Valley. To help alleviate potable water demands placed on these supplies, recycled water is a key source of supply many communities, including Clovis, utilize to enhance management of local water resources.

The boundary for that area is generally formed by Willow Avenue on the west, Copper Avenue on the north, Academy Avenue on the east, and by Ashlan and Shields Avenues to the south.

1.4 Previous Studies

Over the past 10 years, the City of Clovis has relied upon key documents to guide development and implementation of a recycled water system.

- 2014 Waste Discharge Requirements, Master Recycling Permit for City of Clovis
- 2005 City of Clovis Recycled Water Master Plan, Blair Church & Flynn Consulting Engineers
- 2005 Final Environmental Impact Report, City of Clovis Sewage Treatment/Water Reuse Facility Program
- 2004 Engineering Report for the Production, Distribution, and Use of Recycled Water, Red Oak Consulting

1.5 Report Organization

The report is organized into six (6) sections covering regulatory requirements and identifying facilities needed to deliver recycled water to potential users within the Clovis area. **Table 1.5-1** provides a summary of the report sections, titles, and the purpose of each section.

Table 1.5-1: Organization of Recycled Water Master Plan

Section	Subject	Description
ES	Executive Summary	Summarizes the results of the report
1	Introduction	Identifies the purpose, objectives, and overall structure of the report
2	Regulatory Requirements	Summarizes key federal and state regulations affecting the use of recycled water
3	Existing Recycled Water System	Discusses existing recycled water users, system demands, implemented infrastructure, and water quality requirements
4	Potential Recycled Water Use	Evaluates potential recycled water users, potential demands, water quality requirements, and the feasibility of delivery
5	Hydraulic Model	Presents the methodology of a computer hydraulic analysis, the existing system model, and the buildout hydraulic model for a recycled water system
6	Capital Improvements Program	Provides cost assessment, buildout, and phasing plan for the implementation of required capital improvements

1.6 Assumptions and Limitations

Below is a list of assumptions and limitations that were instrumental in the development of this report:

- Cost estimates provided herein are appropriate for budgetary purposes and are consistent with AACE guidelines for a Class IV cost estimate.
- Study only focuses on potential urban users and water districts located within the updated Clovis General Plan area depicted on **Figure 1.2-1**
- First priority customers are within planned communities accessible to current recycled water transmission facilities.
- Utilization of recycled water by potential customers may require retrofitting of existing plumbing and irrigation systems before use is seen by the system.
- Alternative funding sources are potentially available to offset capital facility costs but are not discussed in this report.

2 Regulatory Requirements

2.1 Introduction

Federal, state, and local regulations play a key role in planning and implantation of a recycled water program. Understanding these regulations is essential to addressing opportunities and challenges that will arise when planning for the utilization of water supplies. This section provides a brief overview of key regulations and policies influencing recycled water planning within Clovis, and is separated into three (3) subsections: federal requirements, California regulatory requirements, and Clovis Water Recycling Ordinance.

2.2 Federal Requirements

Federal standards set the precedent for regulations seeking to protect public health and limit environmental degradation. Safe Drinking Water Act (SDWA) provides health based standards for water quality to ensure safe potable water supplies for the public as well as policies to protect drinking water sources. Amendments to the original SDWA have increased the focus on ensuring the quality of drinking water from source to tap. Environmental Protection Agency (EPA) sets the framework of standards for state regulations regarding maximum contaminant levels and constituents of concern. The standards for employing disinfected tertiary treated wastewater effluent as irrigation water, commercial & industrial non-potable use, or indirect potable reuse through groundwater recharge are predicated on the standards of the SDWA.

Additionally, the Clean Water Act (CWA) seeks to maintain the quality of waters of the United States by regulating the discharge of pollutants to waterways. These standards determine the allowable discharges of effluent into the environment and required pollution control programs, including wastewater standards for industry and the National Pollution Discharge Elimination Systems (NPDES) permitting process. The NPDES permit for the Water Reuse Facility must incorporate all new proposed discharge locations and standards for recycled water application. Overall, CWA advocates technology and practices which will allow reclamation of high quality treated wastewater.

2.3 California Regulatory Requirements

The jurisdiction over the use of recycled water is shared between the State Water Resources Control Board (SWRCB or State Water Board), the Regional Water Quality Control Board (RWQCB or Regional Board), and the SWRCB, Division of Drinking Water (DDW). The California Legislature recently updated the primary water regulations within the California Code of Regulations, including Title 17 and Title 22. This update includes significant adjustment to the permitted uses of recycled water, including regulatory requirements for groundwater recharge projects employing recycled water. The update was enacted in direct response to the drought affecting California. Overall, state regulations promote use of recycled water to shift the demand from municipal drinking water supplies and improve overdraft conditions through recharge efforts.

SWRCB was created by the Legislature in 1967, with the goal of ensuring the highest reasonable quality of waters of the State. SWRCB allocates water rights, adjudicates water rights disputes, develops statewide water protection plans, establishes water quality standards, and guides the Regional Water Quality Control Boards located in the major watersheds of the State. There are nine (9) RWQCBs under the SWRCB. The RWQCBs develop and enforce water quality objectives and implementation plans to protect the beneficial uses of the State's waters, recognizing local differences in climate, topography, geology, and hydrology. Regional Boards develop "Basin Plans" for their hydrologic areas, issue waste discharge permits for wastewater treatment facilities, take enforcement action against violators, and monitor water quality.

Together with the Regional Boards, the SWRCB is authorized to implement the Federal Water Pollution Control Act (Clean Water Act) in California. The objective of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands. The Clean Water Act gives the EPA the authority to set effluent limits to ensure protection of the receiving water. Pollutants regulated under the Clean Water Act include priority pollutants, conventional pollutants such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH, and non-conventional pollutants including any pollutants not identified as either conventional or priority.

Each of California's nine regional water quality control boards is required to formulate and adopt a basin plan for all areas within its region. The basin plans must conform with statewide policy set forth by the legislature and by the State Water Resources Control Board. Basin plans consist of designated beneficial uses to be protected, water quality objectives to protect those uses, and a program of implementation needed for achieving the objectives (California Water Code, Section 13050(j)).

The Central Valley Regional Water Quality Control Board is that portion of the RWQCB with jurisdiction over the City of Clovis (Clovis). The Central Valley Region includes about forty (40) percent of the land in California stretching from the Oregon border to the Kern County/Los Angeles County line with the Sierra Nevada Mountains and Coast Range forming eastern and western boundaries, respectively. Given the vastness of this region, it is divided into three basins: Sacramento River Basin, San Joaquin River Basin, and Tulare Lake Basin. Water quality issues for that portion of drainage area for the San Joaquin Valley south of the San Joaquin River, including Clovis, are covered in a Water Quality Control Plan for the Tulare Lake Basin.

2.3.1 Waste Discharge Requirements

The Facility is currently regulated by the Central Valley RWQCB under Waste Discharge Requirements (WDR) Order R5-2014-0005, NPDES No. CA0085235. Permitted discharges from the ST/WRF include 1) Fancher Creek, 2) Big Dry Creek and 3) groundwater underlying recycled water use sites (REC-001). Recycling specifications outlined for point REC-001, including compliance with all Title 22 regulations, generally pertain to landscape irrigation use, specifically regarding allowable concentrations of constituents of concern, irrigation practices, and protection of drinking water supplies.

2.3.2 California Code of Regulations – Title 22

Specifications for recycled water use are found in Title 22 of the California Code of Regulations (Title 22), Division 4, Chapter 3, Articles 1-11. Tertiary recycled water produced by the ST/WRF is permitted for the irrigation of food crops, parks, playgrounds, residential landscaping, golf courses and any other irrigation use not prohibited by other sections of the California Code of Regulations. In the June 18, 2014 update of Title 22, Articles 5.1 and 5.2 were modified to include additional provisions for using recycled water to recharge the aquifer. These articles outlined standards and required submissions for permitting and monitoring of discharges of recycled water for groundwater recharge.

Table 2.3-1: Title 22 Recycled Water Uses

Recycled Water Uses	Treatment Level			
	Disinfected Tertiary	Disinfected Secondary-2.2	Disinfected Secondary-2.3	Undisinfected Secondary
Urban Irrigation				
Parks and playground	●			
School yards	●			
Residential landscaping	●			
Unrestricted-access golf courses	●			
Restricted-access golf courses	●			
Cemeteries	●	●	●	
Freeway landscaping	●	●	●	
Agricultural Irrigation	●	●	●	
Impoundment Uses				
Non-restricted recreation impoundments, with supplemental monitoring for pathogenic organisms	●			
Restricted recreation impoundments, with supplemental monitoring for pathogenic organisms	●	●		
Restricted recreational impoundments and publically accessible fish hatcheries	●	●		
Landscape impoundments without decorative fountains	●	●	●	
Cooling Water Uses				
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist	●			
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist	●	●	●	
Agricultural Irrigation Uses				
Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop	●			
Food crops where the edible portion is produced above ground and not contacted by the recycled water	●	●		
Food crops that must undergo commercial pathogen-destroying processing before being consumed by humans	●	●	●	●
Orchards where the recycled water does not come into contact with the edible portion of the crop	●	●	●	●
Vineyards where the recycled water does not come into contact with the edible portion of the crop	●	●	●	●
Non-food bearing trees (Christmas trees are included provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting or allowing access to the general public)	●	●	●	●

Recycled Water Uses	Treatment Level			
	Disinfected Tertiary	Disinfected Secondary-2.2	Disinfected Secondary-2.3	Undisinfected Secondary
Fodder and fiber crops and pasture animals not producing milk for human consumption	●	●	●	●
Seed crops not eaten by humans	●	●	●	●
Ornamental nursery stock and sod farms where access by the general public is not restricted	●	●	●	
Pasture for animals producing milk for human consumption	●	●	●	
Any non-edible vegetation where access is controlled so that the irrigated area cannot be used as if it were part of a park, playground, or school yard	●	●	●	
Ornamental nursery stock and sod farms provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting, retail sale, or allowing access to the general public	●	●	●	●
Other Uses				
Flushing toilets and urinals	●			
Priming drain traps	●			
Industrial process water that may come into contact with workers	●			
Structural fire fighting	●			
Decorative fountains	●			
Commercial laundries	●			
Consolidation of back fill around potable water pipelines	●			
Artificial snow making for commercial outdoor use	●			
Commercial car washes including hand washes if recycled water is not heated, where the general public is excluded from the washing process	●			
Industrial boiler feed	●	●	●	
Nonstructural fire fighting	●	●	●	
Backfill consolidation around non-potable piping	●	●	●	
Soil compaction	●	●	●	
Mixing concrete	●	●	●	
Dust control on roads and streets	●	●	●	
Cleaning roads, sidewalks and outdoor work areas	●	●	●	
Industrial process water that will not come into contact with workers	●	●	●	
Flushing water for sanitary sewers	●	●	●	●

Notes:
1. Refer to Title 22 of the California Code of Regulations for information governing the use of recycled water.
2. This table is for summary purposed only and is not a formal version of the regulations.

2.3.2.1 Groundwater Recharge Permitting

A Groundwater Replenishment Reuse Project (GRRP) must supply an engineering report (Section 60323) assessing the setting and defining current and impacted hydrogeology. Prior to operation, a GRRP project sponsors must also submit an Operation Optimization Plan outlining operations, maintenance, analytical methods, and monitoring to meet requirements of DDR and RWQCB. Additionally, to receive a permit, the project sponsor must:

- Provide a department approved plan to supply drinking water in the event of impacting a drinking water well.
- Collect at least four samples, one sample per quarter, from each potentially affected aquifer.
- Map the zone of controlled drinking water and ensure applied water is not in violation of effluent limits pertaining to groundwater replenishment, generally the MCL.
- Site and construct at least two monitoring wells down-gradient of the GRRP such that one is located at least 30 days up-gradient of the nearest drinking water well and one is between the GRRP and the nearest down gradient drinking water well.
- Apply recycled Municipal wastewater meeting the definition of filtered wastewater and the definition of disinfected tertiary recycled water.
- Not exceed a recycled municipal wastewater contribution (RWC) of 0.20 in proportion to fresh water or an alternative RWC as approved by the department (up to 1.0).
- Produce an engineering report on the proposed GRRP, including hydrogeological analysis.
- Develop an Operation Optimization Plan prior to operation of the GRRP to define operations, maintenance, analytical methods, and required monitoring.
- Participate in a public hearing prior to the issuance of an initial permit as well as for any proposed increase in max RWC.
- Provide a study to determine the occurrence of indicator compounds in the recycled water.
- Conduct required constituent monitoring.
- The recycled water response retention time must be no less than two months and shall be demonstrated with a tracer study.
- Annually report to the Department and Regional Board a summary of GRRP activity monitoring.

2.3.2.2 Groundwater Recharge Monitoring

The GRPP project sponsor must complete quarterly water quality monitoring and annual reports to be submitted to DWR and CVWQCB. Reports must include:

- Water Quality Monitoring of recycled water as well as diluent water
  - A project sponsor shall, collect total nitrogen samples twice weekly and must notify the board if samples exceed 10 mg/L total N (60320.110).
  - At least once each week, a project sponsor shall analyze TOC from representative 24-hour composite samples of the undiluted recycled municipal wastewater, with analytical results of

the TOC monitoring not exceeding 0.5 mg/L divided by the running monthly average recycled water concentration.

- Each quarter, as specified in the GRRP's Operation Optimization Plan, a project sponsor shall collect and analyze samples (grab or 24-hour composite) representative of the applied recycled municipal wastewater for inorganic chemicals, radionuclide chemicals, organic chemicals, disinfection byproducts and lead and copper
- Each quarter, the GRRP's project sponsor shall sample and analyze the recycled municipal wastewater and the groundwater (from the downgradient monitoring wells for Priority Toxic Pollutants and chemicals the Department has specified.
- Annually a project sponsor shall monitor the recycled municipal wastewater for indicator compounds specified by the Department and Regional Board.

2.3.2.3 Subsurface Groundwater Recharge

Subsurface groundwater recharge, or direct injection, of recycled water has additional requirements as part of the approval process. Direct discharge requires an approved reverse osmosis and an oxidation treatment process that can be validated through monitoring of nine (9) indicator compounds for selected functional groups.

- Full advanced treatment is the treatment of an oxidized wastewater, as defined in section 60301.650, using a reverse osmosis and an oxidation treatment process that, at a minimum, meets the criteria provided (60320.201).
- Requires ongoing monitoring of process integrity.
- Demonstrate a sufficient oxidation process with at least nine indicator compounds groups over a 12 month period.

2.3.3 California Code of Regulations – Title 17

Title 17 defines regulations regarding the protection of potable water systems from contaminants related to recycled water systems. Article 2 specifies the backflow prevention required under various scenarios for which the hazard level has been defined for backflow based upon probability, piping system complexity, and likelihood of piping system modification. Available backflow prevention includes air-gap separation, double check valve assemblies and reduced pressure principle backflow prevention device.

2.3.4 California Health and Safety Code

Health and Safety Code (HSC) specifies the requirements to protect the potable water supply, specifically preventing the contamination in water distribution systems and water bodies. This includes the issuance of a permit for the use of water bodies augmented by recycled water as a source of a public water system, which requires an engineering evaluation of treatment technology and hold a public hearing period (Division 104, Part 12, Chapter 4, Article 7).

Division 104, Part 12, Chapter 5, Article 2, of the HSC defines the compliance requirements for water equipment and control to protect drinking water from potential backflow contamination. Water users are required to comply with local health office programs in inspecting potential hazards and installing adequate backflow prevention devices. Additionally, all recycled water piped for municipal and industrial purposes must be colored purple; agriculture deliveries are exempt.

2.3.5 California Water Code

Multiple articles within the California Water Code (CWC) include additional regulations regarding the production and use of recycled water throughout Chapter 7 of Division 7. Chapter 7 establishes the authority for recycling criteria, reporting requirements, master permitting, and enforcement powers. A master permit includes full waste discharge requirements and an expectation to comply with state recycling criteria, submit a quarterly report summarizing recycled water use, and conduct periodic facilities inspections of user facilities. Chapter 7.3 outlines the timeline for establishing criteria for direct and indirect potable reuse, which has been fulfilled in the implementation of the Title 22 updates.

2.3.6 Anti-Degradation Policy & Basin Plans

The allowable discharge of effluent is dependent on the current water quality and the designated beneficial uses of a water body. The defined beneficial uses are influenced by the anti-degradation policy as enacted by the Porter-Cologne Act. The anti-degradation provision specifies that discharges to a water body may not cause the quality of the water to degrade past the levels required for the designated beneficial use. The receiving water limitations outlined in the Facility WDR/NPDES permit are based upon the designated beneficial uses of the discharge points and any degradation (even within limits) must be shown to be beneficial to the people of the State.

2.3.6.1 Water Quality Control Plan for the Tulare Lake Basin

Tulare Lake Basin Plan (TLBP) does not specify beneficial uses for Fancher Creek or the Diversion Channel. But, beneficial uses are designated for Valley Floor Waters, which both Fancher Creek and the Diversion Channel are included. Beneficial uses include:

- Agricultural supply, including irrigation and stock watering (AGR)
- Industrial service supply (IND)
- Industrial process supply (PRO)
- Water contact recreation, including canoeing and rafting (REC-1)
- Non-contact water recreation (REC-2)
- Warm freshwater habitat (WARM)
- Wildlife habitat (WILD)
- Rare, Threatened, or Endangered Species (RARE)
- Groundwater recharge (GWR)

The TLBP includes a reiteration of the requirements for the application of recycled water as specified in the California Code of Regulations. But, as Title 22 has no criteria for wastewater distributed with irrigation supplies, the TLBP specifies the introduction of reclaimed water to irrigation canals for unrestricted irrigation will be required, as a minimum, to disinfect to 23 MPN coliform per 100 ml. In all cases the DDW will be consulted. To facilitate the use of treated wastewater with short notice, wastewater reclamation requirements may be waived for up to one year if the use complies with Title 22 criteria, the proposed use has received approval from local health departments and the executive officer, and the project is consistent with DDW policy.

Overall, TLBP advocates the use of reclaimed water and includes allowances for reclamation projects to operate prior to approval with an effort to revise WDRs as soon as possible to allow reuse. Where opportunity exists to employ reclaimed water it is unacceptable to continue to discharge or evaporate. Construction and expansion of wastewater facilities must specify wastewater reclamation efforts or explain why it is not possible.

2.3.6.2 Water Quality Control Plan for the San Joaquin River Basin

The San Joaquin Basin Plan (SJBP) states that the "…*beneficial uses of any specifically identified water body generally apply to its tributary streams*." Table II-1 of the San Joaquin Basin Plan identifies the beneficial uses of water bodies, but does not specifically identify beneficial uses for Little Dry Creek. The SJBP does identify present and potential uses in Table II-1 for San Joaquin River, to which Little Dry Creek is an ephemeral tributary. In addition, the SJBP implements state policy that all waters, with certain exceptions, should be considered potentially suitable for municipal or domestic supply. Consequently, discharges must be protective of these beneficial uses applicable to Little Dry Creek, including existing and potential uses.

- Municipal and domestic supply (MUN)
- Agricultural supply, including irrigation and stock watering (AGR)
- Industrial process supply (PRO)
- Water contact recreation, including canoeing and rafting (REC-1)
- Non-contact water recreation (REC-2)
- Warm freshwater habitat (WARM)
- Cold freshwater habitat (COLD)
- Migration of aquatic organisms, warm and cold (MIGR)
- Spawning, reproduction, and/or early development, warm (SPWN)
- Wildlife habitat (WILD)

All discharges are also evaluated based on the impact on underlying groundwater. The beneficial uses for the Detailed Analysis Units (DAU) beneath the discharges include:

- Municipal and domestic supply (MUN)
- Agricultural supply (AGR)
- Industrial service supply (IND)

- Industrial process supply (PRO)
- Water contact recreation (REC-1)
- Non-contact water recreation (REC-2)

SJBP makes limited mention of reclaimed water, but specifies the need to "make maximum use of reclaimed water while protecting public health and avoiding severe economic penalties to a particular user or class of users."

2.3.7 State Water Resources Control Board Recycled Water Policy (2013)

SWRCB Recycled Water Policy (SRWP) is to be used in conjunction with existing regulations, including the provisions of the Recycled Water Policy and Title 22. SRWP mandates use of recycled water throughout the state, includes provisions for protecting the quality of ground water and surface water, evaluating constituents of emerging concern (CEC), and incentivizes the use of recycled water.

- To protect groundwater quality from degradation the reclaimed water discharge must be in accordance with all salt/nutrient management plans established for a groundwater basin which does not meet water quality objectives.
- Landscape irrigation projects must include a management and facility plan to minimize incidental runoff. Permitting of landscape irrigation which meets requirements is expedited to within120 days of completion by the Regional Water Board.
- The State Board requires that recharge projects must be reviewed on a site specific basis, and must comply with CDPH regulation and implement monitoring of CECs.
- Where salt and nutrient management plans are not in effect the recharge project must conduct an anti-degradation analysis to verify the project utilizes less than ten (10) percent of the available assimilative capacity in a basin, as previously defined or calculated by the initial project proponent.

2.4 City of Clovis Water Recycling Ordinance

Clovis Municipal Code includes a provision for recycled water use in Chapter 6.8, the "Recycled Water Use Ordinance." The ordinance specifies the requirements for user agreements to apply reclaimed water to private property, the prohibitions of unpermitted discharges and cross connections with potable water systems, and the requirements for metering. Clovis reserves the right to terminate user agreements and to terminate recycled water immediately to safeguard public health and safety.

3 Existing Recycled Water System

3.1 Introduction

Clovis' recycled water system is comprised of many key components that affect utilization of recycled water, water management decisions, and operations. Recycled water use in 2015 was primarily concentrated within a service area immediately adjacent to existing recycled water pipes and along State Route 168. Large transmission pipelines move recycled water from the ST/WRF to users spread out along the pipeline alignment; Clovis continues to expand on this customer base, which will help reduce groundwater pumping. More discussions are contained herein regarding the aforementioned issues and are provided in the following subsections: permitting, service area, existing infrastructure, and existing users.

3.2 Permitting

Use of recycled water generated by the ST/WRF is subject to waste discharge requirements as promulgated by the Regional Water Quality Control Board (RWQCB). Permitted discharges for Clovis' ST/WRF are Fancher Creek, a diversion channel from Big Dry Creek reservoir to Little Dry Creek, and groundwater underlying recycled water use sites in a manner, which protects the defined beneficial uses of affected aquifers. The treatment sequence consists of headworks with screens, a cyclone to remove grit and settle materials, anaerobic and aerobic treatment tanks, membrane filtration units, and final disinfection by ultraviolet light. Solids are consumed by the Cannibal™ Solids Reduction Process[1]. Effluent limitations include technology based and water quality based effluent limits. The current uses of recycled water are consistent with the anti-degradation provision and do not impair beneficial uses of receiving water bodies.

The treated wastewater achieves a very high degree of filtration and disinfection to produce high quality effluent water. There is removal of greater than ninety (90) percent BOD_5 and TSS, with a maximum allowable monthly average of ten (10) mg/L for each. **Table 3.2-1** summarizes the additional treatment criteria.

[1] Cannibal solids reduction process is a new process in wastewater treatment designed to reduce biological solids and non-biological degradable material. This process incorporates sidestream module for physical separation and a sidestream interchange reactor for biological solids degradation. Cost savings typically achieved by lower aeration requirements and lower biosolids.

Table 3.2-1: ST/WRF Treatment Criteria

Parameter	Unit	Average Monthly	Average Weekly	Maximum Daily	Percent Removed
BOD_5	mg/L	10	15	20	>90%
pH	NA	6.5 to 8.2	6.5 to 8.2	6.5 to 8.1/8.2	-
Total Suspend Solids	mg/L	10	15	20	>90%
Electrical Conductivity	umhos/cm	<1000	-	-	-
Nitrogen (N)	mg/L	10	-	-	-
Ammonia (NH_3)	mg/L	1.0	-	5.4/4.6	-
Turbidly	NTU	0.2	-	-0.5	-
Coliform	MPN/100 mL	2.2	<2	23	-

Notes:
Data was taken from Clovis' permit.
Maximum daily values ammonia reflect water quality criteria at discharge points 1 and 2, respectively.

The facility treatment level produces effluent, which meets the definition of disinfected tertiary water:

> A filtered and subsequently disinfected wastewater that has been disinfected by either;
>
> Chlorine disinfection process following filtration that provides a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or
>
> A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.

The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed an MPN of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any calendar month. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

Quarterly monitoring reports of the effluent at permitted discharge points indicate all permitted water quality criteria are fully met, as outlined below in **Table 3.2-2**.

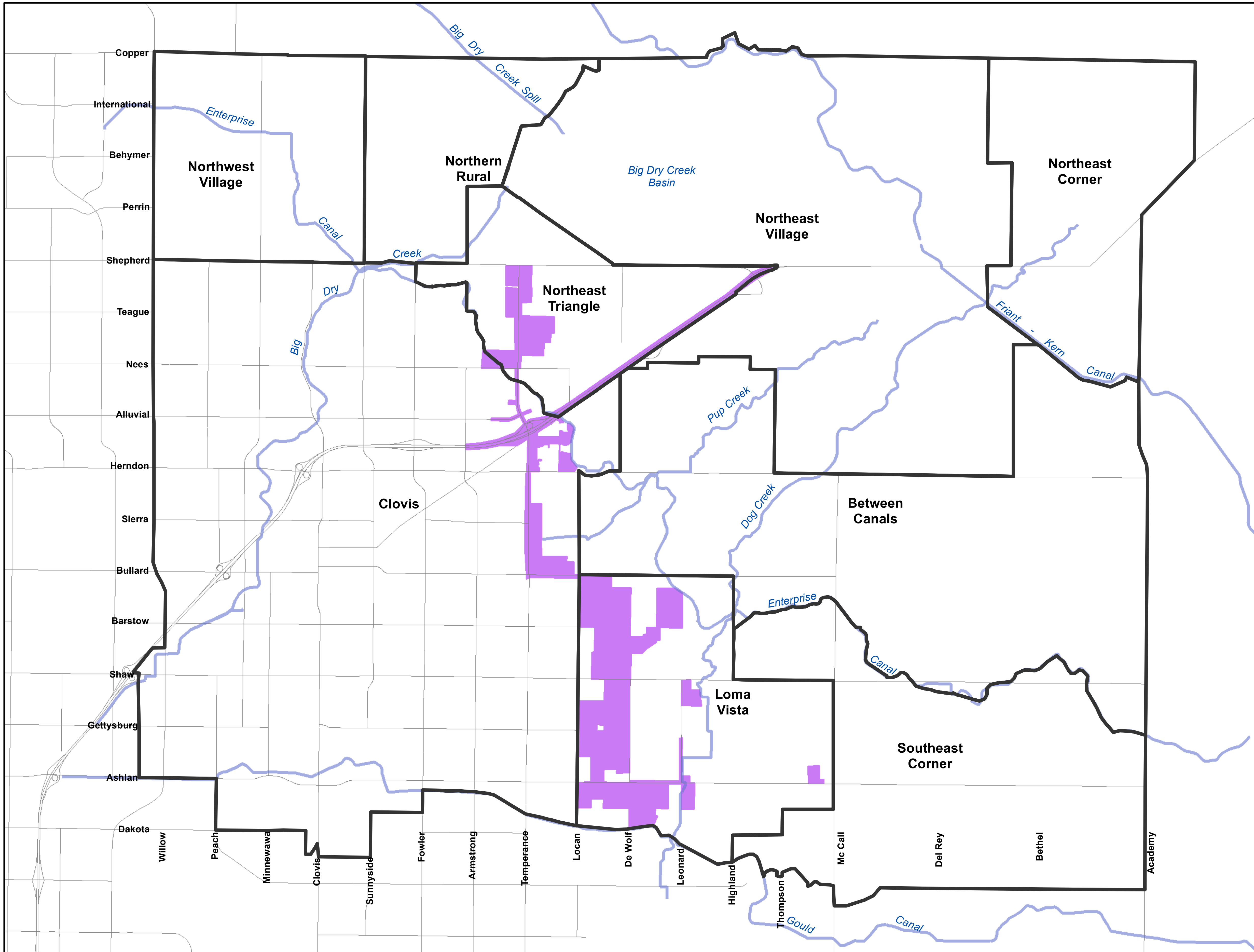
Table 3.2-2: ST/WRF Recycled Water Quality

Parameter	Unit	Design Criteria	Annual		
			Average	Minimum	Maximum
BOD_5	mg/L	10	0.6	0.5	5
pH	NA	>7 and <9	6.99	6.58	7.80
Total Suspend Solids	mg/L	10	0.5	0.1	1.70
Electrical Conductivity	umhos/cm	<1000	504	389	745
Total Nitrogen	mg/L	10	5.5	2.8	9.8
Total Phosphorous	mg/L	1.5	-	-	-
Filtered Water Turbidly	NTU	0.3	0.06	0.03	0.6
Total Coliform (7-day median)	MPN/100 mL	2.2	<2	<2	<2

Notes:
Clovis provided the effluent water quality data for this table based on 2015 daily data.
Total suspended solids is typically abbreviated TSS.

3.3 Service Area

The recycled water service area for Clovis continues to expand as more customers are added to the recycled water system. In 2015, this service area encompassed approximately one hundred seventy-eight (178) acres along the corridor of the transmission main heading northeasterly from the ST/WRF towards Big Dry Creek Reservoir. Although Clovis sent recycled water south from the ST/WRF to Fancher Creek in 2015, this corridor was excluded from the service area acreage total because there was not any recycled water use. **Figure 3.3-1** shows the approximate limits of the recycled water service area in 2015.



Legend

- Village Boundaries
- 2015 Recycled Water Service Area

Figure 3.3-1
2015 Service Area

Clovis Recycled Water Master Plan Update

EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

0 0.5 1
Miles

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3.4 Existing Infrastructure

3.4.1 Treatment Plant

The existing recycled water system includes a ST/WRF and dedicated recycled water lines within the southeast portion of Clovis comprising the backbone of the recycled water distribution system. The system is shown in **Figure 3.4-1**. The amount of recycle water available depends on capacity of the treatment facility and flow coming to the facility. Phase 1 of the ST/WRF was designed for an average daily flow of 2.8 million gallons per day (MGD), equating to an annual average treatment capacity of about 3,100 AFY. Although this is the maximum amount of recycled water available for Phase 1, planned facility expansions will not occur until increased capacity is required. As such, timing of expansions may be modified to match growth projections and wastewater generation. Planned facility upgrades have the potential to double and triple recycled water supply available under Phase 1.

Table 3.4-1: Treatment Capacity

Phase	Startup	Treatment Capacity		
		Average Day (MGD)	Average Day (cfs)	Annual Average (AF)
1	2008	2.8	4.3	3,100
3	2030	5.6	8.7	6,300
5	2042	8.4	13.0	9,400

Notes:
Startup for planned expansions is a function of the sewage treatment needs of Clovis.
ST/WRF Expansions will occur in Phases 3 and 5. In Phases 2 and 4, additional available capacity built with preceding Phase will be utilized to meet demands.

Although the hydraulic treatment capacity of the facility is currently designed for an average daily flow of 2.8 MGD, the system may be biologically limited. Reports indicate the biological treatment design capacity is closer to an average daily flow of 2.3 MGD, approximately eighty (80) percent of the hydraulic capacity. It may be assumed that future phases will either also have a biological limit, which determines system capacity and the maximum recycled water available for distribution or more likely the expanded phases will provide more biological treatment capacity to match the hydraulic capacity.

3.4.2 Transmission and Distribution System

The recycled water transmission and distribution consists of pipelines primarily running north and south through the eastern half of the sphere of influence generally along De Wolf and Temperance Avenues. This pipeline system has a cumulative length of nearly five (5) miles and was divided into four (4) distinct groups. **Table 3.4-2** summarizes the pipeline groups and the approximate length of pipe within each group.

The McCall group represents that portion of the recycled water pipeline system between the ST/WRF and Fancher Creek. This group consists of a single 36-in gravity pipeline heading east along Ashlan Avenue and generally continues south along McCall Avenue until terminating at Fancher Creek. The DeWolf group includes a single thirty-six (36) inch pressure pipeline originating at the ST/WRF and generally heading north toward the intersection of Sierra and Temperance Avenues. Most recycled water customers in 2015 were located within the limits of this group. Temperance group is comprised of a single thirty (30) inch pipeline continuing north from the terminus of the DeWolf group pipeline at Sierra Avenue, generally along Temperance Avenue and terminating at Little Dry Creek. The portion north of Shepherd Avenue is a gravity pipeline. The final grouping, Harlan Ranch, encompasses that portion of the pipeline system within a master planned community bearing the same name plus a small segment of pipeline, outside the master planned community, within Owens Mountain Parkway. Cumulative pipeline length is 2.54 miles and diameters varying from ten (10) inches to fourteen (14) inches. Recycled water use within the Harlan Ranch group is not possible until a transmission main is installed in Nees Avenue and connects to the existing transmission main in Temperance Avenue. Plans have been prepared for the work with construction planned for 2016-17.

Table 3.4-2: Existing Recycled Water Pipeline System

Name	From	To	Diameter (in)	Length (mi)
McCall	ST/WRF	Fancher Creek	36	2.45
DeWolf	ST/WRF	Sierra	36	5.14
Temperance	Sierra	Little Dry Creek	30	4.65
Harlan Ranch	Nees	-	10 to 14	2.54

Notes:
Lengths do not include pipelines with diameters less than 10 inches.

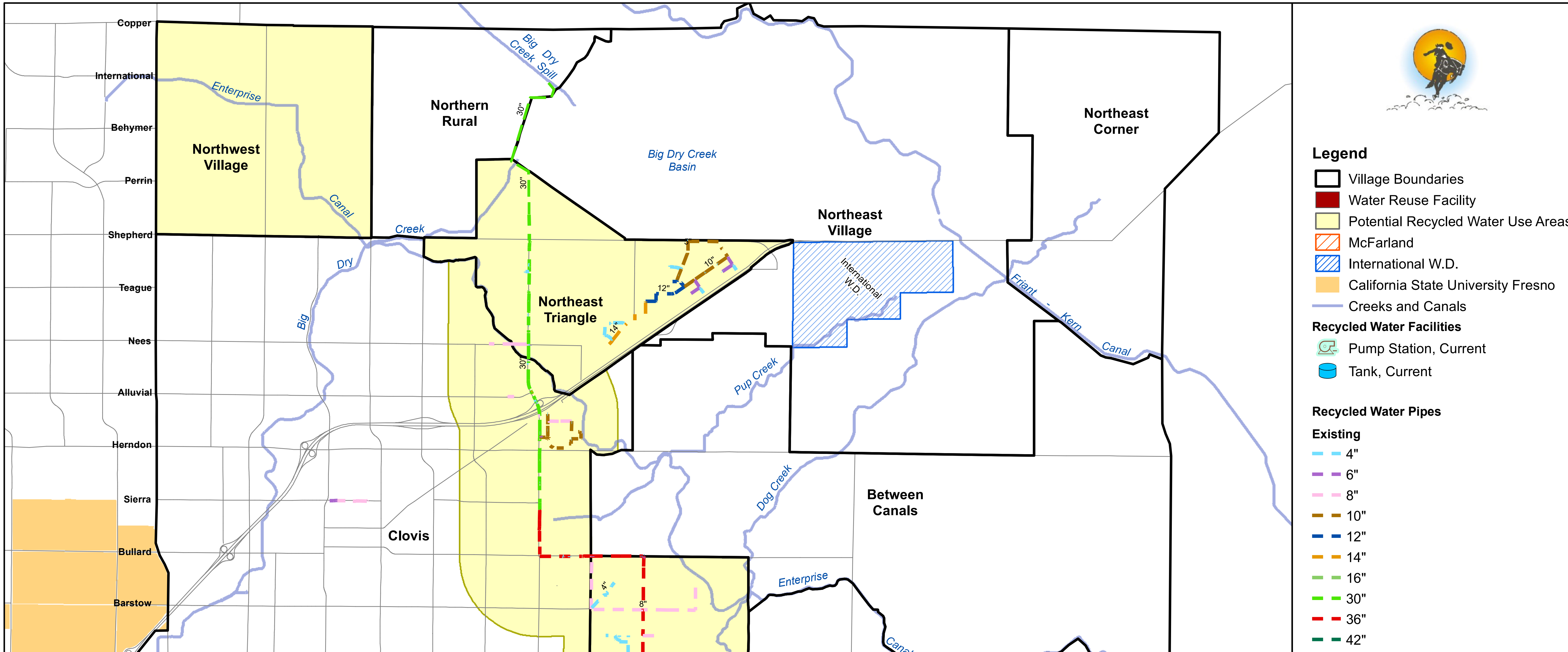

Figure 3.4-1
Existing Recycled Water Facilities

Clovis Recycled Water Master Plan Update

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CONSULTING GROUP
An Employee Owned Company

3.5 Existing Users

3.5.1 Usage

Recycled water use within Clovis' sphere of influence is steadily increasing and will continue to do so as more customers are added to the system. Users were separated into two categories – existing customers and Fancher Creek – because each benefits Clovis differently. While discharging recycled water does provide Clovis with a place to use the water when a sufficient number of customers are not available within the city, this end use does not offset potable water demand so it was assigned to a category bearing the same name as the discharge location. Since all other customers had an end use that reduced potable water demand, the reminder was assigned to the existing customer's category. In 2015, the ST/WRF generated about 1,870acre-feet with existing customers using 396 acre-feet and the remainder, 1,474 acre-feet, discharged to Fancher Creek. **Figure 3.5-1** shows a visual breakdown of recycled water use between these categories.

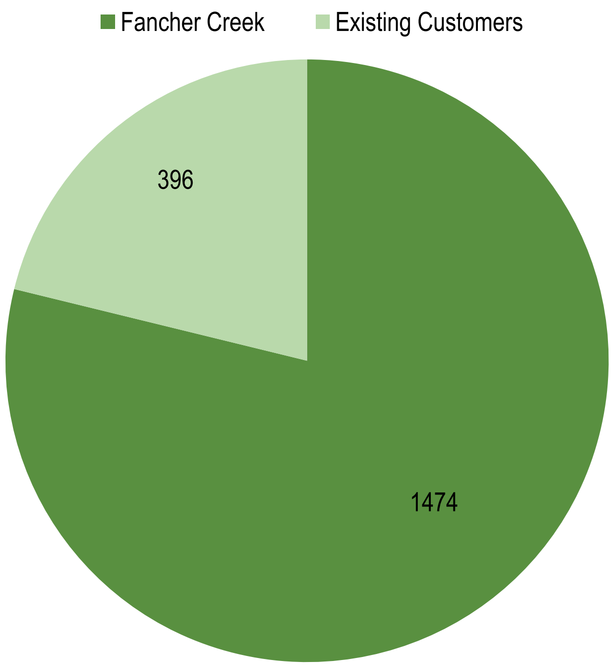

Figure 3.5-1: Pie Chart of 2015 Recycled Water Uses

In 2015, the existing customer class consisted of twenty-four (24) water use areas. Recycled water use within the existing customer class varied from no use up to one hundred seventy-three (173) acre-feet at Clovis Community Medical Center – largest user of recycled water. Sierra Meadows Park, located at Temperance and Sierra Avenues, was the second largest user of recycled water in 2015 at thirty-six (36) acre-feet. Collectively, Clovis Community Hospital and Sierra Meadows Park accounted for fifty-five (55) percent of the recycled water use in 2015. **Table 3.5-1** provides a breakdown of recycled water use by customer.

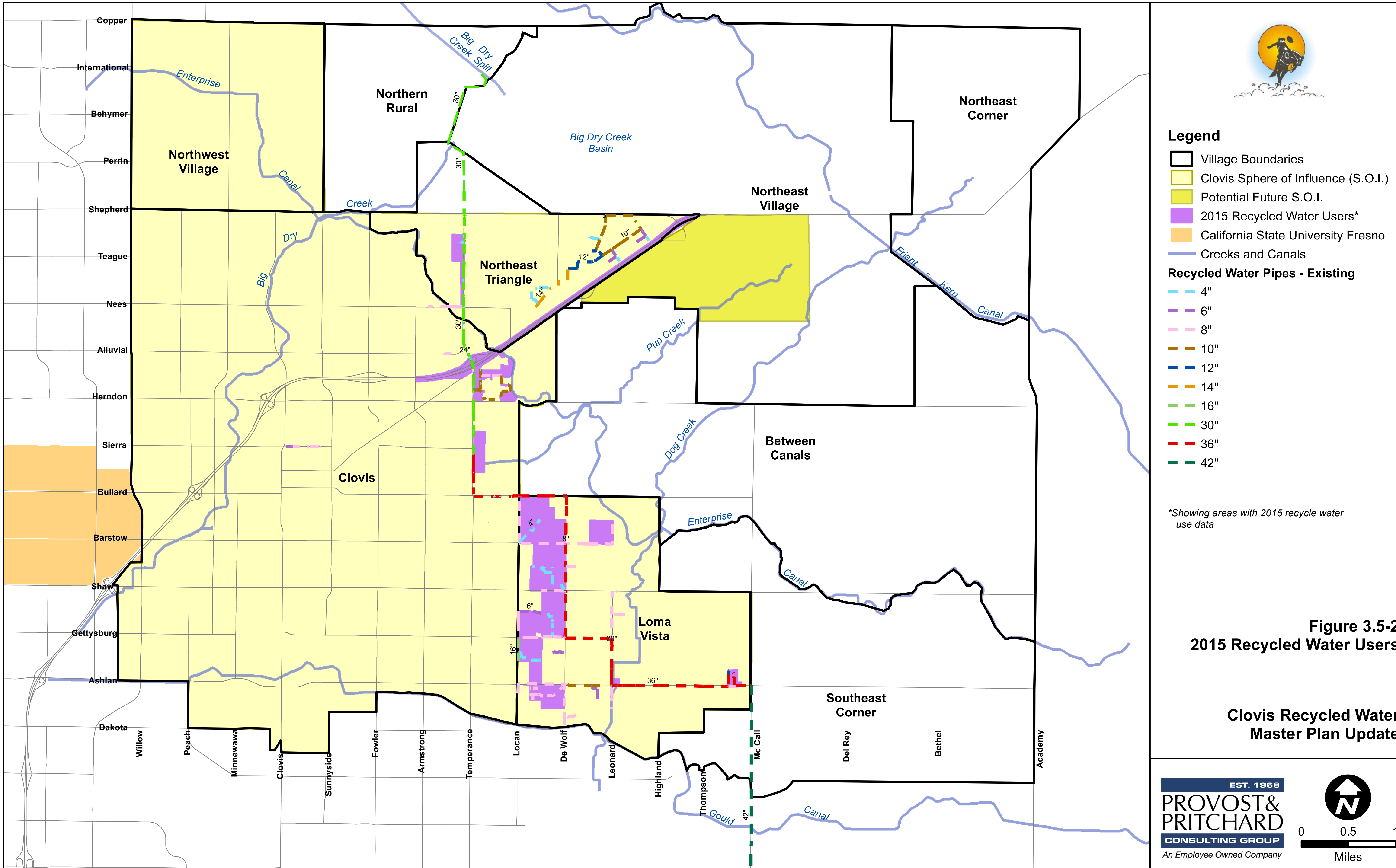
Figure 3.5-2
2015 Recycled Water Users
Clovis Recycled Water
Master Plan Update
Legend
Village Boundaries
Clovis Sphere of Influence (S.O.I.)
Potential Future S.O.I.
2015 Recycled Water Users*
California State University Fresno
Creeks and Canals
Recycled Water Pipes - Existing
4"
6"
8"
10"
12"
14"
16"
30"
36"
42"
*Showing areas with 2015 recycle water use data
Northwest Village
Northern Rural
Northeast Corner
Northeast Triangle
Northeast Village
Clovis
Between Canals
Loma Vista
Southeast Corner
Big Dry Creek Basin
Big Dry Creek Spill
Enterprise Canal
Big Dry Creek
Pup Creek
Dog Creek
Friant - Kern Canal
Gould Canal
Copper
International
Behymer
Perrin
Shepherd
Teague
Nees
Alluvial
Herndon
Sierra
Bullard
Barstow
Shaw
Gettysburg
Ashlan
Dakota
Willow
Peach
Minnewawa
Clovis
Sunnyside
Fowler
Armstrong
Temperance
Locan
De Wolf
Leonard
Highland
Thompson
Mc Call
Del Rey
Bethel
Academy
EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company
0
0.5
1
Miles

Table 3.5-1: Annual Recycled Water Use in 2015

Customer	Site No.	Usage (AF)
ST/WRF	1	20
Tract 5254	2	3.6
Pasa Tiempo Park	3	11
Tract 5874, Tract 5961	4	17
Tract 5168 Paseo, Park, and Frontage	5	17
Tract 5336 Paseo & Frontage	6	9
Tract 5484 Park, Frontage & Paseo	7	16
Tract 5193	8	8
Pump Station E	9	3
Tract 5418 & 5970	10	11
Tract 5583 Paseo, Park, Frontage	11	23
Tract 5565 & 5981	12	1.4
Tract 5825 Paseo and Frontage	13	2.6
Tract 5825, 5965, 5984, 5985 & 6020	14	2
Sierra Meadows Park and Frontage	15	36
Caltrans Construction & Landscaping	16	30
Deauville Tract 4762	19	10
Tract 5950	29	2
Tract 5664	37	0.2
Clovis Community Hospital	181	26
Clovis Community Hospital	182	40
Clovis Community Hospital	183	58
Clovis Community Hospital	184	43
Clovis Community Hospital	185	6

Notes:
Usage data based off 2015 meter records from the City of Clovis
Discharge to Fancher Creek is not included in this table.

3.5.2 Usage Variability

Recycled water uses has an inherit variability, control by its end use, that must be considered as part of a master planning process because it affects different components of a recycled water system. Systems where outdoor landscaping is the primary use of recycled water, such as Clovis, without commercial or industrial uses, it follows a pattern similar to an evapotranspiration (ET) rate for grass. The sites with a full year of recycled water usage were the basis of a monthly use evaluation. **Figure 3.5-3** shows the monthly variability in recycled water use for these customers along with monthly ET for grass. Peak recycled water use months for these customers were not coincident; however they are generally either, June, July or August. The average maximum month peaking factor for the sites was 2.67.

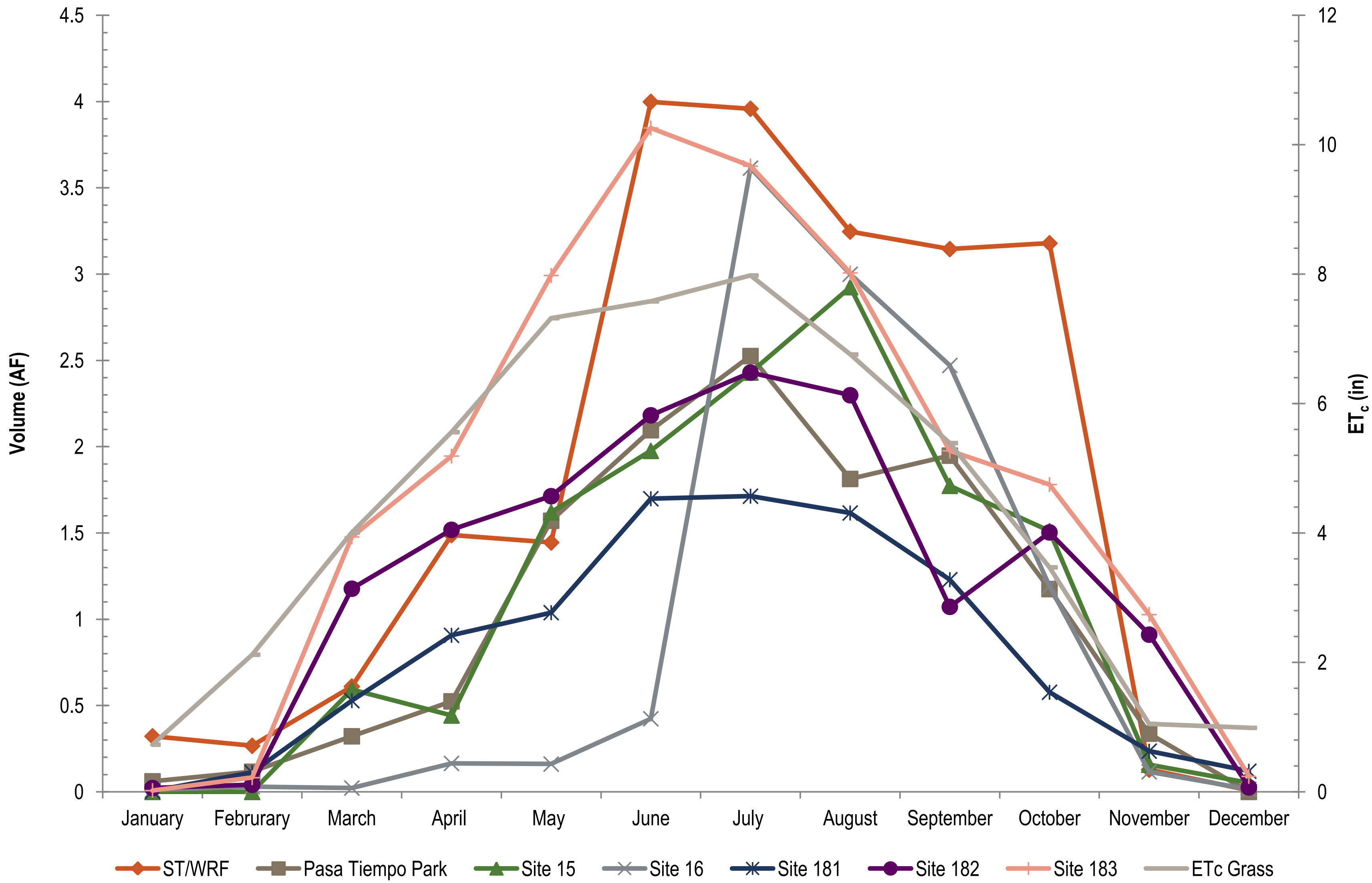

Figure 3.5-3: Monthly Recycled Water Use by Large Customers in 2015

4 Potential Recycled Water Use Evaluation

4.1 Introduction

Disinfected tertiary treated effluent produced by the Clovis WRF can be used in landscape and agricultural irrigation, industrial processing and cooling, decorative water features, recharge, and commercial toilet flushing. Entities throughout Clovis are interested in employing recycled water for one or multiple of these applications throughout the year. Evaluating the options for recycled water use is predicated on the cost effectiveness of conveyance and the reliability of the entity. Recycled water demand estimates for landscaped areas are calculated using an annual water factor per acre of irrigable land. Current irrigable land areas were defined through aerial review and GIS analysis of current landscaping. Future landscape was estimated based on the ratio of current irrigable areas to facilities for each potential recycle water site.

4.2 Assumptions and Limitations

Several assumptions were made in development and evaluation of potential recycled water users within Clovis, and that if any of these assumptions are modified recommendations contained herein may need to be updated as well. Below is a list of assumptions and limitations that were instrumental in the development of this section:

- Probable future demands may not represent actual future demands.
- Use of recycled water is and will be constrained by the volume of water generated daily by the ST/WRF since it is the only source and the amount of water needed to match evapotranspiration of the landscaped area.
- Some potential recycled water users will not be able to receive recycled water because of the economics associated with high capital improvement cost and low volumetric use.
- Retrofitting plumbing of existing users may reduce the willingness of these customers' types to participate in the recycled water program due to the added cost.
- Landscape irrigation is, and will likely continue to be, the largest use of recycled water.

Table 4.2-1: Summary Potential Recycled Water Users

Recycled Water Site ID Near Term	Recycled Water User	Potential Demand (AFY)	Evaluation Explanation
N/A	Regional Agriculture	Varies; depends on end users	About 1,800 acres surrounding recycled water infrastructure is agriculture. Recycled water can be efficiently delivered to on-farm irrigation systems; water delivery would be depend on individual agreements between Clovis and regional growers
N/A	International Water District	1,500-3,600	704 acres of permanent crops could employ recycled water; recycled water pipelines water lines would need to be constructed to connect to District conveyances and the general plan currently designates the area for future industrial uses.
CI-49	CSUF	3,200	Recycled Water delivery would require FID conveyance and may be exchanged for surface water rights. Potential recharge opportunities on east side of campus.
CI-15	Marion Recharge	2,700	Efficiently filling recharge cells requires a large flow rate, a dedicated recycled water line would need to be constructed along the Nees alignment or the Shepherd/Sunnyside alignment.
NT-26, CI-24	Caltrans (SR 168)	300	Caltrans has a length of SR 168 currently plumbed for recycled water delivery, with additional systems to be completed.
CI-26, 27	Clovis Community Medical Center	190	Onsite landscaping currently receives recycled water, additional development may expand demand and use as cooling water at onsite utilities is being considered
CI-30	Clovis Cemetery	90	Clovis cemetery is a large landscaped facility near the Marion Recharge and SR 168. There may be opportunity to use FID Clovis W. Branch No. 521 for connection with the Temperance Conveyance pipeline.
LV-23	ST/WRF	20	On site recycled water use is limited. The water treatment facility will expand to Phase 2 and subsequently Phase 3, increasing demand for onsite irrigation and capacity for RW disposal. However demands may decrease if a solar project is completed at the facility.
Varies	City Parks	Varies by site	Supplying recycled water to parks adjacent to pipelines provides cost effective irrigation, but non adjacent park areas do not provide a cost effective use of recycled water
Varies	Clovis Unified Schools	Varies by school	Clovis Unified schools adjacent to the RW conveyance facilities and large footprint schools produce a significant demand for recycled water. Retrofitting of plumbing required at existing schools.

4.3 Use Categories

Within Clovis primary end uses for recycled water would likely be irrigation of landscaping and agriculture and recharge. The landscape irrigation category consists of customers with large landscaped areas such as city parks, schools, and highway landscaping. Use of recycled water to offset agriculture demands will be specific to the end user; likely candidates could include California State University, Fresno and International Water District. Recharge is another great end use for recycled water because it provides an end use during the winter months when irrigation demands are low and it is a source that is not subject the hydrologic variation like surface water supplies.

4.3.1 Landscape Irrigation

4.3.1.1 City Parks

Clovis has a multitude of public facilities which require landscaping irrigation water. Public parks, schools, and facilities with landscaping adjacent to the primary recycled water line are an affordable market for the application of recycled water as landscape irrigation. An analysis using a ¾ miles buffer from the existing water line determined potential recycled water use sites. Based upon current land use, 44 parks and many green spaces could be served with recycled water. There are additional Clovis facilities which may be served as recycled water is conveyed to large users. Employing FID facilities to provide maximum accessibility to high water use sites, such as the Clovis Cemetery, would allow efficient supply to additional small user's demands. FID would need to agree to use of their facilities for this purpose.

4.3.1.2 Clovis Unified School District

Clovis Unified School District (CUSD) has conveyed interest in receiving recycle water deliveries to schools throughout the district. The same buffer analysis, ¾ mile of recycle water conveyance facilities, was also conducted for the district schools. Currently, 10 CUSD schools are within this buffer zone, and 3 future schools will also be in the buffer.

4.3.1.3 California Department of Transportation

California Department of Transportation (Caltrans) currently employs recycled water to irrigate landscaping along the State Route (SR) 168 corridor. There are potentially 47 acres of irrigable landscaping throughout the 168 corridor, although currently 30 AF is delivered annually. A second phase of landscaping will begin receiving recycled water in 2016.

4.3.1.4 Clovis Community Medical Center

Clovis Community Medical Center (CCMC) currently utilizes irrigation water for landscaping throughout the campus, although there is additional landscaping and undeveloped land available throughout the property to irrigate. In addition to landscape irrigation, the campus has onsite utilities that could employ recycled water in cooling towers and as boiler wash down water. As the hospital campus expands, it is expected the percent of developed landscaping will remain consistent.

4.3.2 Agriculture Irrigation

Irrigated agriculture, approximately 1,785 acres, is also within close proximity of the current recycled line. Distribution to accessible farmland would be dependent upon agreements with owners and the presence of required conveyance and irrigation infrastructure. The City is proceeding with the farmer adjacent to the STWRF to provide excess recycled water to irrigate the agricultural crops. During the growing season all excess water could be utilized.

4.3.2.1 California State University, Fresno

California State University, Fresno (CSUF) has extensive agricultural programs including annual crops, permanent crops, in addition to livestock management. During the growing seasons the farming operations use approximately 16 acre-feet per day. The campus farm was formerly irrigated by 15 wells, but currently only 5 of these are working wells with 10 no longer producing usable water quantity. The campus currently maintains entitlements to Kings River from FID, although they do not expect substantial surface water deliveries this year. CSUF is interested in taking recycled water for agricultural water supply in addition to use at on-site utilities and potentially as flush water.

Existing FID infrastructure is available to convey recycled water across Clovis from the treatment facility to the campus. The campus would plan to receive recycled water deliveries at an existing pond located at Bullard Avenue. The campus also has acreage it would be willing to dedicate to intentional recharge by recycled water and storm water, located within the bounds of Bullard Avenue, Highway 168, and Willow Avenue. In exchange for recycled water, CSUF has intimated they would be willing to trade FID Kings River surface water entitlements to the city

4.3.2.2 International Water District

International Water District (IWD) supplies water to a family owned farming operation of 704 acres which primarily produces olives, citrus, pistachios, and almonds. These permanent cropping systems require a steady supply of water to ensure no loss of investment. In some cases well levels have dropped over 5 feet per year in the recent drought years. Overall, using recycled water to supply irrigation needs in dry hydrologic years is cost effective and highly desirable for IWD. IWD has stated a specific interest in exchanging surface water rights for recycled water to supply irrigations needs.

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There currently is a 30-in diameter pipeline to distribute to IWD at Shepherd Ave and Temperance Avenue, but additional recycled water pipelines would need to be constructed to connect to District conveyance facilities. Two alternative line alignments are available to connect to these conveyances, along Shepherd Ave or Nees Avenue and Harlan Ranch Trail. The latter provides the least cost alternative as it consists of unpaved and undeveloped road. All conveyance facilities within the IWD property boundary are privately owned and managed. The district is located just east of the Clovis Sphere of Influence, and, currently, the Clovis general plan designates the area as light to heavy industrial uses in the general plan update.

4.3.3 Groundwater Recharge

4.3.3.1 Fresno Metropolitan Flood Control District

Fresno Metropolitan Flood Control District (FMFCD) has received recycled water at two facilities in the past, Copper River Ranch and Quail Lakes. Copper River Ranch is no longer a potential use site, and these previous water recycling efforts created public relations issues which currently hinder the district from receiving recycled water for intentional recharge. FMFCD will evaluate recharge operations in Clovis before committing to recycling water in district basins. The district is still open to employing recycled water in any landscaped areas within the basins which may be developed in the future.

The FMFCD also includes Big Dry Creek Reservoir, although use of this impoundment would require rehabilitation of the existing earthen dam and permitting from the Army Corp of Engineers and Fish & Wildlife. FMFCD voiced interest in developing recharge basins within this impoundment area.

4.3.3.2 Clovis Public Utilities

Clovis Public Utilities oversees the Marion recharge facility, a nearly 100 acre facility located at Sunnyside Avenue and Alluvial Avenues. Intentional recharge of recycled water as indirect potable reuse is a key to improving groundwater overdraft conditions in the region. The facility is in a prime location to benefit the long-term sustainability of the municipal supply wells of Clovis along the western border of the community.

4.4 Potential Users

Table 4.4-1 provides a summary of all the potential users of recycled water in Clovis regardless of economic feasibility. Users vary from a pocket park or school with limited recycled water use to the Reagan Educational Complex, which is already set up with a dual plumbing system. Areas with the greatest potential for recycled water are shown on **Figure 3.3-1**, including users within the following regions: a ¾-mile buffer of the existing recycled water transmission main, Northeast Triangle, Northwest Village, Loma Vista and the Northeast Village.

The summary of potential users shows significant quantities of recycled water demand for the Marion Recharge Water Basin, International Water District and California State University, Fresno. Without those demands, the potential users of recycled water in Clovis account for up to 4,476 AFY. At full build-out, the ST/WRF will be capable of providing water in excess of this demand. The excess will be delivered to one or more of these three large users, as needed.

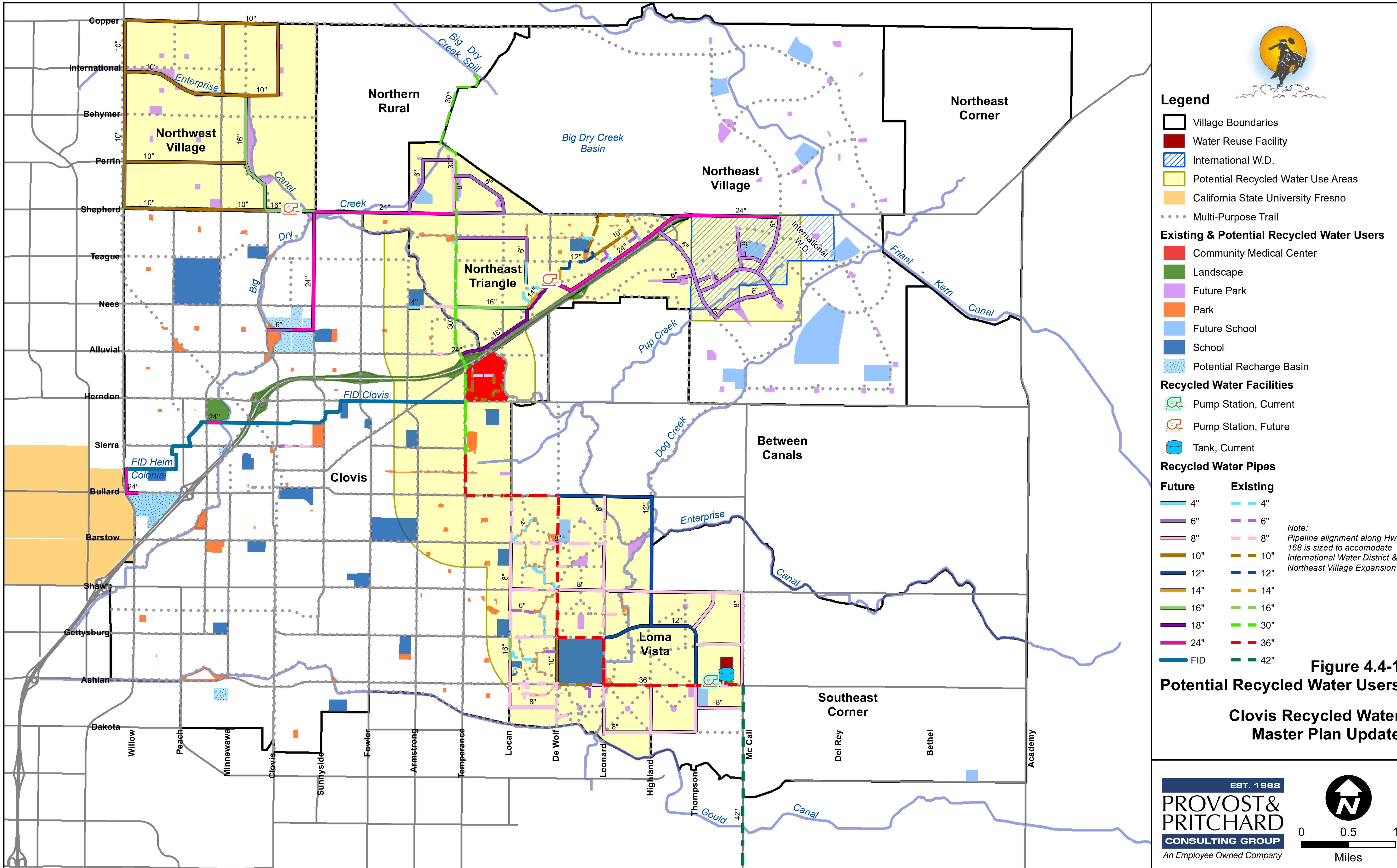

Figure 4.4-1
Potential Recycled Water Users

Table 4.4-1: Potential Recycled Water Users

User	Village	Village ID	Gross Area (ac)	Annual Demand (AF)
3/4 Mile Buffer				
Clovis East High School	Loma Vista	LV-22	60	179
Clovis High School	Clovis	CI-54	36	107
Dry Creek Elementary School	Clovis	CI-9	11	32
Red Bank Elementary School	Clovis	CI-64	8	25
Cedarwood Elementary School	Clovis	CI-36	8	24
Cox Elementary School	Clovis	CI-34	8	24
Freedom Elementary School	Clovis	CI-72	7	22
Clovis Christian Preschool	Loma Vista	LV-15	6	19
Reagan Elementary School	Loma Vista	LV-23	6	17
Reyburn Intermediate School	Loma Vista	LV-21	5	16
Future 1 School	Loma Vista	LV-4	32	49
Future 13 School	Northeast Triangle	NT-4	16	24
Sierra Meadows Park and Frontage	Clovis	CI-35	12	37
Loma Vista Linear 4 Park	Loma Vista	LV-26	4	13
Thorburn Park	Clovis	CI-71	4	12
Pasa Tiempo Park	Loma Vista	LV-3	4	11
Clovis Linear 5 Park	Clovis	CI-46	4	11
Deauville Park	Northeast Triangle	NT-10	4	11
Los Arbolitos Park	Loma Vista	LV-10	3	9
Loma Vista Linear 1 Park	Loma Vista	LV-18	3	9
Northeast Triangle Linear 3 Park	Northeast Triangle	NT-9	3	8
Loma Vista 4 Park	Loma Vista	LV-17	3	8
Future Linear 7 Park	Clovis	CI-48	2	7
Clovis Linear 4 Park	Clovis	CI-45	2	6
Fox Run Park	Clovis	CI-57	2	6
Loma Vista Linear 5 Park	Loma Vista	LV-7	2	5
Palmina Park	Loma Vista	LV-8	1	4
California Countrywood Park	Clovis	CI-63	1	4
Loma Vista - Blackwood Park	Loma Vista	LV-2	1	4
Loma Vista Linear 3 Park	Loma Vista	LV-1	1	4
Loma Vista Linear 2 Park	Loma Vista	LV-11	1	4
Town & Country 2 Pocket Park	Northeast Triangle	NT-8	1	4
Pump House Park	Loma Vista	LV-24	1	4
East West Park	Loma Vista	LV-19	1	3
Northeast Triangle Linear 2 Park	Northeast Triangle	NT-11	1	3
Camden Park	Loma Vista	LV-27	1	3

User	Village	Village ID	Gross Area (ac)	Annual Demand (AF)
Town & Country 1 Park	Northeast Triangle	NT-7	1	3
WestCal Park	Clovis	CI-55	1	3
Monte Vista 21 Park	Clovis	CI-56	1	3
Loma Vista Linear 6 Park	Loma Vista	LV-20	1	3
Monte Vista 10 Park	Clovis	CI-61	1	3
Rancho Paloma Park	Clovis	CI-18	1	3
Clovis Linear 6 Park	Clovis	CI-47	1	3
Private 3 Pocket Park	Clovis	CI-70	1	2
Loma Vista 1 Pocket Park	Loma Vista	LV-30	0.4	1
Portland & Carson Pocket Park	Northeast Triangle	NT-25	0.4	1
Arrowhead park	Loma Vista	LV-16	0.2	1
Loma Vista 2 Pocket Park	Loma Vista	LV-29	0.2	0
Loma Vista 3 Pocket Park	Loma Vista	LV-13	0.1	0
Loma Vista 2 Pocket Park	Loma Vista	LV-28	0.0	0
Future NE Area 1 Park	Northeast Triangle	NT-6	14	20
Future Loma Vista 3 Park	Loma Vista	LV-9	9	14
Future Loma Vista 2 Park	Loma Vista	LV-12	6	9
Future Loma Vista 5 Park	Loma Vista	LV-34	5	8
Future NE Area 2 Park	Northeast Triangle	NT-6	4	6
Future NE Neighborhood 3 Park	Northeast Triangle	NT-3	3	4
Future Loma Vista Quarter Section 1 Park	Loma Vista	LV-31	2	2
Future Loma Vista Quarter Section 2 Park	Loma Vista	LV-32	2	2
Future Loma Vista Quarter Section 3 Park	Loma Vista	LV-33	2	2
Future Loma Vista Quarter Section 5 Park	Loma Vista	LV-5	1	2
Future NE Neighborhood 1 Park	Northeast Triangle	NT-1	1	1
Future NE Neighborhood 2 Park	Northeast Triangle	NT-2	1	1
Northwood Park	Clovis	CI-19	0	1
Highway 168 Caltrans Landscape & Construction	Northeast Triangle	NT-26	60	179
Highway 168 Caltrans Irrigation	Clovis	CI-24	47	141
Clovis Community Hospital Landscape	Clovis	CI-27	37	111
Clovis Community Hospital Landscape	Clovis	CI-26	25	75
Waste Water Treatment Facility	Loma Vista	LV-23	6	17
Loma Vista Village Future Frontage	Loma Vista		60	181
	3/4 Mile Buffer Subtotal		559	1,531
Harlan Ranch				
Harlan Ranch Linear Park	Northeast Triangle	NT-26	4	11
Bud Rank Elementary School	Northeast Triangle	NT-20	9	26
Future 7 School	Northeast Village		23	34

User	Village	Village ID	Gross Area (ac)	Annual Demand (AF)
Harlan Ranch Community Recreation Center	Northeast Triangle	NT-21	4	11
Northeast Triangle Linear 1 Park	Northeast Triangle	NT-12	1	3
Harlan Ranch Park	Northeast Triangle	NT-19	1	2
Harlan Ranch 1 Pocket Park	Northeast Triangle	NT-15	0	1
Harlan Ranch 2 Pocket Park	Northeast Triangle	NT-14	0	1
Harlan Ranch 3 Pocket Park	Northeast Triangle	NT-16	0	1
Harlan Ranch 5 Pocket Park	Northeast Triangle		0.3	1
Harlan Ranch 4 Pocket Park	Northeast Triangle	NT-23	0	1
Harlan Ranch 6 Pocket Park	Northeast Triangle	NT-18	0	1
Harlan Ranch 7 Pocket Park	Northeast Triangle	NT-17	0	1
Harlan Ranch 8 Pocket Park	Northeast Triangle	NT-22	0	1
Harlan Ranch 9 Pocket Park	Northeast Triangle	NT-24	0	1
	Harlan Ranch Subtotal		43	95
Loma Vista				
Future Loma Vista 6 Park	Loma Vista	LV-6	12	18
Future Loma Vista Quarter Section 4 Park	Loma Vista	LV-14	2	2
	Loma Vista Subtotal		13	20
Home Place				
Home Place Open Space	Loma Vista	x	12	19
Home Place Lake	Loma Vista	x	20	1,202
Home Place Creeks	Loma Vista	x	8	23
	Home Place Subtotal		40	1,243
Northwest Village				
Future NW Community Park	Northwest Village	NW-14	29	86
Future NW Community Park	Northwest Village	NW-5	9	26
Future NW Area 2 Park	Northwest Village	NW-16	8	23
Future NW Area 1 Park	Northwest Village	NW-4	7	20
Future NW Community Park	Northwest Village	NW-5	4	11
Future NW Area 3 Park	Northwest Village	NW-11	3	9
Future NW Community 4 Park	Northwest Village	NW-7	3	8
Future NW Neighborhood 6 Park	Northwest Village	NW-15	2	5
Future NW Neighborhood 5 Park	Northwest Village	NW-13	2	5
Future NW Neighborhood 8 Park	Northwest Village	NW-10	2	5
Future NW Neighborhood 3 Park	Northwest Village	NW-6	2	5
Future NW Neighborhood 7 Park	Northwest Village	NW-3	2	5
Future NW Neighborhood 4 Park	Northwest Village	NW-12	1	4
Future NW Neighborhood 2 Park	Northwest Village	NW-2	1	4
Future NW Neighborhood 1 Park	Northwest Village	NW-1	1	4

User	Village	Village ID	Gross Area (ac)	Annual Demand (AF)
Future NW Community 2 Park	Northwest Village	NW-8	1	4
Future NW Community 1 Park	Northwest Village	NW-9	5	16
Northwest Village Future Street & Trail Frontage	Northwest Village		71	213
	Northwest Village Subtotal		151	452
Clovis				
Buchannan High School	Clovis	CI-8	68	203
Century Elementary School	Clovis	CI-16	7	20
Clark Middle School	Clovis	CI-52	13	38
Clovis Community Day Elementary School	Clovis	CI-33	4	11
Cole Elementary School	Clovis	CI-37	8	24
Future 10 School	Clovis	CI-49	69	208
Gateway High School	Clovis	CI-32	3	8
Gettysburg Elementary School	Clovis	CI-76	8	25
Jefferson Elementary School	Clovis	CI-60	11	34
Miramonte Elementary School	Clovis	CI-79	9	28
Sierra Vista Elementary School	Clovis	CI-59	7	22
Tarpey Elementary School	Clovis	CI-66	5	15
Weldon Elementary School	Clovis	CI-38	5	16
Woods Elementary School	Clovis	CI-4	10	29
Basin 1E Park	Clovis	CI-75	1	2
Been Park	Clovis	CI-28	1	2
Birchwood Estates Park	Clovis	CI-20	1	2
Blackhorse II Park	Clovis	CI-22	1	2
Bullard/Fifth Couplet Pocket Park	Clovis	CI-44	0	0
Cambridge Colony Park	Clovis	CI-13	1	4
Century Park	Clovis	CI-17	5	15
Clovis Pocket Park	Clovis	CI-43	0	0
Clovis Cemetery Landscape	Clovis	CI-30	31	94
Cottonwood Park	Clovis	CI-21	3	9
Countryside Park	Clovis	CI-7	1	3
Dry Creek Park	Clovis	CI-14	18	54
European Parc Park	Clovis	CI-1	1	4
Fifth & Harvard Park	Clovis	CI-39	0	1
Future Enterprise Trailhead Park	Clovis	CI-6	3	10
Gettysburg Elementary School	Clovis	CI-76	5	14
Helm & Holland Park	Clovis	CI-73	0	0
Helm Ranch Park	Clovis	CI-74	8	24
Kiwanis Pocket Park	Clovis	CI-51	0	1

User	Village	Village ID	Gross Area (ac)	Annual Demand (AF)
Letterman Park	Clovis	CI-50	11	34
Liberty Park	Clovis	CI-42	1	2
Monte Vista 26 Park	Clovis	CI-25	0	1
Monte Vista 31 Park	Clovis	CI-23	1	3
Music Avenue Pocket Park	Clovis	CI-53	0	1
Pinnacles Park	Clovis	CI-2	1	3
Private 1 Pocket Park	Clovis	CI-68	0	1
Private 2 Pocket Park	Clovis	CI-69	1	2
Quail Hollow Park	Clovis	CI-12	1	4
Railroad Park	Clovis	CI-11	7	20
Riordan Pocket Park	Clovis	CI-5	1	2
Rotary Park	Clovis	CI-58	13	40
San Gabriel Park	Clovis	CI-65	3	9
Seville Park	Clovis	CI-81	1	2
Sierra Bicentennial Park	Clovis	CI-31	18	53
Silverton 2 Park	Clovis	CI-62	1	2
Summit 4 Park	Clovis	CI-82	1	3
Summit 5 Park	Clovis	CI-77	1	4
Sun River Pocket Park	Clovis	CI-67	0	1
Tenaya Sun Ranch Pocket Park	Clovis	CI-29	0	0
Treasure Ingmire Park	Clovis	CI-41	1	4
West End Couplet Islands Park	Clovis	CI-40	0	0
Westcal II Park	Clovis	CI-78	3	8
Williamsburg Manor Park	Clovis	CI-10	1	2
Woods Park	Clovis	CI-3	2	5
	Clovis Subtotal		376	1,128
Northeast Village				
Future NE Neighborhood Park	Northeast Village		3	5
Future NE Pocket Park	Northeast Village		1	2
	Northeast Subtotal		4	7
Marion Recharge Water Basin	Clovis	CI-15	*101*	*2,712*
International Water District	Northeast Village	*x*	*723*	*3,800*
California State University, Fresno	*x*	*x*	*1,302*	*3,233*
Totals			***3,312***	***14,221***

Notes:

1. Recycled water use at Marion will be a function of permit requirements and availability of flood water and Kings River water. Value shown here reflects actual delivery and not the amount of recycled water that could potentially be recharged at this facility.
2. The ability to use recycled water quantities shown in this table is predicated on having infrastructure connecting to the existing recycled water transmission main.
3. A majority of the recycled water demand for the Northeast Village is included in the International Water District demand and not accounted for separately.

5 Existing Recycled Water

This section discusses elements associated with developing and constructing a hydraulic model to evaluate capital improvement projects for Clovis' recycled water system at present day conditions (2015) and at buildout. There are four (4) key elements in association with this section and they are 1) assumptions and limitations, 2) model development, 3) existing system model, and 4) buildout system model. Assumptions and Limitations section identifies boundaries for work associated with this section along with the restating of project information vital to completion of this effort. Model Development describes the methodology associated with creation of a model along with explanations of hydraulic model elements contained within the computer model. The remaining two (2) sections, Existing System Model and Buildout System Model, summarized results from the hydraulic model at present day conditions (2015) and at built out.

5.1 Assumptions and Limitations

Several assumptions were made in development and evaluation of Clovis recycled water system, and that if any of these assumptions are modified recommendations contained herein may need to be updated as well. Below is a list of assumptions and limitations that were instrumental in the development of this report:

- Model is adequate for master planning level investigations and not surge analyses.
- Hydraulic model reflects a steady-state condition with the focus being a maximum month scenario.
- Hydraulic model is a "skeletonized"[2] representation of both the actual and proposed recycled water systems, containing sufficient detail to recreate actual conditions.
- Digital elevation data obtained from Clovis was used for nodal elevations.
- GIS data from Clovis was the basis for pipeline alignments and attribute information such as diameter and length.

5.2 Model Development

Developing a hydraulic model requires the collection of information from a wide variety of sources, which is disseminated into various components of a modeling program. Initial efforts focused on obtaining physical and usage data about the existing recycled water system. Data collection included, but was not limited to the following: 1) GIS shapefiles of recycled water system infrastructure, 2) flow meter records for recycled water users, 3) pump curve(s) for finished water pumps at the ST/WRF, and 4) operational data[3] for pump(s) and tank. Using information obtained from the data collection effort, activities focused on creating nodes and links, and inputting attribute and operation data into the hydraulic modeling program. Additional information

[2] A "skeletonized" model includes components of a hydraulic network significantly affecting actual operations of a system, and is adequate for master planning or energy studies.

[3] Operational pump data includes pressure settings for starting and stopping pumps and flow measurement in the discharge line, if available. Tank operational data includes hourly water level readings during peak usage.

regarding modeling elements and how they were used to represent physical features of a recycled water system are discussed in the subsection below.

5.2.1 Level of Detail

The level of detail incorporated into a hydraulic model varies with its end use(s). Models used to assist in the overall planning of a large region require significantly less detail than a model analyzing pressure or supply at a specific point in time. The primary objective when constructing a model is to include a sufficient level of detail so that results are representative of actual conditions in a system. Given that this master plan effort includes an existing system with a limited number of users, primarily adjacent to major transmission mains, and that this model is one of many tools in the overall planning process, it was not necessary to include every pipe, existing or proposed, within a hydraulic model. As urbanization continues within urban growth areas, Clovis may find it necessary to evaluate localized impacts so future facilities can be added to the system.

5.2.2 Nodes and Links

In hydraulic modeling, nodes and links are the cornerstone elements used to represent physical components of a recycled water system. Nodes are dual-purpose features essential for connecting links or providing demand[4]. Physical elements represented by a node include customer demand, reservoir, or a tank. Attribute information associated with a node includes elevation, demand, water quality, geospatial, and other general modeling information. In addition, nodes represent locations where a model calculates hydraulic grade lines, pressure, demands, and water quality parameters. Links correspond to physical features such as pipelines, pumps, and control valves, each with a unique set of parameters associated with them. Pipeline attribute information generally comprises the following: diameter, length, roughness[5], loss coefficient[6], bulk and wall coefficients[7], status, and other parameters for failure and surge analyses. Pump attributes include: pump and efficiency curves, speed and status (on/off), and energy costs. Control valve is a category comprised of six (6) different types of valves capable of flow or pressure-based controls. Key attribute information for control valves includes the following: type of valve, setting (flow or pressure), and status.

5.2.2.1 Tanks

Although there are many similarities between tanks and reservoirs, utilization of one feature over another depends on the purpose of a hydraulic model. Both elements have hydraulic grade lines and outflows, but a tank also includes an inflow component and has a finite volume. When a real-world system is modeled at steady-state conditions, a tank is hydraulically equivalent to a reservoir. Given that the master plan effort is

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[4] Nodes with a negative demand represent a source of supply (inflow) into the model while a positive demand represents water leaving (outflow) the system..

[5] Roughness is a parameter used to represent the resistance to flow in pipeline and it is a function pipe age and material. Resistance factors vary with head loss methods and the three (3) primary methods used in modeling of pressure pipe systems are Darcy-Weisbach, Hazen-Williams, and Manning. Hazen-Williams method was selected as the head loss method for the recycled water master plan.

[6] Loss coefficient is a parameter used to represent minor losses caused by valves and fittings. This parameter is typically set to zero for master planning model efforts because it is a negligible value when velocity is less than eight (8) feet per second.

[7] Bulk and wall coefficient parameters are associated with water quality modeling and are not necessary for hydraulic models. Bulk coefficient models reactions occurring within the bulk fluid while the wall coefficient is model interactions at the pipe wall between biofilms and pipe material.

for overall planning purposes, a steady-state run is appropriate for this effort and as such, the recycled water system model does not include any tanks. See **Section 5.3** for additional information about the use of reservoirs to model the recycled water system.

5.2.2.2 Booster Pumps

Representation of a booster pump station in a hydraulic model depends on modeling philosophy. Modelers may choose to use a node or link, each with pros and cons, to represent a pump station. Given the level of precision typically associated with a master plan, it is acceptable to use a reservoir with a water surface elevation equal to discharge pressure of a pump station, especially for steady-state scenarios.

5.2.2.3 Demands

Demands associated with existing and potential recycled water users were placed at specific nodes within the model to generate results representative of an existing system. Demands associated with the existing system model were developed from meter data, recorded monthly, and assigned to a nodal location closest to the point of use. In 2015, Clovis delivered recycled water to twenty-four use areas – users located south of Shepherd Avenue. For the future system analysis, demands were estimated using land use information from the 2014 General Plan and a park unit demand developed as part of the water master plan update. Assignment of future demands also utilized the nodal proximity method.

5.3 Model Evaluation Criteria

Prior to identifying potential improvements to an existing recycled water system and recommending facilities for future expansion, a set of criteria must be established in order be able to ascertain what action is needed in a system. Evaluation criteria for the recycled water master plan included the following categories: 1) service pressure, 2) pipeline velocity, and 3) pipeline. Evaluation criteria for service pressure and pipeline velocity included ranges of values while the pipeline category had specific values for each parameter. **Table 5.3-1** summarizes values for each of the key parameters.

Operating pressures within a recycled water system are similar to pressures within a potable water system. In a recycled water system, operating requirements of a sprinkler system influence the setting of minimum pressures. For Clovis, the operating pressure range in the recycled water system was set to 60 psi in order to maintain system flexibility, which coincides with maximum and minimum pressures of 80 psi and 50 psi, respectively.

Sizing of pipelines is influence by three parameters – pipeline velocity, head loss, and Hazen-Williams coefficient. By setting up a range of acceptable velocities within a pipeline, this helps prevent excessive head loss (high velocity) and reduces the likelihood of underutilized pipelines (low velocity). Velocity range criteria for the recycled water system vary from a minimum of three (3) feet per second (fps) to eight (8) fps. Head loss within the model was restricted to a maximum of five (5) feet per thousand feet (ft/kft) throughout the entire distribution systems. Friction loss for the pipeline was determined using the Hazen-Williams equation with the "C"-factor set to 130 for all conditions.

Table 5.3-1: Hydraulic Model Evaluation Criteria

Parameter	Value
Service Pressure (psi)	
Minimum	50
Maximum	80
Pipeline Velocity (fps)	
Minimum	3
Maximum	8
Pipeline	
Maximum Head Loss (ft/kft)	5
Hazen-Williams “C” Factor	130

5.4 Existing System

Modeling of the existing recycled was system, at steady-state conditions, revealed that this system is able to accommodate additional recycled users. Flows in the model were based on 2015 meter records, which showed about 382 acre-feet (AF) of recycled water use within Clovis and 1,488 AF delivered into Fancher Creek. Using this same flow distribution in the model and a hydraulic grade line of 503 feet at the ST/WRF, there was negligible head loss across that portion of the recycled water system within Clovis' sphere of influence. This result was not unexpected since maximum month recycled water use was about 70.89 acre-feet, which is equivalent to a daily flow rate of 517 gpm, and a 30-in diameter pipeline is able to convey 9,000 gpm with a head loss of less 0.03 ft/kft. With negligible variance in the HGL across the systems and recycled water users located within close proximity to the 503-ft contour, pressures were nearly constant.

5.5 Future System Model

Modeling of the buildout recycled water system was also based on steady-state conditions and a backbone or skeletonized version of the potential system. Flows incorporated into the model were a combination of 2015 meter records and projected demands based on land use and a specific unit demand factor associated with the application of recycled water to “green space.”[8] Cumulative demand is estimated to total about 5,900 gpm. There were multiple evaluations or model runs that were performed. These consisted of:

1. Delivery to meet irrigation demands within the City system. With the HGL at the ST/WRF of 503.5, the model showed a gradual decrease in the HGL along the transmission mains with the lowest value, 492 ft, occurring near the intersection of Teague and Locan Avenues. Since the resulting pressure, 37 psi, at that location was less than a minimum value, 50 psi, a booster pump station was added at the intersection of Teague and Locan Avenues to boost system pressure within the Harlan Ranch master planned community and Northeast Village. The model also showed pressure deficiencies in the Northwest Village area. A booster pump was added to the model at the intersection of Sunnyside and Shepherd Avenues to correct the deficiency. **Table 5.5-1** provides a

[8] “Green space” is a generic term for recycled water applied to landscaping along streets and highway and to other large grass areas such as parks.

summary of pressures and flows at key locations within the recycled water system at buildout before the addition of the proposed booster pump at the intersection of Sunnyside and Shepherd Avenues. **Table 5.5-2** provides a summary of pressures and flows at key locations after the addition of the booster pump.

Table 5.5-1: Pressure and Flow Results from Model without Booster Pump

Location	Pressure (psi)	Flow (gpm)
ST/WRF Discharge Line	50	6,218
Clovis East (Leonard/Ashlan)	58	4,903
Clovis Community Hospital (Temperance/Herndon)	51	2,318
Harlan Ranch (Nees/DeWolf)	36	1,590
Shepherd/Leonard	51	226
Willow/Copper	45	53
Shepherd/Del Rey	35	128

Table 5.5-2: Pressure and Flow Results from Model with Booster Pump

Location	Pressure (psi)	Flow (gpm)
ST/WRF Discharge Line	50	6,218
Clovis East (Leonard/Ashlan)	58	4,903
Clovis Community Hospital (Temperance/Herndon)	51	2,318
Harlan Ranch (Nees/DeWolf)	36	1,590
Shepherd/Leonard	51	226
Willow/Copper	56	53
Shepherd/Del Rey	35	128

2. Delivery to meet agricultural demands to the Northeast of Harlan Ranch. With the HGL at the ST/WRF unchanged from the model run for the previous scenario analysis, the model showed that the system could get a theoretical maximum flow of approximately 6,700 gpm to the area just northeast of Harlan Ranch near the intersection of Shepherd and Tollhouse Avenues. This scenario assumed that there were zero demands on the system and the entire ST/WRF plant production would be discharged northeast of Harlan Ranch. Assuming the ST/WRF maximum daily production is approximately 5,900 gpm the City could theoretically discharge its entire daily recycled water production in the area northeast of Harlan Ranch. **Table 5.5-3** provides a summary of pressures and flows at key locations within the recycled water system.

Table 5.5-3: Pressures and Flows Results from Model – Harlan Ranch

Location	Pressure (psi)	Flow (gpm)
ST/WRF Discharge Line	50	6,673
Harlan Ranch (Shepherd and Tollhouse)	4	6,673

3. Delivery to Marion Recharge facility during winter. With the HGL at the ST/WRF unchanged from the model run for the previous scenario analysis, the model showed that the system could get a theoretical maximum flow of approximately 9,700 gpm to the Marion Recharge Facility near the intersection of Nees and Marion Avenues. This scenario assumed that there were zero demands on the system, which would be likely during a winter period when irrigation water application is typically very small. Assuming the ST/WRF maximum daily production is approximately 5,900 gpm the City could theoretically discharge its entire daily recycled water production into the Marion Recharge Facility. **Table 5.5-4** provides a summary of pressures and flows at key locations within the recycled water system.

Table 5.5-4: Pressures and Flows Results from Model – Marion Recharge Facility

Location	Pressure (psi)	Flow (gpm)
ST/WRF Discharge Line	50	6,673
Marion Recharge Facility	2	6,673

4. Delivery to meet irrigation deliveries to the Big Dry Creek Diversion. With the HGL at the ST/WRF unchanged from the model run for the previous scenario analysis, the model showed that the system could get a theoretical maximum flow of approximately 12,700 gpm to the Big Dry Creek Diversion Channel. This scenario assumed that there were zero demands on the system. Assuming the ST/WRF maximum daily production is approximately 5,900 gpm the City could theoretically discharge its entire daily recycled water production into the Big Dry Creek Diversion Channel. **Table 5.5-5** provides a summary of pressures and flows at key locations within the recycled water system.

Table 5.5-5: Pressures and Flows Results from Model – Big Dry Creek Diversion

Location	Pressure (psi)	Flow (gpm)
ST/WRF Discharge Line	50	12,707
Big Dry Creek Diversion Channel	>1	12,707

6 Potential Recycled Water Use

6.1 Introduction

As of 2015, approximately twenty percent of the Clovis WRF effluent is delivered to recycled water sites within the city of Clovis. Recycled water users included Clovis city parks and frontages, Caltrans, and the Clovis Community Medical Center (CCMC). As the City of Clovis (Clovis) embarks on urbanization in growth areas beyond the current city limit it will trigger a need to expand utilization of alternative water supplies, such as recycled water. To help facilitate increased utilization of recycled water, Clovis requires the use of recycled water on public green spaces in new growth areas when feasible. Major distribution infrastructure required to deliver this water will typically consist of 10- to 30-inch diameter pipes and transmission mains with pump stations at strategic locations.

This section provides an overview of the primary components associated with the proposed capital improvement program. Major components include 1) cost assumptions, 2) cost components, 3) buildout conditions, and 4) phasing.

6.2 Assumptions and Limitations

Several assumptions were made in development of this section of the Recycled Water Master Plan, and should any of these assumption be modified recommendations contained herein may need to be updated as well. Given that most of the proposed facilities will be installed by and are triggered by new development, Clovis should revisit this plan and update this plan when conditions vary from those stated herein. Below is a list of assumption instrumental in development of this section.

- Facilities sizing are influenced by land uses from the 2014 General Plan.
- Expansion of the recycled water system is a function of the sewage treatment needs of Clovis and the timing of development.
- Unit costs are consistent with a Class 3/4 designation as defined by the American Association of Cost Engineers, and are appropriate for feasibility studies and master plan level work.
- Little Dry Creek and Fancher Creek outfalls will be available to receive excess recycled water from Clovis.
- Recycled water will be used to recharge the aquifer during "shoulder" months (months other than summer) or when demands are less than supply.
- Capital projects only include infrastructure associated with the "backbone" of the recycled water system and as such other local improvements may be necessary for connecting to this system.
- Land acquisition cost was excluded from unit cost values and as such should be incorporated into project level budgets as needed. In 2015, land cost in the Clovis area is about $100,000 per acre.
- Sub-mains and local piping necessary to make recycled water available from the "backbone" of the recycled water system are the responsibility of developers of projects that will utilize this resource.

6.3 Costs

To help facilitate increased utilization of recycled water, Clovis requires the use of recycled water on public green spaces in new growth areas where feasible. Information presented in this analysis will lay out the framework for development conditions for potential recycled water infrastructure within this area. Assumptions associated with this analysis are as follows:

1) Land use information is based on the 2014 General Plan.
2) Only pipelines associated with the "backbone" recycled water distribution system will be sized.
3) Development impacts are estimated based on plat maps provided by the City of Clovis.
4) Irrigable area for street landscaping is based on a cumulative green space width of 11-ft on each side of a roadway.
5) Development of the Northwest Village will generally follow a westerly path beginning at the intersection of Shepherd and Sunnyside Avenues.
6) Development of the Northeast Village will generally follow an easterly path, sharing backbone infrastructure with the Northeast Triangle along Hwy 168.

6.3.1 Capital Costs

A budget level estimate of the various costs associated with the conveyance of recycled water supplies is presented in detail below. Although the recycled water costs presented below include the capital construction costs, there will also be annual costs associated with the operation and maintenance of those facilities.

Order-of-magnitude unit cost estimates were developed for pipelines, storage reservoirs, wells, and booster pump stations for 2015 conditions. Infrastructure cost estimates also include contingencies of thirty percent (30%) construction contingency and eighteen percent (18%) engineering, survey, and administration factors applied to unit costs. **Table 6.3-1** presents a summary of probable construction costs for major recycled water information.

The cost estimates presented in this study are developed from cost curves, vendors, information obtained from previous studies, and recent project experience. The costs should be considered order-of-magnitude and have an expected accuracy range of +30 percent to -20 percent as defined by the American Association of Cost Engineers (AACE).

The cost estimates have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. As constructed, final costs of the project will depend on actual labor and material costs, competitive market conditions, specific details of recommended modifications, final project scope, implementation schedule, and other variable factors. As a result, the final capital and operating project costs will vary from the estimates presented. Therefore, project feasibility and funding needs must be reviewed carefully prior to specific financial decisions to help ensure proper project evaluation and adequate funding.

Table 6.3-1: Probable Unit Cost of Proposed Infrastructure

Item No.	Description	Unit Price ($/unit)
1	4-in Diameter Pipeline	84/lf
2	6-in Diameter Pipeline	90/lf
3	8-in Diameter Pipeline	94/lf
4	10-in Diameter Pipeline	99/lf
5	12-in Diameter Pipeline	105/lf
6	14-in Diameter Pipeline	114/lf
7	16-in Diameter Pipeline	121/lf
8	18-in Diameter Pipeline	134/lf
9	24-in Diameter Pipeline	204/lf
10	3,000 gpm Booster Station	450,000/ls

6.3.2 Cost Components

6.3.2.1 Pipelines

Construction cost for pipelines includes furnishing and installation of key components and activities necessary for a fully operational facility. Major components and activities include Class 150 pressure pipe, valves, minor utility interference, and minor street resurfacing when connecting to the existing system. Easement costs were excluded because it was assumed construction activity occurs within existing rights-of-way for Clovis. Since most of the recycled water system is in future growth areas, street resurfacing was also assumed minimal because existing roadways in rural areas would be improved as part of the development work. Pipeline unit costs range from a low of eight-four dollars ($84) per linear foot (LF) for a four (4) inch diameter pipeline up to two-hundred and four dollars ($204) per LF for a twenty-four (24) inch diameter pipeline.

6.3.2.2 Booster Pump Station

Utilizing cost data from past projects along with estimates from recent bids, a preliminary opinion of probable cost was developed for a booster pump station. Unit cost for this type of facility was based on a value of $150 per gallon per minute (gpm) and with a capacity of 3,000 gpm, which equated to a lump sum cost of about $450,000. The Harlan Ranch pump station and a single booster pump station near the intersection of Sunnyside and Shepherd Avenues would both pressurize a recycled water system serving the Northwest Village and Harlan Ranch; both are included in **Table 6.4-2**.

6.4 Buildout

The existing ST/WRF was constructed to treat 2.8 MGD of wastewater to Title 22 disinfected tertiary standard and was planned for an ultimate treatment capacity of 8.4 MGD. A small portion of the recycled water currently produced from the ST/WRF offsets potable water demands within the city limit with the majority discharged to Fancher Creek. To better utilize recycled water discharged to Fancher Creek and recycled water generating potential of the ST/WRF at buildout, construction of additional infrastructure is required throughout Clovis.

As identified in the Potential Recycled Water Use section of this report, there are five main areas considered viable for recycled water use (see **Figure 6.4-1**). These five areas are referred to as:

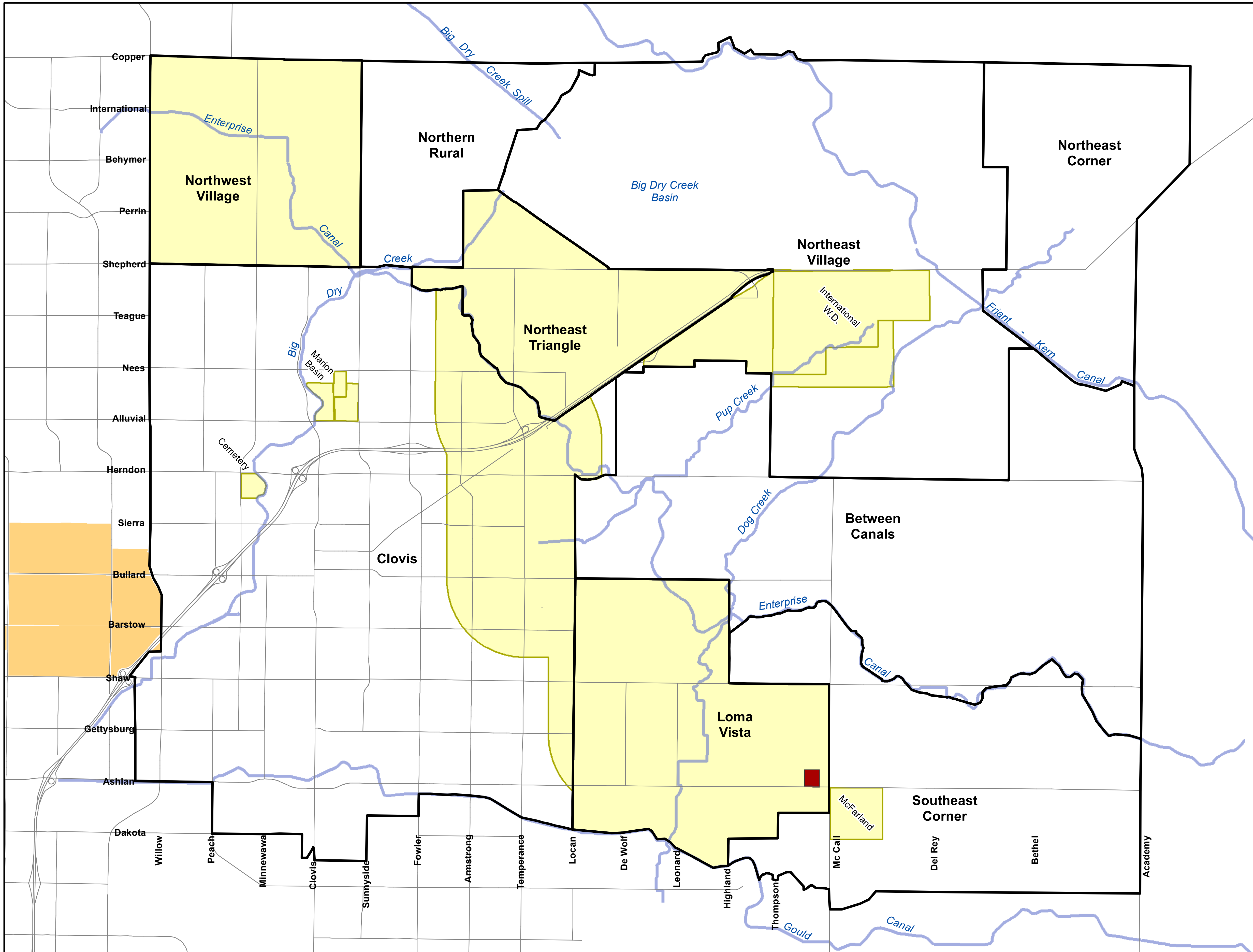
- Northwest Village
- Clovis
- Northeast Triangle
- Loma Vista
- Northeast Village

The backbone infrastructure necessary for conveying recycled water to these five areas are shown in **Figure 6.4-2** Pipelines represent the prominent facility type within the buildout configuration of the potential recycled water infrastructure system; total length of pipe is approximately fifty-on (51) miles. The total cost of the proposed recycled water system is about $27.6 million with capital cost in the five (5) service areas varying from a low of about $2.6 million for the Clovis area to a high of $8.3 million for the Northwest Village. The primary reason for this cost disparity was the absence of existing recycled water infrastructure internal to the Northwest Village while most other areas have some recycled water infrastructure. **Table 6.4-1** shows the anticipated distribution of capital costs and cumulative length of pipe within each area associated with these facilities. The total capital cost for the potential infrastructure was estimated and itemized in **Table 6.4-2**. It should also be recognized that in addition to the facilities identified below that Clovis will incur additional costs for expanding the ST/WRF from its present capacity of 2.8 MGD to 8.4 MGD at buildout and that these costs were accounted for as a sewer infrastructure cost identified in the sewer master plan and are not shown in the tables in this report.

Table 6.4-1: Preliminary Opinion of Probable Construction Costs by Village

Area	Total Pipe Length	Capital Cost
Northwest Village	71,090 LF	$8.3M
Clovis	33,800 LF	$2.6M[1]
Northeast Triangle	50,020 LF	$5.8M
Loma Vista	79,500 LF	$7.2M
Northeast Village	32,420 LF	$3.7M

Notes:
1. Includes conversion of FID canal system as a line item but cost is unknown at this time and therefore not included in the total cost.
2. Anticipated capital costs shown to the nearest tenth (1/10th) of a million dollars.
3. Infrastructure cost for the Northwest Village includes a 3,000 gpm booster pump station.
4. Infrastructure cost for the Northeast Triangle includes a 3,000 gpm booster pump station and backbone infrastructure to serve the Northeast Triangle and Northeast Village.



Legend

- Village Boundaries
- Potential Recycled Water Use Areas
- Water Reuse Facility
- California State University Fresno
- Creeks and Canals

Figure 6.4-1
Recycled Water Use Areas

Clovis Recycled Water Master Plan Update

EST. 1968
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company

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Miles

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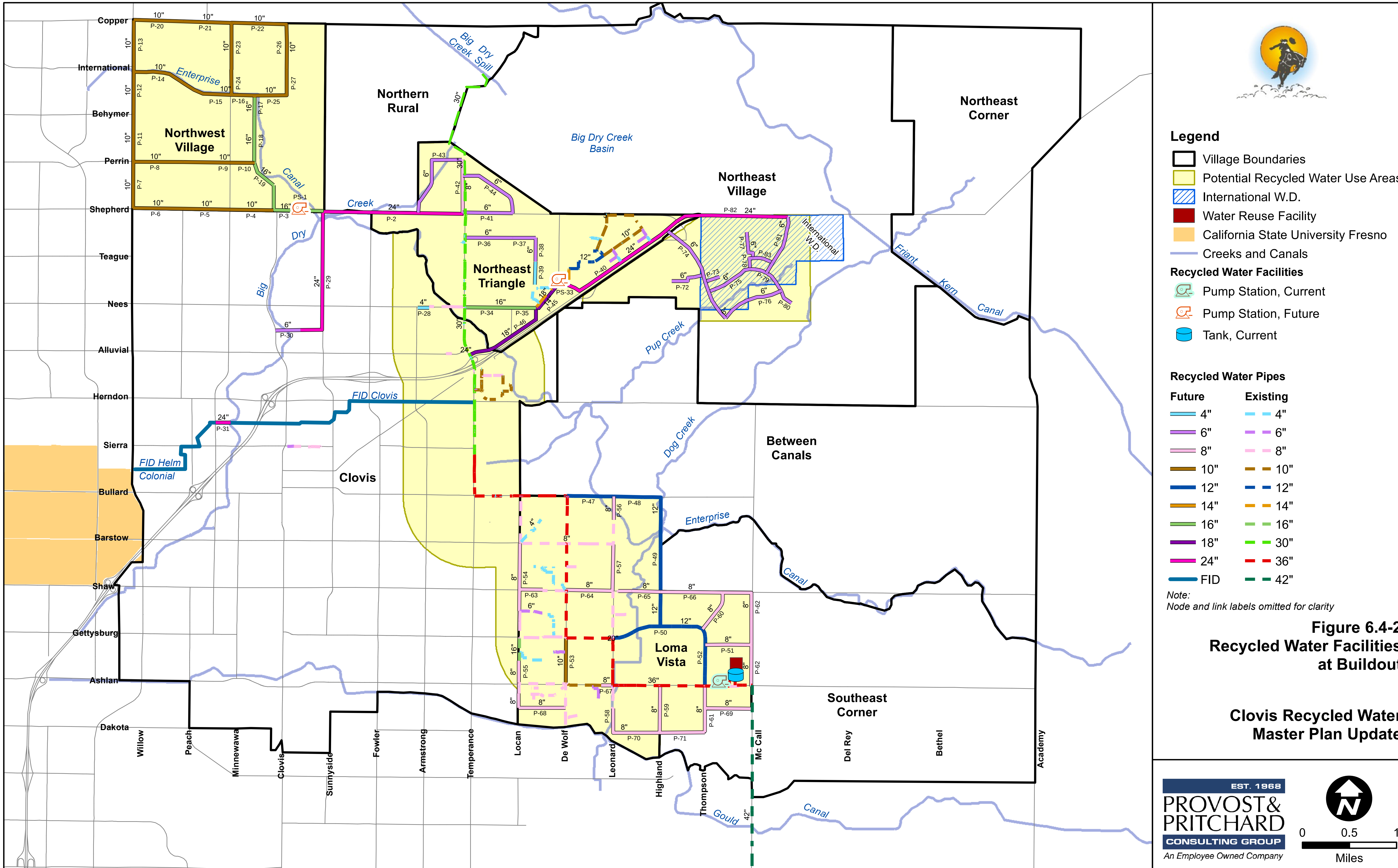

Figure 6.4-2
Recycled Water Facilities at Buildout

Clovis Recycled Water Master Plan Update

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Table 6.4-2: Preliminary Opinion of Probable Construction Costs

Item No.	Description	From	To	Quantity		Cost
Northwest Village						
PS-1	3,000 gpm Shepherd Ave Pump Station			1	LS	$450,000
P-2	24-in Pipe along Shepherd	N Sunnyside	N Temperance	7,860	LF	$1,603,400
P-3	16-in Pipe along Shepherd	N Clovis	N Sunnyside	2,800	LF	$338,800
P-4	10-in Pipe along Shepherd	Minnewawa	N Clovis	2,420	LF	$239,600
P-5	10-in Pipe along Shepherd	Peach	Minnewawa	2,700	LF	$267,300
P-6	10-in Pipe along Shepherd	Willow	Peach	2,800	LF	$273,200
P-7	10-in Pipe along Willow	Perrin	Shepherd	2,700	LF	$267,300
P-8	10-in Pipe along Perrin	Willow	Peach	2,760	LF	$273,200
P-9	10-in Pipe along Perrin	Peach	Minnewawa	2,700	LF	$267,300
P-10	10-in Pipe along Perrin	Minnewawa	16-in Pipe	1,380	LF	$136,600
P-11	10-in Pipe along Willow	E Behymer	Perrin	2,700	LF	$267,300
P-12	10-in Pipe along Willow	International Ave	E Behymer	2,700	LF	$267,300
P-13	10-in Pipe along Willow	Copper	International Ave	2,600	LF	$257,400
P-14	10-in Pipe along Enterprise Canal	Willow	Peach	2,940	LF	$291,100
P-15	10-in Pipe along Enterprise Canal	Peach	Minnewawa	2,900	LF	$287,100
P-16	10-in Pipe along Enterprise Canal	Minnewawa	16-in Pipe	1,400	LF	$138,600
P-17	16-in Pipe along Enterprise Canal Park	Enterprise Canal	Behymer	1,060	LF	$128,300
P-18	16-in Pipe along Enterprise Canal Park	Behymer	Perrin	2,700	LF	$326,700
P-19	16-in Pipe along Enterprise Canal Park & Trailway	Perrin	Shepherd	3,120	LF	$377,500
P-20	10-in Pipe along Copper	Willow	Peach	2,800	LF	$277,200
P-21	10-in Pipe along Copper	Peach	Minnewawa	2,800	LF	$277,200
P-22	10-in Pipe along Copper	Minnewawa	10-in Pipe	3,100	LF	$306,900
P-23	10-in Pipe along Minnewawa	Copper	International Ave	2,700	LF	$267,300
P-24	10-in Pipe along Minnewawa	International Ave	International Canal	1,460	LF	$144,500
P-25	10-in Pipe along Enterprise Canal	Enterprise Canal	Future Park	1,800	LF	$178,200
P-26	10-in Pipe along future park	Copper	International	2,530	LF	$250,500
P-27	10-in Pipe along future park	International	8-in Pipe	1,460	LF	$144,500

Item No.	Description	From	To	Quantity		Cost
			Northwest Village Subtotal	***68,890***	***LF***	***$8,308,300***
Clovis						
P-28	4-in Pipe along Nees	N Armstrong	Temperance	2,540	LF	$213,400
P-29	24-in Pipe along Sunnyside & Nees	Shepherd	N Marion	7,860	LF	$1,603,400
P-30	6-in Pipe intersect Dry Creek Park	N Clovis	N. Marion	1,400	LF	$126,000
P-31	24-in Pipe along South Clovis Cemetery & N Willow			3,000	LF	$612,000
P-32	Conversion of FID Canal System	Temperance	Willow	19,000	LF	Unknown
			Clovis Subtotal	***33,800***	***LF***	***$2,554,800***
Northeast Triangle						
PS-33	3,000 gpm Harlan Pump Station			1	LS	$450,000
P-34	16-in Pipe along Nees	Temperance	Locan	2,800	LF	$338,800
P-35	16-in Pipe along Nees	Locan	Owens Mtn Pkwy	1,300	LF	$157,300
P-36	6-in Pipe along trailway (Deauville-Linear Park)	Temperance	Locan	2,800	LF	$252,000
P-37	6-in Pipe along trailway (Deauville-Linear Park)	Locan	Loyola	1,300	LF	$117,000
P-38	6-in Pipe along trail way (Linear Park)	Loyola	E Teague	1,340	LF	$120,600
P-39	6-in Pipe along trail way (Redington Ave)	E Teague	Enterprise Ave	1,300	LF	$117,000
P-40	24-in Pipe along 168	Owens Mtn Parkway	Shepherd	10,000	LF	$2,040,000
P-41	6-in Pipe along Shepherd	Temperance	Locan	2,820	LF	$253,800
P-42	8-in Pipe along N. Temperance	6-in Pipe West Loop	Shepherd	3,000	LF	$282,000
P-43	6-in Pipe West Loop	Temperance	Shepherd	4,860	LF	$437,400
P-44	6-in Pipe East Loop	8-in Pipe Temperance	Shepherd	4,000	LF	$360,000
P-45	14-in along Owens Mtn Pkwy	Nees	De Wolf	2,000	LF	$228,000
P-46	18-in Trail along 168	Temperance	Owen Mtn Pkwy	5,000	LF	$670,000
			Northeast Triangle Subtotal	***42,520***	***LF***	***$5,823,900***
Loma Vista						
P-47	12-in Pipe along Bullard	De Wolf	Leonard	2,600	LF	$273,000
P-48	12-in Pipe along Bullard	Leonard	Highland	2,600	LF	$273,000
P-49	12-in Pipe along Highland	Bullard	Gettysburg	7,920	LF	$831,600
P-50	12-in Pipe along Gettysburg	Leonard	Thompson	5,280	LF	$554,400
P-51	8-in Pipe along Gettysburg	Thompson	McCall	2,600	LF	$244,400

Item No.	Description	From	To	Quantity		Cost
P-52	12-in Pipe along Thompson	Gettysburg	Ashlan	3,200	LF	$336,000
P-53	10-in Pipe along De Wolf	Gettysburg	Ashlan	2,600	LF	$257,400
P-54	8-in Pipe along Locan	Barstow	Gettysburg	3,960	LF	$372,200
P-55	8-in Pipe along Locan	Holland	Bellaire	2,600	LF	$244,400
P-56	8-in Pipe along Leonard	Bullard	Wrenwood	1,300	LF	$122,200
P-57	8-in Pipe along Leonard	Barstow	Shaw	2,600	LF	$244,400
P-58	8-in Pipe along Leonard	Bellaire	Dakota	1,300	LF	$122,200
P-59	8-in Pipe along Highland	Ashlan	Dakota	2,600	LF	$244,400
P-60	8-in Pipe along Thompson	Shaw	Gettysburg	2,000	LF	$188,000
P-61	8-in Pipe along Thompson	Ashlan	Dakota	2,600	LF	$244,400
P-62	8-in Pipe along McCall	Shaw	Ashlan	5,280	LF	$496,300
P-63	8-in Pipe along Shaw	Locan	Maine	1,300	LF	$122,200
P-64	8-in Pipe along Shaw	De Wolf	Leonard	2,600	LF	$244,400
P-65	8-in Pipe along Shaw	Leonard	Highland	2,600	LF	$244,400
P-66	8-in Pipe along Shaw	Highland	McCall	5,280	LF	$496,300
P-67	8-in Pipe Along Ashlan	Cordova	Leonard	1,000	LF	$94,000
P-68	8-in Pipe along Sussex	Locan	De Wolf	2,600	LF	$244,400
P-69	8-in Pipe along Sussex	Thompson	McCall	2,600	LF	$244,400
P-70	8-in Pipe along Dakota	Leonard	Thompson	5,280	LF	$496,300
P-71	8-in Pipe along Dakota	Highland	Thompson	2,600	LF	$244,400
			Loma Vista Subtotal	***74,220***	***LF***	***$7,227,200***
<u>Northeast Village</u>						
P-73	6-in Pipe in Future Road	Future Park	Future Road	1,980	LF	$178,200
P-74	6-in Pipe in Future Road	Future Park	Future Road	860	LF	$77,400
P-75	6-in Pipe in Future Road	Shepherd	Future Road	6,490	LF	$584,100
P-76	6-in Pipe in Future Road	Future Road	Future Road	2,690	LF	$242,100
P-77	6-in Pipe in Future Road	Future Road	Future Road	3,590	LF	$323,100
P-78	6-in Pipe in Future Road	Future Park	Future Road	1,700	LF	$153,000
P-79	6-in Pipe in Future Road	Future Park	Future Road	800	LF	$72,000
P-80	6-in Pipe in Future Road	Future Road	Future Road	2,280	LF	$205,200

Item No.	Description	From	To	Quantity		Cost
P-81	6-in Pipe in Future Road	Future Park	Future Road	940	LF	$84,600
P-82	6-in Pipe in Future Road	Future Road	Shepherd	3,440	LF	$309,600
P-83	24-in Pipe along Shepherd	Hwy 168	Future Road	6,480	LF	$1,321,900
P-84	6-in Pipe in Future Road	Future Park	Future Road	1,170	LF	$105,300
			Northeast Village Subtotal	***32,420***	***LF***	***$3,656,500***
			Total	**251,850**	**LF**	**$27,570,700**

Notes:
1. Lengths are based on data obtained from GIS.
2. Item No. 32 is only needed if the City decides to deliver recycled water to CSUF.

6.5 Phasing

The capital improvements will be constructed in phases based on the location of existing facilities, new growth areas, demands, and availability of recycled water from the ST/WRF. For the purposes of this capital improvement program, improvements were divided into four (4) phases (**Figure 6.5-1**) and are summarized in **Table 6.5-1**.

6.5.1 Market Development

The phasing of the capital facilities includes consideration of potential users and recycled water demand, with the intent to scale development in the most significant use areas with the most efficient implementation. Potential uses, by phase, range from a low of approximately 1,400 acre-feet per year (AFY) in Phase 1 to a cumulative high of 13,000 AFY for Phase 5; total potential use is anticipated to exceed treatment capacity of the ST/WRF. **Table 6.5-1** outlines the potential demand that can be served in each phased expansion based on facilities in close proximity.

Table 6.5-1: Potential Recycled Water Use By Phase

Phase	Period	Potential Additional Use (AFY)
1	2015 to 2020	1,400
2	2020 to 2025	2,900
3	2025 to 2030	1,500
4	2030 to 2035	7,200
5	2045 to Buildout	-
	Total	**13,000**

Phase 1 is anticipated to include capital facilities necessary to delivery recycled water to areas within ¾ mile, each side, of the existing transmission main, including areas within Loma Vista and the Northeast Triangle, as well as infrastructure to deliver recycled water to the southern portion of the Northwest Village. By 2020, total deliveries of recycled water could total up to 1,400 AF.

Phase 2 would include additional facilities within the Northwest Village, pipeline to the Marion Basin and Dry Creek Park within the Clovis village area, and additional facilities within the Northeast Triangle and Loma Vista. The total estimated additional potential deliveries were estimated to be 2,900 AF by 2025.

Phase 3 would consist primarily of new recycled water facilities throughout Loma Vista, as well as some additional facilities in the Northwest Village. The majority of the 2030 estimated demands, 1,500 AF, are due to the development of the Home Place planned community and lakes in Loma Vista.

Phase 4 would include buildout of proposed recycled water facilities within Loma Vista, the Northeast Triangle, and the Northwest Village to accommodate all remaining recycle water demands within those areas, as well as the infrastructure to serve two significant recycle water users; specifically California State University, Fresno and the International Water District. California State University, Fresno demands would be planned to be met with deliveries via FID canals as well as connecting recycled water infrastructure. The connection serving International Water District, on the boundary of the Northeast Triangle, may subsequently serve demands throughout the Northeast Village, pending buildout.

Phase 5 would include buildout of the final ST/WRF expansion to supply all remaining recycled water demands; the costs for this are accounted for in the Sewer Master Plan.

These phases are approximated based on current conditions and assumptions. Actual development may differ from the projected phases shown and the final users served. The phases developed through 2035 will provide access to potential recycle water users throughout the Clovis area up to and in excess of current ST/WRF production capacity.

Recycled water production capacity of the facility must increase in scale according to the growth of the city, which will occur throughout the phased implementation of the RW infrastructure. Previous ST/WRF capacity was scheduled to reach 9,400 AF by 2026. Due to recent conservation measures significant capacity increases will likely be limited until significant buildout within the General Plan. **Table 6.5-2** provides a proposed timeline of estimated ST/WRF capacity based on the planned expansions during each phase of recycled water capital infrastructure to buildout.

Table 6.5-2: Potential Recycled Water Use Evaluation By Phase

Phase	Period	Total Annual Demand Estimate	ST/WRF Annual Capacity Estimate	% Annual Capacity
1	2015 to 2020	1,400 AFY	2,100 AFY[1]	67%
2	2020 to 2025	4,300 AFY[6]	3,100 AFY[2]	139%
3	2025 to 2030	5,800 AFY[7]	5,500 AFY[3]	105%
4	2030 to 2035	13,000 AFY[8]	6,300AFY[4]	206%
5	2045 to Buildout	13,000 AFY[9]	9,400 AFY[5]	138%

Notes:
1. Current capacity of the ST/WRF is constrained by the flow available to the facility.
2. Assumed full capacity of current facility by 2020.
3. Assumed 2017 capacity increase reached by 2025.
4. Assumed 2025 capacity increase reached by 2030
5. Assumed plan capacity increase by 2042.
6. Estimated demand increase of 2,900 AFY in Phase 2.
7. Estimated demand increase of 1,500 AFY in Phase 3.
8. Estimated demand increase of 7,200 AFY in Phase 4.
9. No estimated demand increase in Phase 5.

It is critical to evaluate the ability of the ST/WRF to meet recycle water demand on a consistent basis annually. Below, the maximum demand month, July, is used to define the maximum recycle water service area of the ST/WRF based on daily production for each phase.

Table 6.5-3: Potential Recycled Water Use Evaluation by Acreage

Phase	Period	Total Potential Demand Area[1] (acres)	ST/WRF Max Service Area- July Demands[2,5] (acres)	ST/WRF Max Service Area- Annual Demands[3,5] (acres)
1	2015 to 2020	470	370	700
2	2020 to 2025	520[4]	560	1,000
3	2025 to 2030	700	970	1,800
4	2030 to 2035	3,010	1,110	2,100
5	2045 to Buildout	-	1,670	3,100

Notes:
1. Total Potential Demand Area is based on when service is available to each potential user, not when supply is available based on ST/WRF expansions
2. Calculated using the landscape irrigation unit demand for the month of July: .48 AF/acre and the AF produced by the ST/WRF in July
3. Calculated using the landscape irrigation unit demand for year, 3 AF/acre and the annual production
4. Excludes Marion Recharge acreage as it is considered a 'sink' rather than a demand and has no unit demand
5. Max Service Area (July and Annual) is based on when supply is available based on ST/WRF expansions

The information in **Table 6.5-3** indicates the maximum acreage that can be served annually with reliable recycle water deliveries, namely about 370 in Phase 1 up to nearly 3,100 acres in Phase 5. The plant would actually only be at 5.6 MGD of capacity by 2035. Based on current development wastewater generation rates the plant would likely be expanded to its ultimate capacity by 2042. The acreages defined provide the basis for the maximum allowable recycle water deliveries annually employing the 3 AF/acre factor for irrigable landscaping. This yields potential service area demands ranging from 1,100 AF up to 3,400 AF through 2035 and accompanying recycle water infrastructure development.

The total demands of the maximum service area allow an annual analysis of ST/WRF discharges to recycle water users, which offsets potable water use. As the total service area is limited to the capacity of the plant to meet the maximum demand month there is additional, excess recycle water, produced annually in the winter, when users experience low winter water demands. This excess annual recycle water would be available for discharge to facilities such as Marion Recharge to benefit groundwater sustainability efforts and allow an additional beneficial use for recycle water. An evaluation of annual plant capacity of recycle water, service area demand, excess recycle water to Marion Recharge, and the remaining recycle water to the Fancher Creek outfall is presented in **Table 6.5-4**.

Table 6.5-4: Potential Recycled Water Use Evaluation By Delivery

Phase	Period	ST/WRF Capacity Estimate (AFY)	ST/WRF Service Area Demand (AFY)[1]	Excess RW to Marion Recharge (AFY)[2]	Excess RW to Outfall (AFY)
1	2015 to 2020	2,100	1,400	-	700
2	2020 to 2025	3,100	1,600	1,500	-
3	2025 to 2030	5,500	3,100	2,000	400
4	2030 to 2035	6,300	10,300	-	-
5	2045 to Buildout	9,400	10,300	-	-

Notes:
1. Service Area Demand from Table 6.5-2 is reduced by 2,700 AFY to account for potential Marion Recharge in Phases 2 through 5
2. Maximum deliveries to Marion Recharge defined as the available capacity above average Kings River deliveries, about 2,000 AF

6.5.2 Delivery Infrastructure

The CIP for each phase was analyzed by village of implementation, sizing, alignment, quantity, and cost. **Figure 6.5-1** shows the potential phasing of the recycled water system.

Significant aspects of the Phase 1 implementation include two 3,000 gpm pump station and 10"-24" pipelines to serve the Northwest Village and the pipeline connection to serve the Harlan Ranch community. Initial cost estimates for Phase 1 are $6.9 million with 50,940 LF of pipeline installed. **Table 6.5-5** provides the detailed implementation plan and cost estimate for Phase 1.

Phase 2 includes the additional facilities required to serve Marion Recharge Basin, a 24" pipeline along Sunnyside Avenue, connecting to the Phase 1 infrastructure providing service to the NW village and a 24" pipeline along Hwy 168 and Shepherd Avenue providing service to the Northeast Village. Additional facilities within the Northeast Triangle, Northwest Village, and Loma Vista, will also be served as shown in **Figure 6.4-2**. Potential capital improvements for Phase 2 are presented in **Table 6.5-6.** The initial cost estimate provided is $15.6 million with 133,040 LF of pipeline laid.

Phase 3 would consist primarily of additional facilities in the Northwest Village. Phase three includes entirely 10" connections to serve members off of the RW infrastructure placed in Phase 1 and Phase 2. Potential capital improvements for Phase 3 provided in **Table 6.5-7**, with a preliminary cost estimate of $1.2 million and 11,740 LF installed.

Phase 4 would include buildout of proposed recycled water facilities within the three village areas to accommodate all potential demands within those areas as well as potential deliveries to California State University, Fresno. Potential capital improvements for Phase 4 (buildout) provided in **Table 6.5-8** complete the backbone of recycled water infrastructure, as recommended. Estimated capital cost for Phase 4 improvement was about $3.9 million with 56,130 LF of pipeline implemented.

All costs presented in the following tables reflect 2015 pricing, a Class ¾ level estimates (as defined by AACE International) and contingency factors for construction and surveying, engineering and construction observation of 30 and 18 percents, respectively. The lengths shown are based on data obtained from GIS.

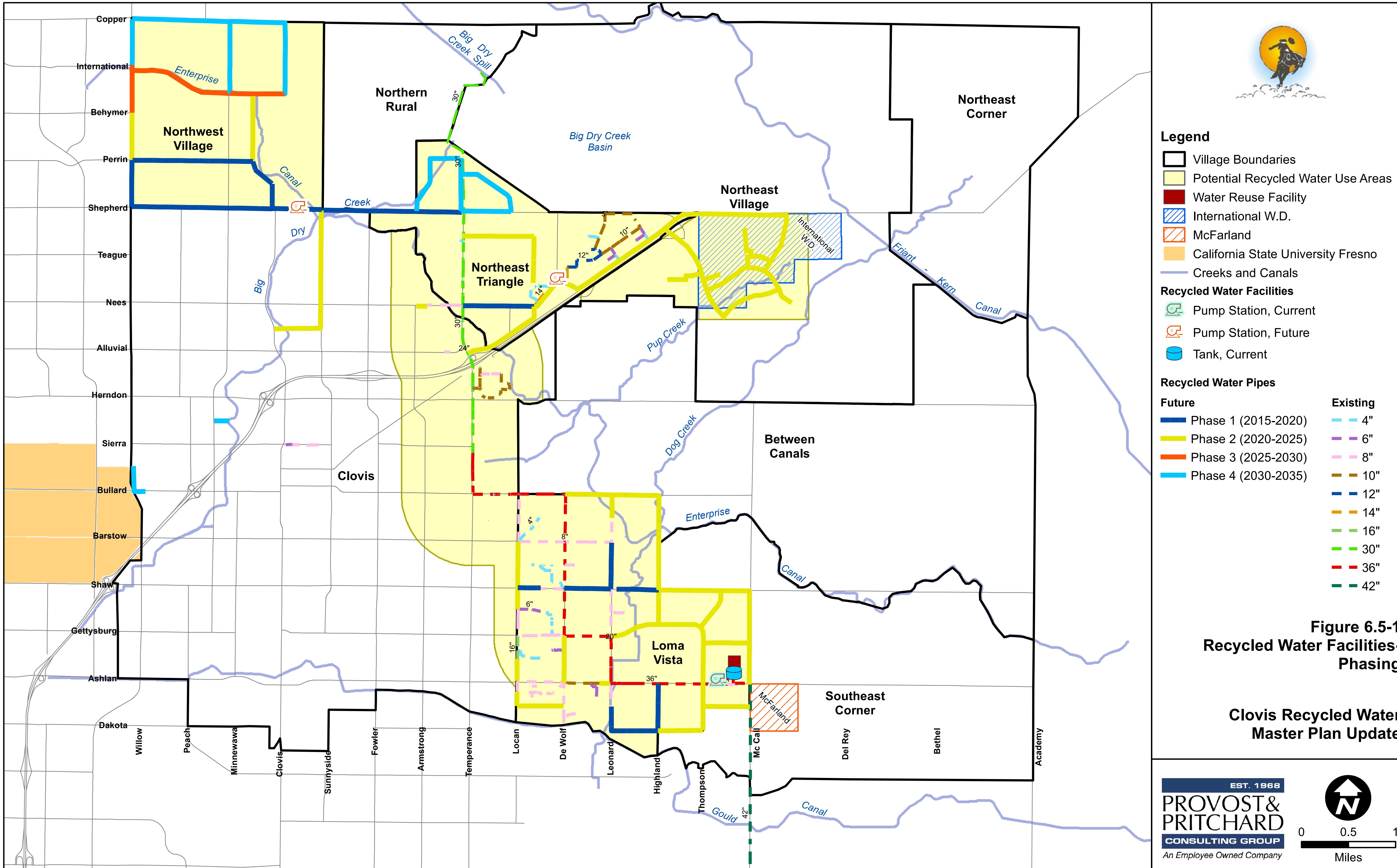

Figure 6.5-1 Recycled Water Facilities-Phasing

2/14/2017: G:\Clovis_City of - 1017\Projects\101715V1-2014 RWMP\GIS\Map\RevisedRptFig\recwater_phasing.mxd

Table 6.5-5: Capital Improvements Phase 1 (2015-2020)

Item No.	Description	From	To	Quantity		Cost
Northwest Village						
PS-1	3,000 gpm Shepherd Ave Pump Station			1	LS	$450,000
P-2	24-in Pipe along Shepherd	N Sunnyside	N Temperance	7,860	LF	$1603,400
P-3	16-in Pipe along Shepherd	N Clovis	N Sunnyside	2,800	LF	$338,800
P-4	10-in Pipe along Shepherd	Minnewawa	N Clovis	2,420	LF	$239,600
P-5	10-in Pipe along Shepherd	Peach	Minnewawa	2,700	LF	$267,300
P-6	10-in Pipe along Shepherd	Willow	Peach	2,800	LF	$277,200
P-7	10-in Pipe along Willow	Perrin	Shepherd	2,700	LF	$267,300
P-8	10-in Pipe along Perrin	Willow	Peach	2,760	LF	$273,200
P-9	10-in Pipe along Perrin	Peach	Minnewawa	2,700	LF	$267,300
P-10	10-in Pipe along Perrin	Minnewawa	16-in Pipe	1,380	LF	$136,600
P-19	16-in Pipe along Enterprise Canal Park & Trailway	Perrin	Shepherd	3,120	LF	$377,500
			Northwest Village Subtotal	***31,240***	***LF***	***$4,498,200***
Northeast Triangle						
PS-33	3,000 gpm Harlan Pump Station			1	LS	$450,000
P-34	16-in Pipe along Nees	Temperance	Locan	2,800	LF	$338,800
P-35	16-in Pipe along Nees	Locan	Owens Mtn Pkwy	1,300	LF	$157,300
			Northeast Triangle Subtotal	***4,100***	***LF***	***$946,100***
Loma Vista						
P-57	8-in Pipe along Leonard	Barstow	Shaw	2,600	LF	$244,400
P-58	8-in Pipe along Leonard	Bellaire	Dakota	1,300	LF	$122,200
P-59	8-in Pipe along Highland	Ashlan	Dakota	2,600	LF	$244,400
P-63	8-in Pipe along Shaw	Locan	Maine	1,300	LF	$122,200
P-64	8-in Pipe along Shaw	De Wolf	Leonard	2,600	LF	$244,400
P-65	8-in Pipe along Shaw	Leonard	Highland	2,600	LF	$244,400
P-70	8-in Pipe along Dakota	Leonard	Highland	2,600	LF	$244,400
			Loma Vista Subtotal	***15,600***	***LF***	***$1,466,400***
			Total	**50,940**	**LF**	**$6,910,700**

Table 6.5-6: Capital Improvements Phase 2 (2020-2025)

Item No.	Description	From	To	Quantity		Cost
Northwest Village						
P-11	10-in Pipe along Willow	E Behymer	Perrin	2,700	LF	$267,300
P-17	16-in Pipe along Enterprise Canal Park	Enterprise Canal	Behymer	1,060	LF	$128,300
P-18	16-in Pipe along Enterprise Canal Park	Behymer	Perrin	2,700	LF	$326,700
			Northwest Village Subtotal	***6,460***	***LF***	***$722,300***
Clovis						
P-28	4-in Pipe along Nees	N Armstrong	Temperance	2,540	LF	$213,400
P-29	24-in Pipe along Sunnyside & Nees	Shepherd	N Marion	7,860	LF	$1,603,400
P-30	6-in Pipe intersect Dry Creek Park	N Clovis	N. Marion	1,400	LF	$126,000
			Clovis Subtotal	***11,800***	***LF***	***$1,942,800***
Northeast Triangle						
P-36	6-in Pipe along trailway (Deauville-Linear Park)	Temperance	Locan	2,800	LF	$252,000
P-37	6-in Pipe along trailway (Deauville-Linear Park)	Locan	Loyola	1,300	LF	$117,000
P-38	6-in Pipe along trail way (Linear Park)	Loyola	E Teague	1,340	LF	$120,600
P-39	6-in Pipe along trail way (Redington Ave)	E Teague	Enterprise Ave	1,300	LF	$117,000
P-40	24-in Pipe along 168	Owens Mtn Parkway	Shepherd	10,000	LF	$2,040,000
P-45	14-in along Owens Mtn Pkwy	Nees	De Wolf	2,000	LF	$228,000
P-46	18-in Trail along 168	Temperance	Owens Mtn Pkwy	5,000	LF	$670,000
			Northeast Triangle Subtotal	***23,740***	***LF***	***$3,544,600***
Loma Vista						
P-47	12-in Pipe along Bullard	De Wolf	Leonard	2,600	LF	$273,000
P-48	12-in Pipe along Bullard	Leonard	Highland	2,600	LF	$273,000
P-49	12-in Pipe along Highland	Bullard	Gettysburg	7,920	LF	$831,600
P-50	12-in Pipe along Gettysburg	Leonard	Thompson	5,280	LF	$554,400
P-51	8-in Pipe along Gettysburg	Thompson	McCall	2,600	LF	$244,400
P-52	12-in Pipe along Thompson	Gettysburg	Ashlan	3,200	LF	$336,000
P-53	10-in Pipe along De Wolf	Gettysburg	Ashlan	2,600	LF	$257,400

Item No.	Description	From	To	Quantity		Cost
P-54	8-in Pipe along Locan	Barstow	Gettysburg	3,960	LF	$372,200
P-55	8-in Pipe along Locan	Holland	Bellaire	2,600	LF	$244,400
P-56	8-in Pipe along Leonard	Bullard	Wrenwood	1,300	LF	$122,200
P-60	8-in Pipe along Thompson	Shaw	Gettysburg	2,000	LF	$188,000
P-61	8-in Pipe along Thompson	Ashlan	Dakota	2,600	LF	$244,400
P-62	8-in Pipe along McCall	Shaw	Ashlan	5,280	LF	$496,300
P-66	8-in Pipe along Shaw	Highland	McCall	5,280	LF	$496,300
P-67	8-in Pipe Along Ashlan	Cordova	Leonard	1,000	LF	$94,000
P-68	8-in Pipe along Sussex	Locan	De Wolf	2,600	LF	$244,400
P-69	8-in Pipe along Sussex	Thompson	McCall	2,600	LF	$244,400
P-71	8-in Pipe along Dakota	Highland	Thompson	2,600	LF	$244,400
			Loma Vista Subtotal	***58,620***	***LF***	***$5,760,800***
<u>Northeast Village</u>						
P-72	6-in Pipe in Future Road	Future Park	Future Road	1,980	LF	$178,200
P-73	6-in Pipe in Future Road	Future Park	Future Road	860	LF	$77,400
P-74	6-in Pipe in Future Road	Shepherd	Future Road	6,490	LF	$584,100
P-75	6-in Pipe in Future Road	Future Road	Future Road	2,690	LF	$242,100
P-76	6-in Pipe in Future Road	Future Road	Future Road	3,590	LF	$323,100
P-77	6-in Pipe in Future Road	Future Park	Future Road	1,700	LF	$153,000
P-78	6-in Pipe in Future Road	Future Park	Future Road	800	LF	$72,000
P-79	6-in Pipe in Future Road	Future Road	Future Road	2,280	LF	$205,200
P-80	6-in Pipe in Future Road	Future Park	Future Road	940	LF	$84,600
P-81	6-in Pipe in Future Road	Future Road	Shepherd	3,440	LF	$309,600
P-82	24-in Pipe along Shepherd	Hwy 168	Future Road	6,480	LF	$1,321,900
P-83	6-in Pipe in Future Road	Future Park	Future Road	1,170	LF	$105,300
			Northeast Village Subtotal	***32,420***	***LF***	***$3,656,500***
			Total	**133,040**	**LF**	**$15,627,000**

Table 6.5-7: Capital Improvements Phase 3 (2025-2030)

Item No.	Description	From	To	Quantity		Cost
Northwest Village						
P-12	10-in Pipe along Willow	International Ave	E Behymer	2,700	LF	$267,300
P-14	10-in Pipe along Enterprise Canal	Willow	Peach	2,940	LF	$291,100
P-15	10-in Pipe along Enterprise Canal	Peach	Minnewawa	2,900	LF	$287,100
P-16	10-in Pipe along Enterprise Canal	Minnewawa	16-in Pipe	1,400	LF	$138,600
P-25	10-in Pipe along Enterprise Canal	Enterprise Canal	Future Park	1,800	LF	$178,200
			Northwest Village Subtotal	***11,740***	***LF***	***$1,162,300***
			Total	**11,740**	**LF**	**$1,162,300**

Table 6.5-8: Capital Improvements Phase 4 (2030-2035)

Item No.	Description	From	To	Quantity		Cost
Northwest Village						
P-13	10-in Pipe along Willow	Copper	International Ave	2,600	LF	$257,400
P-20	10-in Pipe along Copper	Willow	Peach	2,800	LF	$277,200
P-21	10-in Pipe along Copper	Peach	Minnewawa	2,800	LF	$277,200
P-22	10-in Pipe along Copper	Minnewawa	10-in Pipe	3,100	LF	$306,900
P-23	10-in Pipe along Minnewawa	Copper	International Ave	2,700	LF	$267,300
P-24	10-in Pipe along Minnewawa	International Ave	International Canal	1,460	LF	$144,500
P-26	10-in Pipe along future park	Copper	International	2,530	LF	$250,500
P-27	10-in Pipe along future park	International	8-in Pipe	1,460	LF	$144,500
			Northwest Village Subtotal	***19,450***	***LF***	***$1,925,500***
Clovis						
P-31	24-in Pipe along South Clovis Cemetery & N Willow			3,000	LF	$612,000
P-32	Conversion of FID Canal System	Temperance	Willow	19,000	LF	Unknown
			Clovis Subtotal	***22,000***	***LF***	***$612,000***
Northeast Triangle						
P-41	6-in Pipe along Shepherd	Temperance	Locan	2,820	LF	$253,800
P-42	8-in Pipe along N. Temperance	6-in Pipe West Loop	Shepherd	3,000	LF	$282,000
P-43	6-in Pipe West Loop	Temperance	Shepherd	4,860	LF	$437,400
P-44	6-in Pipe East Loop	8-in Pipe Temperance	Shepherd	4,000	LF	$360,000
			Northeast Triangle Subtotal	***14,680***	***LF***	***$1,333,200***
			Total	**56,130**	**LF**	**$3,870,700**

Notes:
1. Item No. 32 is only needed if the City decides to deliver recycled water to CSUF.