5.0 EXISTING RECLAMATION SYSTEM

5.1 PURPOSE

The purpose of this chapter is to provide a description of the City of Lincoln's existing reclamation system and facilities including the existing recycled water distribution system, storage facilities, and recycled water use areas.

This chapter is divided into the following sections:

- Treatment – Lincoln WWTRF
- Storage – Tertiary Storage
- Distribution – Reclamation System
- Disposal – Use Areas and Discharges

5.2 TREATMENT – LINCOLN WWTRF

The City collects and treats wastewater from residents within city limits, serving a population of approximately 47,000 residents and a number of industrial and commercial users. The WWTRF also accepts and treats regional wastewater flow from Placer County's Sewer Maintenance District No. 1 (SMD1) subject to a Joint Exercise of Powers Agreement. The WWTRF Expansion Project (CIP 411) will expand the existing treatment capacity of the WWTRF. The details of this project are described in **Section 2.4**. **Table 5-1** presents the existing hydraulic capacities, as well as those associated with the phased expansion project.

Table 5-1 WWTRF Hydraulic and Treatment Capacities

Hydraulic Capacity					
Item	**Abbreviation**	**Units**	**Existing**	**Phase I Expansion**	**Phase II Expansion**
Average Dry Weather Flow	ADWF	MGD	5.9	7.1	8.0
Average Annual Flow	AAF	MGD	6.9	8.3	9.3
Peak Month Flow	PMF	MGD	10.6	12.4	13.7
Maximum Daily Flow	MDF	MGD	20.3	23.2	25.4
Peak Hour Flow	PHF	MGD	29.5	33.4	36.3

Final effluent from the WWTRF is used to supply the City's reclamation system. Water that isn't used as it is produced is sent to tertiary storage facilities. Before entering the distribution system, water can be re-treated using a dissolved air floatation tank (DAFT) system, which removes algae and other contaminants that may have been introduced during storage. The after start-up and operation of recycled water irrigation at city parks, it was determined that inline filtration and disinfection would further improve water quality at use locations within the City and reduce operation and maintenance activities. Therefore, inline filtration was included at park sites included as part of the Phase II Reclamation Project. The City also plans to include large scale inline filters and disinfection along the primary transmission main serving the City as part of the WWTRF Expansion Project. This additional treatment step helps to reduce growth and build up within the distribution system and reduces the operation and maintenance actives associated with recycled water use in irrigation systems.

5.3 STORAGE – TERTIARY STORAGE

The Tertiary Storage Basins (TSBs) at the WWTRF provide seasonal storage of tertiary treated and disinfected wastewater until disposal is feasible or reclaimed water demand exists. The existing TSBs have a combined capacity of 190 MG, and the on-going WWTRF Expansion Project will provide an additional 142 MG of on-site storage capacity to accommodate the WWTRF Expansion Project for a total storage volume of approximately 332 MG. Recycled water can be pulled from the TSBs during times of high irrigation demand and low effluent production flow.

The required amount of storage volume within the TSBs is determined by the extent that plant effluent flows exceed allowable creek discharges throughout the fall, winter, and spring. A water balance calculation is used to estimate all inflows and outflows within the system. In practice, the primary period of creek discharge occurs in winter months and main period of reclamation occurs in the summer months. To date, the TSB design volume has been minimized based on an effluent management strategy that maximizes discharge and disposal. This approach to design reduces costs associated with additional TSB volume. Historically, this design approach has not considered optimizing or maximizing reclamation potential.

Discharges to the creek are limited in accordance with the WWTRF wastewater discharge permit, Order No. R5-2018-0081 (NPDES No. CA0084476), and the Wastewater Change Petition WW0066 described in **Section 3.4**. The most recent update imposed more stringent receiving water temperature limitations, which may require that the WWTRF store more effluent as opposed to discharging it to Auburn Ravine. The revised receiving water limits were developed without conducting a site-specific study and are based on conservative assumptions. A time schedule order was issued by the RWQCB which provides regulatory coverage and an interim solution to wastewater storage and disposal issues while the City develops a long-term solution. The City intends to conduct a site-specific temperature study before moving forward with costly storage improvements. The RWQCB has approved the use of a nearby Regional Stormwater Basin (RSB) to provide additional storage to comply with the limitations during interim conditions. Further discussion of the time schedule order is provided in **Section 7.4**. A summary of the available tertiary storage capacity at the WWTRF is provided in **Table 5-2**.

Table 5-2 WWTRF Tertiary Storage Capacity

Tertiary Storage Basin	Conditions	Capacity (MG)
TSB 1	Existing	95
TSB 2	Existing	95
TSB 3	Future (WWTRF Expansion Project)	142
RSB	Interim Use (Existing RSB)	70
	Total Tertiary Storage Capacity:	**402**

5.4 DISTRIBUTION – RECLAMATION SYSTEM

The reclaimed water distribution system delivers recycled water from the WWTRF to the City's recycled water use areas. The distribution system consists of approximately twelve miles of transmission pipelines and the Reclamation Booster Pump Station (RBPS).

5.4.1 Pipelines

Portions of the existing distribution system consist of abandoned sewer force mains that were converted and reconstructed to convey recycled water as part of the City's Phase I Reclamation Project.

The existing distribution system can be divided into the following main pipelines:

- Moore Road Pipeline (18-inch): North bound transmission pipeline that extends from the Reclamation Booster Pump Station (RBPS) at the WWTRF, generally running along Moore Road and ending at Joiner Parkway.
- Joiner Parkway Pipeline (12-inch): Transmission pipeline extending north and south in Joiner Parkway from Venture Drive to Del Webb Blvd. The Joiner Parkway Pipeline provides service to the existing use areas within the City.
- Fiddyment Road Pipeline (24-inch): South bound transmission pipeline in Fiddyment Road, that extends from the RBPS at the WWTRF to Athens Avenue. This pipeline serves the County Leased disposal areas to the south and supplies agricultural user to the south-west.
- Machado Farm Pipeline (16- and 14-inch): Transmission pipeline that branches off the Fiddyment Road Pipeline to the west. This pipeline provides service to two agricultural use areas referred to as the Machado Farm.

The Phase I Reclamation Project expanded reclaimed water facilities at the WWTRF and extended the distribution system to sections of Moore Road, Joiner Parkway, and 9th Street, making recycled water available within the City. The overall project featured the construction and conversion of existing of 12-inch and 18-inch pipelines, improvements to the reclaimed booster pump station, and the addition of a surge protection system. The on-going Phase II Reclamation Project further extends the distribution system by adding three new system branches that extend from the Joiner Parkway Pipeline. This project is further described in **Section 2.4**.

5.4.2 Reclamation Booster Pump Station (RBPS)

The Reclamation Booster Pump Station (RBPS) is the only pump station within the distribution system and is located onsite at the WWTRF. The RBPS receives final fully treated effluent (reclaimed water), directly from the Effluent Pump Station (EPS). The RBPS was designed to include six pumps, five of which are currently installed. The design criteria of the existing RBPS is presented in **Table 5-3**.

Table 5-3 RBPS, Existing Equipment Specifications

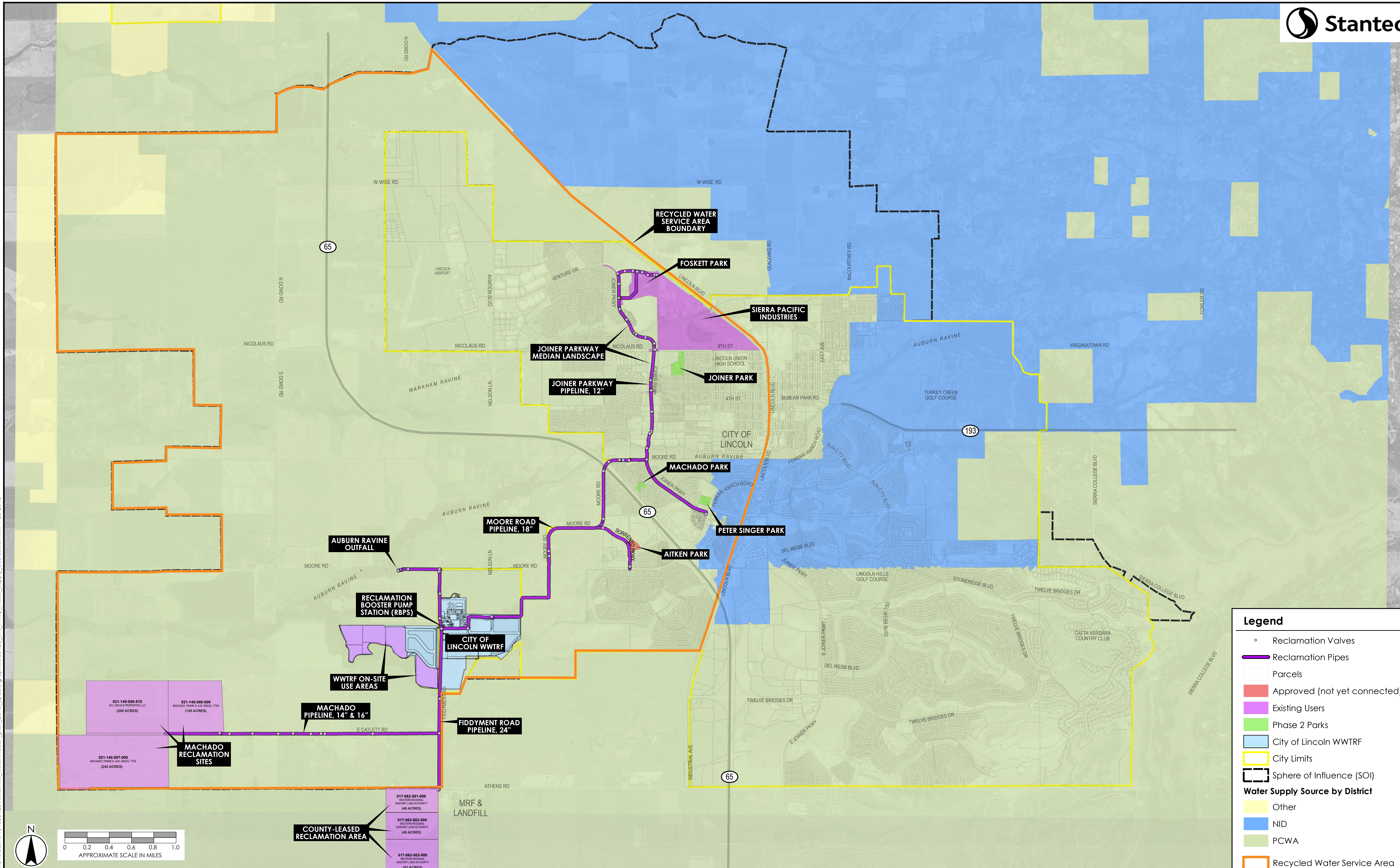
ID #	Pump Name	Manufacturer	Rating (1)	HP
PMP 48111	RBPS Pump 1	Floway	1,100 gpm at 180 TDH	75
PMP 48112	RBPS Pump 2	Floway	1,100 gpm at 180 TDH	75
PMP 48113	RBPS Pump 3	Floway	1,100 gpm at 180 TDH	75
PMP 48114	RBPS Pump 4	Floway	1,100 gpm at 180 TDH	75
PMP 48115	RBPS Pump 5	Floway	1,100 gpm at 180 TDH	75

1. Pump rating corresponds to system curve.

The maximum pumping capacity of the existing RBPS is approximately 7.9 MGD, and the reliable capacity is approximately 6.3 MGD. The reliable capacity is determined under the assumption that one of the five pumps is out of service and the remaining pumps operate in parallel. A 10,000-gallon pneumatic tank is used to regulate pressure and minimize surges in the distribution system. The peak flow recorded at the RBPS in 2017 was 7.8 MGD, which is roughly equivalent to its maximum pumping capacity.

5.4.3 Recycled Water Service Area

The City identified the need to limit the bounds of the recycled water service area and prioritize demands that exist at lower elevations on the east side of the City as part of this Master Plan update. This planning decision considers the relative availability of other non-potable water sources in the eastern portion of the City, and that the elevation and greater distances between potential use sites would make serving these areas cost prohibitive. Additionally, beyond the identified potential uses within the City's General Plan area, no significant recycled water demand potential was identified beyond the SOI boundary to the east of the City. The future limits of the recycled water service area, the existing distribution system, and approximate water service area boundaries of other non-potable water sources are shown on **Figure 5-1**.



City of Lincoln
Reclamation Master Plan

Figure 5-1
Existing Recycled Water Distribution System

5.5 DISPOSAL – USE AREAS AND DISCHARGES

Disposal and reclamation of final effluent occurs through a network of pumps, pipes, and land referred to as the Effluent Distribution System (EDS), generally located within the vicinity of the WWTRF.

5.5.1 Effluent Distribution System (EDS)

The EDS is supplied by the Effluent Pump Station (EPS) with a low-pressure water supply for distribution to downstream facilities, with the exception of some of the on-site irrigation areas which can be supplied directly from the TSBs. The pumped effluent is distributed to the required locations using flow meters, check valves (backflow preventing), and throttling valves, to ensure that the correct quantity is delivered to each destination.

The EDS can deliver effluent to any combination of the following five locations:

1. Auburn Ravine Creek Outfall, surface water discharge
2. On-site Reclamation Area 1, located west of the Maturation Ponds
3. On-site Reclamation Area 2, located south of the Emergency Storage Basins
4. Off-site Reclamation Areas, via the Reclamation Booster Pump Station (RBPS) and reclamation distribution system
5. Tertiary Storage Basins (TSBs), 190 MG used for strategic storage

A schematic of the existing effluent distribution system is shown on **Figure 5-2.**

Effluent from the WWTRF is of sufficient quality to allow unrestricted reuse. The existing permit narrative requires that priority is given to reclamation before discharging effluent to surface waters. There are currently three ways to reuse effluent produced from the WWTRF, on-site irrigation, agricultural irrigation, or off-site City reclamation (demands within the City). Uses of recycled water within the City include irrigation of parks, median landscapes, agriculture, and industrial cooling and process water. During times of minimal recycled water use, recycled water is discharged to Auburn Ravine Creek in accordance with the WWTRF's waste discharge permit.

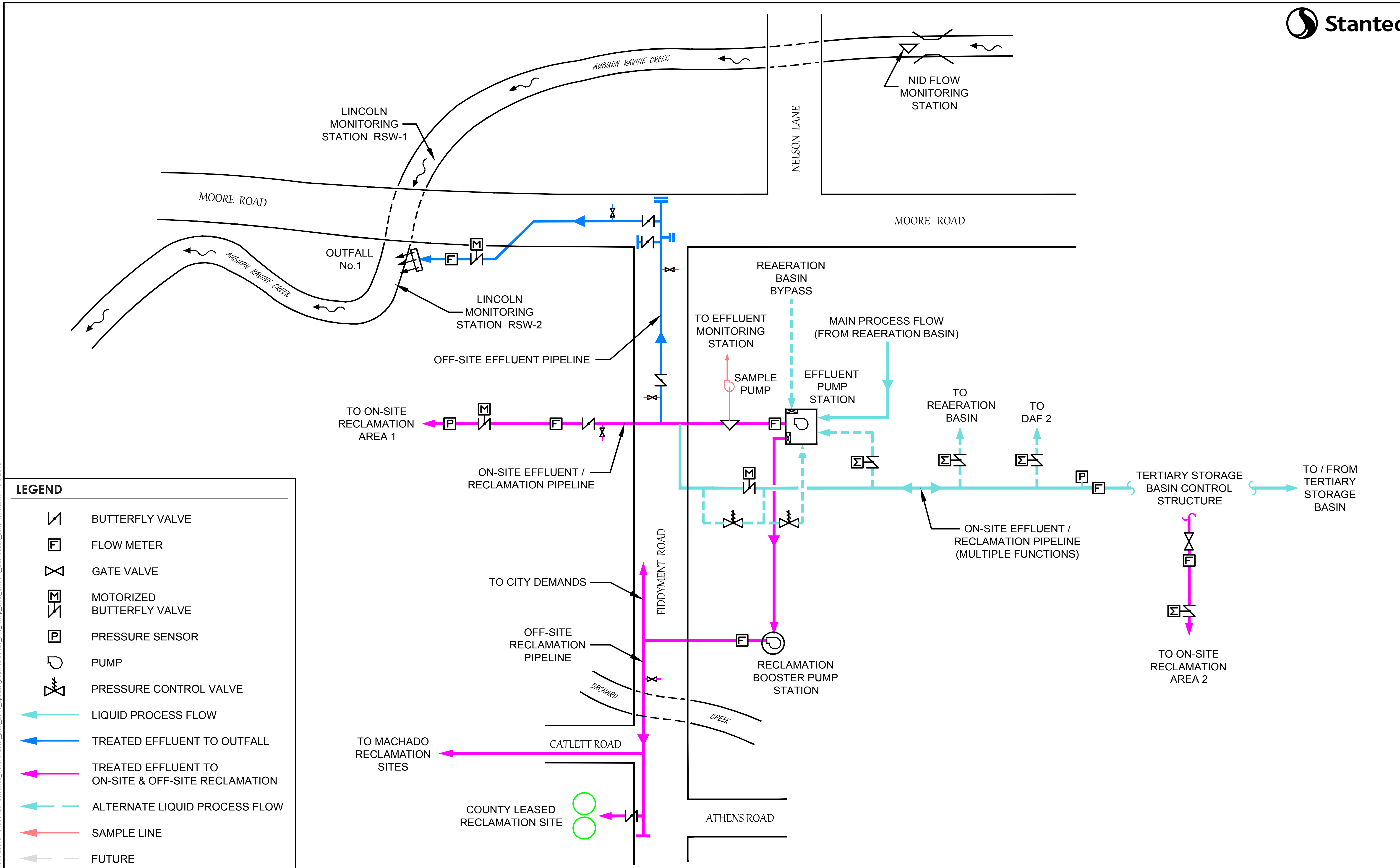


Figure 5-2
Existing Effluent Distribution System Schematic

Existing Use Areas and Disposal Types:

- Discharges to Auburn Ravine
  - Outfall
- On-site Irrigation
  - Warm Springs Irrigation
- Off-site City Reclamation
  - Sierra Pacific Industries (SPI)
  - Joiner Parkway Landscape Medians
  - Use in Construction
  - Foskett Regional Park (pending final connection)
- Agricultural Irrigation
  - County Leased Reclamation Area
  - Machado Farm Irrigation

5.5.2 Auburn Ravine Creek Outfall

The discharge of treated wastewater to Auburn Ravine Creek is regulated under Waste Discharge Requirements Order No. R5-2018-0081 (NPDES No. CA0084476). The quantity of water that is released to the Auburn Ravine outfall is controlled by variable frequency drive (VFD) settings on the EPS pumps and the position of the throttling valve on the discharge pipe. The City's NPDES permit limits effluent releases based on flow rate of the creek, in addition to temperature, pH, and the dissolved oxygen concentration of effluent and the creek. Outfall discharge is critical and the most restrictive constraint to the effluent management. Allowable creek discharge must be optimized when determining allowable discharge flows. Without means to adjust the effluent temperature, temperature-based restrictions have been historically the most limiting constraint. Further discussion of the effluent management and creek discharge is provided in **Section 7.4**.

5.5.3 Off-site City Use Areas

The existing uses of recycled water within the City include: the irrigation of landscape medians along Joiner Parkway, industrial use at Sierra Pacific Industries (SPI), and use in construction, primarily for dust control activities. The City converted Foskett Regional Park, the largest park within the City, to use reclaimed water for irrigation in 2018. The Phase II Reclamation Project will further extend the distribution system, providing recycled water service to three more City parks for landscape irrigation.

5.5.4 Agricultural Use Areas

Recycled water is currently used for agricultural uses at two locations, the County Leased Reclamation Area and the Machado Farm. The City has an existing lease agreement for reclamation on parcels owned by Placer County and a recycled water use contract in place with the Machado Family Farm. The County Leased Reclamation Area consists of three parcels equating to approximately 192 total acres. This area is currently farmed to grow fodder crops. The Machado recycled water agreement allows the use of recycled water on three parcels sharing a common irrigation system. These three parcels equate to approximately 590 gross irrigation acres. The formal recycled water agreement outlines the minimum recycled water usage amount and other infrastructure, cost, compliance, and supply parameters.

5.5.5 On-site Reclamation Areas

Approximately 180 acres of land on the WWTRF property are dedicated to land disposal of effluent. The area of the on-site irrigation fields is shown in **Table 5-4**. Fields 6 and 7 are not currently set up for farming or reclamation. Approximately 160 acres is currently used for land disposal.

Table 5-4 WWTRF On-Site Reclamation Areas

On-site Reclamation Field	Approximate Area (Acres)
F1	20.2
F2	21.5
F3	27.0
F4A	9.4
F4B	4.3
F5	26.6
F6 (1)	33.1
F7 (1)	41.8
Total On-site Reclamation Area:	183.9 (2)

1. Fields 6 and 7 are not currently set up for proper farming and therefore cannot be counted as reliable reclamation land area.
2. Total reliable on-site reclamation area is approximately 110 acres.

Reclaimed water may be applied to the on-site reclamation fields from April through October at a rate that does not exceed the agronomic rate of the planted vegetation. During the growing seasons, the operators must carefully coordinate water delivery with the farming operation to ensure that crops are not adversely affected by water shortages or over application.

6.0 RECYCLED WATER DEMANDS

6.1 PURPOSE

This chapter presents a discussion of the City recycled water usage data and recycled water demand projections used in the development of this Master Plan. The City's historical recycled water usage data is presented first, followed by a discussion of the recycled water demand factors, peaking factors, and other assumptions used to estimate the recycled water demand potential of future recycled water users. A recycled water market assessment is also presented to discuss previously considered potential recycled water demands. This chapter concludes with a summary of the recycled water demands and projections.

This chapter is divided into the following sections:

- Existing Recycled Water Use
- Recycled Water Demand Types and Peaking Factors
- Future Recycled Water Demand Estimates
- Market Assessment
- Summary of Recycled Water Demands

6.2 EXISTING RECYCLED WATER USE

The locations of the City's existing recycled water use areas and the existing reclamation system have been presented on **Figure 5-1**. Off-site City reclamation activities were initiated in 2017 with the connection of the irrigation system within the landscape medians along Joiner Parkway and the approval of Sierra Pacific Industries (SPI) for industrial use. The existing reclamation meter records and flow data are limited due to the short duration of service. Data from 2017 is presented in **Table 6-1**.

Table 6-1 Historical Recycled Water Use (2017)

Recycled Water User	Average Annual Use (MGD)	Maximum Month Use (MGD)	Total Annual Use (AF/yr)	Month of Maximum Use (2017)
On-site Irrigation (Warm Springs Irrigation)	0.09	0.64	101	August
County Leased Reclamation Area	0.30	1.01	333	September
Machado Farm Irrigation	1.28	4.72	1,433	July
Off-site Reclamation (SPI and Joiner Parkway Medians)	0.04	0.17	46	June
Total Reclamation:	**1.71**	**5.78**	**1,913**	**July**
Discharges to Auburn Ravine	2.89	8.16	3,235	January

The total wastewater volume treated at the WWTRF in 2017 was 1,911 MG (5,864 AF), of this volume approximately 1,277 MG (3,919 AF) was contributed by the City of Lincoln. Approximately 55% of effluent flow was directed to Auburn Ravine, 33% was directed to the RBPS, 2% was sent to on-site irrigation, and 10% was directed to storage. The RBPS supplied approximately 590 MG (1,812 AF) of recycled water to SPI, the Joiner Parkway Medians, construction uses, the Machado Farm, and the County Leased Reclamation Area. The Machado Farm took approximately 80% of the recycled water sent to the RBPS. Based on discussions with WWTRF operators, existing agricultural users are typically supplied on a 24-hour basis during MMD conditions.

The average day demand (ADD) in 2017 was approximately 1,900 AF/yr or 1.71 MGD. **Figure 6-1** shows the seasonal distribution of demand for the existing users based on monthly demand averages for 2017. As shown in this figure, the demands increase significantly during the summer due to higher temperatures and less precipitation. The Machado Farm is currently the largest user of recycled water.

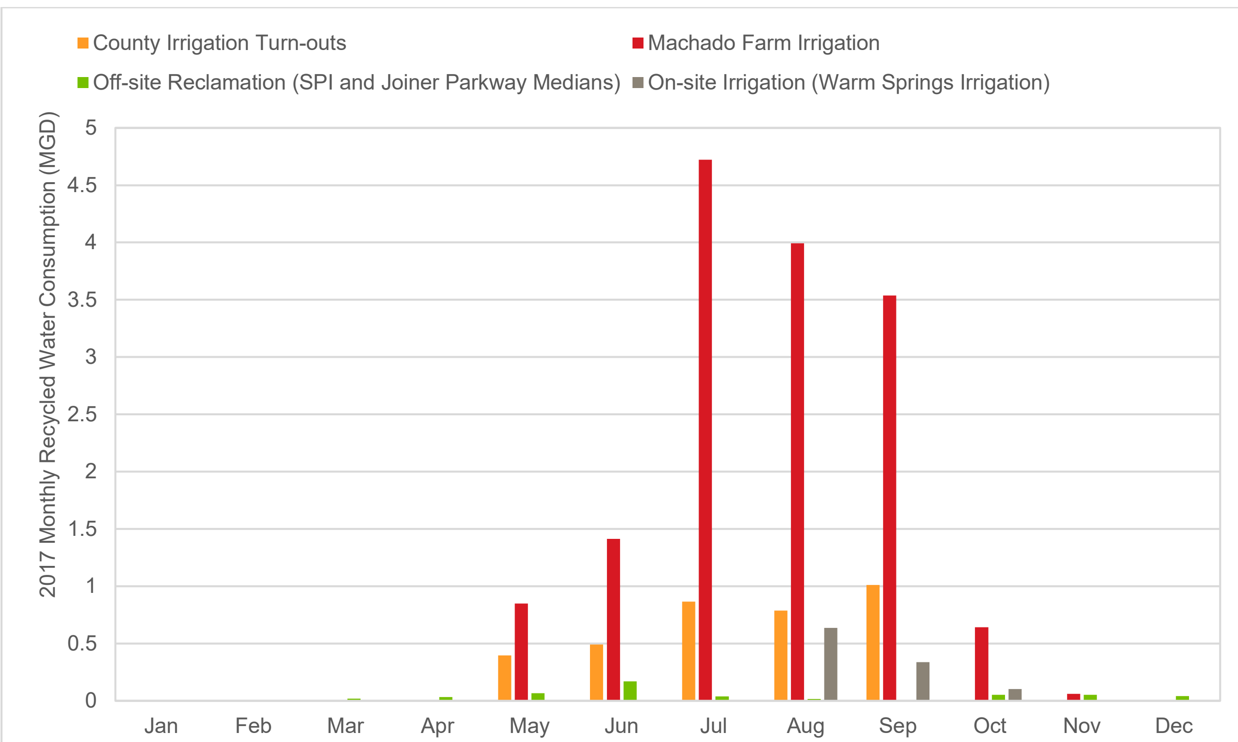


Figure 6-1 2017 Seasonal Demand Distribution for Existing Users

6.3 RECYCLED WATER DEMAND TYPES AND PEAKING FACTORS

This section discusses the water demand factors and peaking factors that were used to approximate future recycled water demands and operating conditions within the distribution system. The definition and application of these factors is discussed below.

6.3.1 Average Daily Demand (ADD)

The Average Daily Demand (ADD) represents the average demand in one calendar year or the total annual demand divided by 365 days. This value is typically derived from water meter records or approximated based on per-acre or per-capita recycled water demand factors. A water demand factor is defined as the estimated amount of water usage per area of a certain land use type or per person. These demand factors can be used to estimate the ADD for development areas by multiplying the demand factor (gpm/acre) by the total area of the corresponding land use designation or population. The City has provided base recycled water demand estimates for areas within its SOI and historical potable water meter records for users that will convert to recycled water use in the future. City provided the demand estimates used in this Master Plan as opposed to developing demand factor-based estimates.

6.3.2 Irrigation Requirements

Landscape irrigation requirements for the City of Lincoln were calculated based on evapotranspiration (ET) and average rainfall data. The amount of irrigation water required by the potential customers is directly dependent on precipitation and evapotranspiration quantities in the region and the efficiency of the irrigation system. To calculate the amount of ET occurring in the study area, the following formula is used: $ET_L = K_L * ET_0$

ET_L = Evapotranspiration of Landscaped Areas (inches)

K_L = Crop Coefficient (landscaping/turf grass/etc.)

ET_0 = Reference Evapotranspiration (inches)

The reference evapotranspiration for the area was developed based on an average of those provided for neighboring communities (Auburn, Davis, and Fair Oaks), obtained from the California Irrigation Management Information System (CIMIS). A crop coefficient of 0.7 was used, corresponding to a mixture of cool season and warm season turf grass species. The landscape coefficient was multiplied by the reference evapotranspiration to determine the average landscape evapotranspiration for the area. The amount of precipitation, evapotranspiration, and calculated irrigation requirement for landscape irrigation in the City of Lincoln, are listed in **Table 6-2**. As shown on **Figure 6-2**, the net annual average landscape irrigation requirement in the study area is approximately 30.9 inches per year or about 2.7 feet per year. Based on this data, recycled water demand factor was estimated as 2.7 AF/yr for each irrigated acre, which is equivalent to 2,400 gpd/acre.

Table 6-2 Average Annual Landscape Irrigation Requirements

Month	Average Precipitation (inches) (1)	Evapotranspiration (inches) (2)	Net Irrigation (inches) (3)	Net Irrigation Requirement (%) (4)
Oct	1.3	2.6	1.5	5%
Nov	3.0	1.3	0.5 (5)	2%
Dec	4.2	0.8	0.0	0%
Jan	4.8	0.9	0.0	0%
Feb	4.5	1.4	0.0	0%
Mar	3.7	2.4	0.5 (5)	2%
Apr	1.6	3.4	2.2	7%
May	0.9	4.6	4.4	14%
Jun	0.2	5.4	6.1	19%
Jul	0.0	5.7	6.7	21%
Aug	0.0	5.1	6.0	19%
Sep	0.4	3.8	4.0	13%
Total	**24.6**	**37.4**	**30.9**	**100%**

1. Source: Sacramento 5 ESE, NCDC 1981-2010 Monthly Normal Rainfall, scaled to an average annual total of 24.7 inches, Lincoln average rainfall total based on FERIX data for 1947-2005.
2. Source: data was obtained from the California Irrigation Management Information System (CIMIS). ET values are adjusted for the landscape irrigation coefficient (K_L = 0.7).
3. [Evapotranspiration – Rainfall] /0.85, Where 0.85 = 85% Irrigation Efficiency Factor
4. Current month net irrigation requirement divided by annual total irrigation requirement.
5. Added to account for irrigation that occurs in the spring and fall since storm events are not evenly distributed throughout the season.

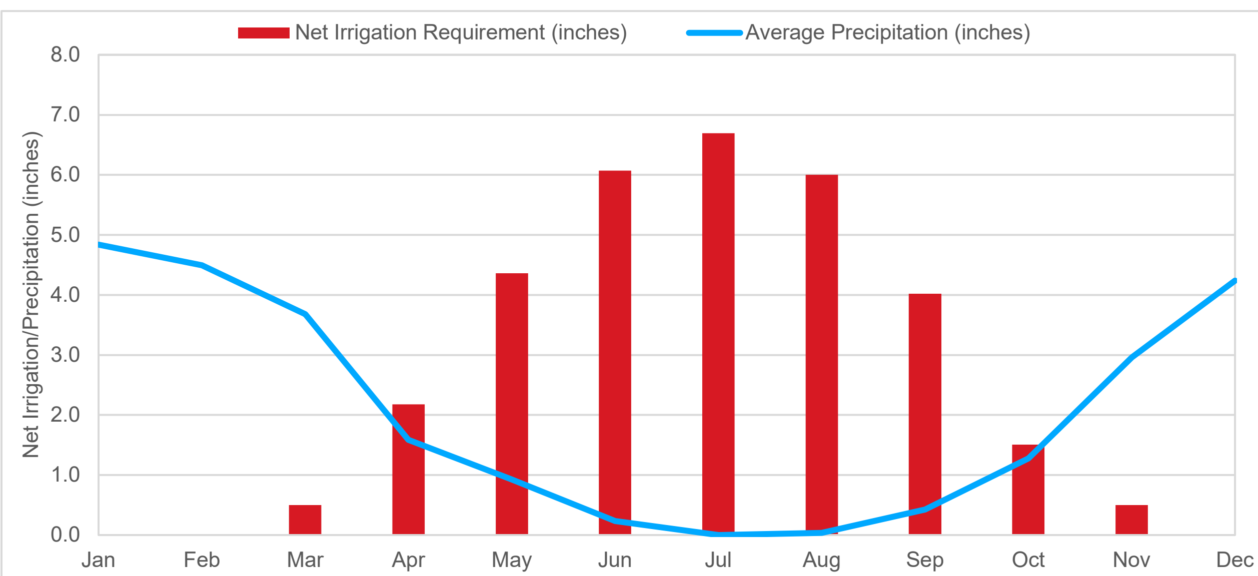


Figure 6-2 Net Irrigation Requirement (City of Lincoln)

6.3.3 Maximum Month Demand (MMD)

The Maximum Month Demand (MMD) is the average demand during the peak month of recycled water use. The MMD is often considered the most representative demand condition due to high irrigation use and variability in annual demands. In recycled water systems, the Maximum Day Demand (MDD) is roughly 10% higher than the MMD because irrigation sprinkler systems are typically only changed on a seasonal basis, rather than a daily basis, unless moisture sensors are utilized. For purposes of this Master Plan, it will be assumed that MMD and MDD are equivalent. Hence, the MMD/ADD ratio is used to estimate the MDD that the City needs to plan for.

During hot summer days, water use is typically higher than on a cold winter day because of increased irrigation demands. Peaking factors are typically used to estimate water demands for conditions other than ADD, accounting for fluctuations in demands on a seasonal or hourly basis. Common peaking factors include those used to estimate maximum day demands (MDD) and maximum month demands (MMD).

The data listed in **Table 6-2** was used to estimate the seasonal variation in landscape demands (and it is assumed that the majority of the reclaimed water demands will follow an agronomic cycle, though industrial demands may vary from this assumption). The irrigation season runs from March through November, a period of nine months. The peak irrigation demand typically occurs in July, equating to approximately 6.7 inches, which is approximately 2.5 times higher than the average irrigation requirement of 2.7 inches (31.8 inches/12 months). Based on this ratio, the MMD peaking factor of 2.5 is used in this Master Plan.

6.3.4 Peak Hour Demand (PHD)

Variations in water demands also occur during a 24-hour period, representing the rate of application of MMD flows throughout the day. Recycled water systems with high irrigation use, typically experience peak demand periods late at night through the early morning hours (to limit impacts to land uses during the day, such as at City parks due to sprinkler operations). Diurnal curves are used to represent the variations in recycled water demand that occur throughout the day. Peaking factors that result from these diurnal curves are dependent on the typical recycled water usage patterns associated with these irrigation cycles. For purposes of this Master Plan it was assumed that typical irrigation cycles would have an 8-hour duration, resulting in a peaking factor of 3.0 when applied to the MMD. Demands associated with industrial uses and use in construction were assumed to have a 24-hour supply cycle, resulting in a peaking factor of 1.0.

A summary of demand types and peaking factors is presented in **Table 6-3**.

Table 6-3 Demand Types and Peaking Factors

Demand Type	Abbreviation	Peaking Factor	Calculation Method
Average Day Demand	ADD	NA	Annual Demand Volume/ 365 days
Maximum Month Demand	MMD	PF = 2.5	MMD = ADD x 2.5
Maximum Day Demand	MDD	PF = 2.5	MDD = ADD x 2.5 MMD = MDD
Peak Hour Demand (1) 8-hour supply cycle 12-hour supply cycle 24-hour supply cycle	PHD	PF = 3.0 PF = 2.0 PF = 1.0	PHD = MMD x 3.0 or ADD x 7.5 PHD = MMD x 2.0 or ADD x 5.0 PHD = MMD x 1.0 or ADD x 2.5

1. 8-hour supply cycle assumed for irrigation demands and 24-hour supply cycle assumed for agricultural demands.

6.4 FUTURE RECYCLED WATER DEMAND ESTIMATES

The future recycled water distribution system will supply the demands of off-site reclamation areas within the City's recycled water service area. Estimates of these future demands have been developed for the following types of users:

Existing Users [3]: Users that currently use, or are entitled to use recycled water

Future Users [4]: Users that will convert to recycled water to meet non-potable demands

New Users [5]: Users that will use recycled water, but have not yet been developed

The future reclamation system has been planned to supply potential demands that exist at an elevation of approximately 160 feet above sea level or less. This portion of the City planning area is generally bounded by Lincoln Boulevard to the east, and the City's SOI boundary to the west. For the purposes of this Master Plan, it is assumed that non-potable demands within the City's recycled water service area will be supplied by the reclamation system.

Demands outside of the City's recycled water service area, but within the City's SOI are assumed to be supplied by the other non-potable supply sources within the City's portfolio. Therefore, delivery of recycled water is focused on the City's west side, where greater localized demand within the City planning area occurs and service can be extended to potential new uses west of the City. The service area may be expanded to the east in the future if significant demand and benefit develop. However, higher head pumps will be needed to overcome the higher elevation at the east.

[3] The demands of existing agricultural users and on-site reclamation will be replaced by those of the City's SOI upon its development. Therefore, these demands are excluded from long-term and buildout development scenarios.
[4] Existing entities currently supplying non-potable demands with potable water.
[5] Planned development areas existing within the City's SOI.

Estimates of the potential recycled water demands of these users have been developed for purposes of this Master Plan. Future demands and the City's recycled water service area are described in this section.

6.4.1 Existing Users

The City's existing recycled water use areas, users, and uses have been described in **Section 5.4** and **Section 6.2**. Existing recycled water users and associated demands are presented in **Table 6-4**. Existing reclamation use types consist of agricultural uses, WWTRF on-site reclamation, and off-site City reclamation (irrigation and industrial use). It has been assumed that the user agreements and legal contracts of agricultural users will expire, and their demands will be replaced by City reclamation demands with the development of Village 6 and buildout of the SOI. It is also assumed that WWTRF on-site irrigation will be phased out as the WWTRF expands and more land area is needed for treatment facilities. This leaves only off-site City reclamation demands to be distributed and supplied through the City's reclamation system, under buildout development conditions.

Existing recycled water demand estimates for City reclamation areas were evaluated to ensure they are representative of future development conditions. Recycled water is currently stored in tanks and impoundments, used in industrial cooling towers, and used to hose down the log deck at Sierra Pacific Industries (SPI). To be conservative, it has been assumed that these demands may increase under future conditions.

Foskett Regional Park is a large park with high irrigation needs, the existing irrigation system limits the amount of water that can be applied at any given time and as a result the park is irrigated for a longer duration. Based on potable water meter records for the park from 2013 and 2015, it uses approximately 190 gpm during the peak month of irrigation. The future MMD for Foskett Regional Park assumes that improvements will be made to the existing irrigation system, which will allow the park to be irrigated more efficiently with a shorter supply cycle, resulting in a higher demand rate. The MDD estimates associated with irrigation of the Joiner Parkway median landscaping, Aitken Park, and Phase II Parks were developed based on historical potable water meter records and are assumed to be representative of future conditions.

Table 6-4 Summary of Existing City Reclamation Demands (within City)

Existing Recycled Water User	Use Type	PF	Existing MMD [1] (gpm)	Future MMD (gpm)	Future PHD (gpm)
Sierra Pacific Industries (SPI)	Industrial	1	130	280	280
Joiner Parkway Irrigation	City Irrigation	3	20	20	60
Foskett Regional Park	City Irrigation	3	190 [2]	280	840
Aitken Park	City Irrigation	3	10 [2]	10	30
Phase II Parks, upon connection	City Irrigation	3	*0*		
Joiner Park				50	150
Machado Park				20	60
Peter Singer Park				55	165
Use in Construction	Construction	1	Delivered as needed and available		
Total			**150 [3]**	**715**	**1,585**

1. Existing MMD were developed from potable water meter records from the maximum month of use in 2013 and 2015. It should be noted that State mandated water restrictions as a result of persistent drought, were in effect. SPI demand from Use Area Report.
2. Entitled but are not yet connected, Foskett Regional Park was connected during the development of this Master Plan.
3. Total excludes recycled water demands that are entitled but are not yet connected and are not currently using recycled water. Actual MMD for these areas, observed at the RBPS was 118 gpm, June 2017.

6.4.2 Existing Entities to Convert to Recycled Water

The City of Lincoln provided irrigation water meter records for entities within the City that may convert to use recycled water in the future. These future users include cemeteries, schools, parks, public facilities, streetscape and other City owned or operated facilities within City limits. The historical potable water meter records were used to estimate the potential recycled water demands of these users. Future MMD estimates were established from data recorded during the month with the highest total potable water use of 2013 and 2015. Specific demands established in the 2004 Reclamation Master Plan were used for Lincoln High School and the Lincoln Crossings subdivision development. A figure showing the location of these demands is presented as **Figure 6-3.** To provide a conservative estimate of future conditions, these demands were assumed to be associated with irrigation, resulting in the use of a peaking factor of 3.0 throughout. These future demand estimates are summarized in **Table 6-5**.

Table 6-5 Future Reclamation Demands of Existing Entities

Recycled Water Users	Use Type	PF	Future MMD (gpm)	Future PHD (gpm)
Cemeteries	City Irrigation	3	50	150
Schools	City Irrigation	3	50	150
Parks	City Irrigation	3	60	180
Facilities	City Irrigation	3	10	30
Streetscape	City Irrigation	3	60	180
Other Depts.	City Irrigation	3	40	120
Lincoln Crossings (1)	City Irrigation	3	350	1,050
Lincoln High School (1)	City Irrigation	3	110	330
Total			**730**	**2,190**

1. These demands were established as part of prior planning, remaining demands were established using historical potable water meter records from the highest month of use during 2013 and 2015.

A detailed list of the included entities and future demand estimates is provided in **Appendix B**.

6.4.3 New Recycled Water Users

New recycled water user demands can be defined as those associated with the Villages and SUDs within the SOI that have yet to be developed or are currently developing. Demand estimates for these areas were provided by the City. These demands are assumed to have an irrigation demand pattern, resulting in a peaking factor of 3.0. A summary of new recycled water user demands is provided in **Table 6-6**.

Table 6-6 Summary of SOI Area Demands

SOI Area	Use Type	PF	Future MMD (gpm)	Future PHD (gpm)
Village 1 (1)	City Irrigation	3	0	0
Village 2 (1)	City Irrigation	3	0	0
Village 3 (1)	City Irrigation	3	0	0
Village 4	City Irrigation	3	405	1,215
Village 5/SUD-B	City Irrigation	3	1,140	3,420
Village 6	City Irrigation	3	605	1,815
Village 7	City Irrigation	3	700	2,100
SUD-A	City Irrigation	3	205	615
SUD-C	City Irrigation	3	0	0
Total			**3,055**	**9,165**

1. Village lies outside the bounds of the recycled water service area

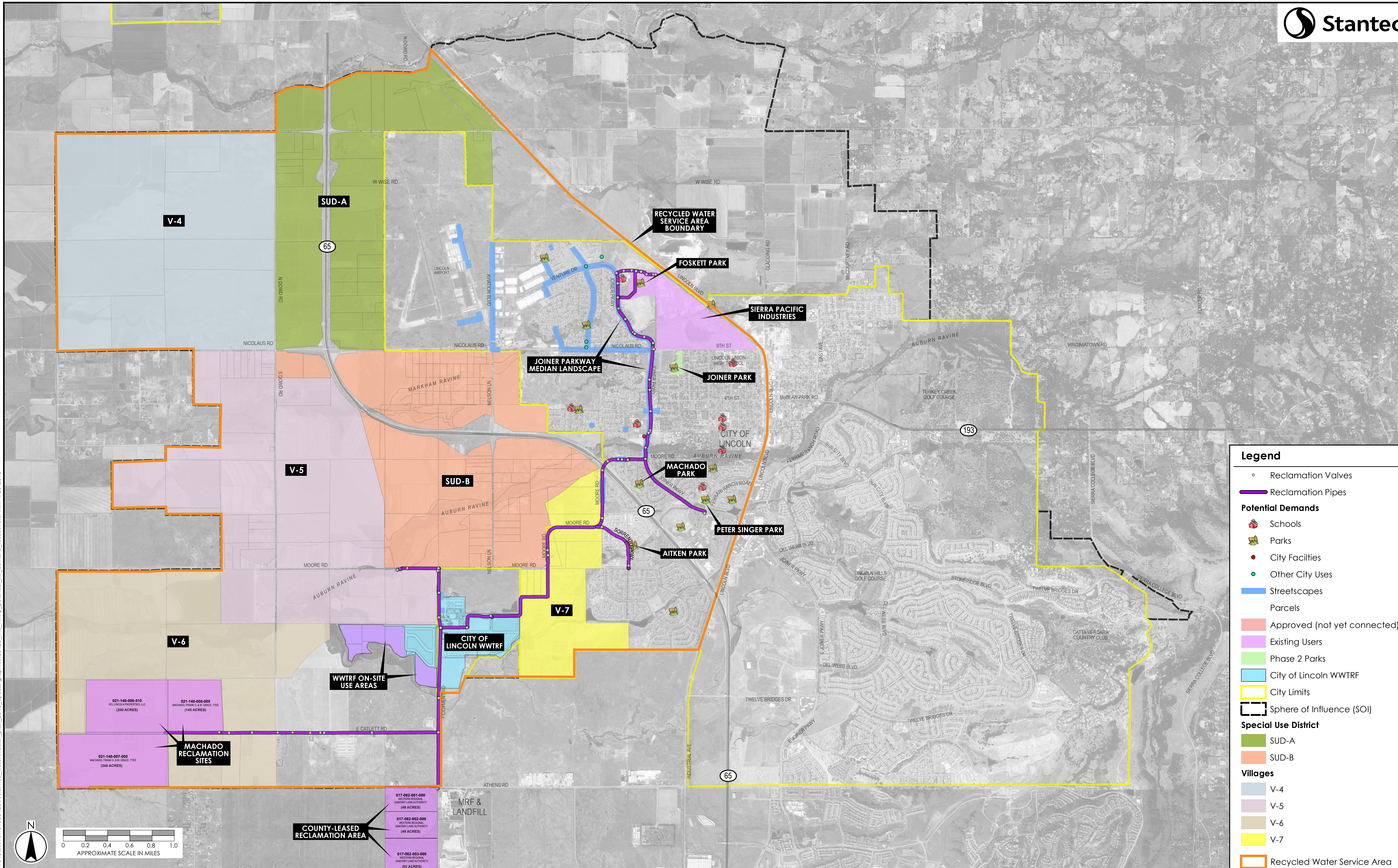


Figure 6-3
Recycled Water Demand Locations

6.5 MARKET ASSESSMENT

The City's 2004 Reclamation Master Plan considered demands that have been excluded in this Master Plan update. The demands previously considered are summarized in **Table 6-7,** including those associated with golf courses within the City, the Placer County Regional Landfill and Material Recovery Facility (MRF), the Rio Bravo Power Plant, the Formica Company, and Livingston Concrete.

Golf courses that had previously been considered to potentially use recycled water include the Twelve Bridges Golf Course, the Lincoln Hills Golf Course, the Del Webb 9-hole Course, and the Turkey Creek Golf Course. These golf courses are considered suitable for recycled water use but lie outside of the revised City service area and have already secured other water sources for irrigation. The Nevada Irrigation District (NID) supplies raw water for irrigation to the Turkey Creek Golf Course and the Del Webb Golf Course. Placer County Water Authority (PCWA) has individual raw water supply contracts with both the Twelve Bridges Golf Course and Del Webb Golf Course. For purposes of this Master Plan, it is assumed that these golf courses will continue to be supplied by raw water in the future due to their relatively high elevation and high potential demands.

The Placer County Regional Landfill and MRF, Rio Bravo Power Plant, Formica Company, and Livingston Concrete have all been omitted from this Reclamation Master Plan because they are located within Placer County, south of the City's existing and future boundaries. Demands within the City of Lincoln will take priority over those outside of city limits and the SOI. It should be noted that these facilities may have the opportunity to be supplied with recycled water from the WWTRF in the future, depending on supply availability. Evaluating the infrastructure needed to supply these demands is outside of the scope of this Master Plan. A summary of the demands of users previously considered is presented in **Table 6-7**.

Table 6-7 Excluded Demands Previously Considered (2004 Master Plan)

Recycled Water User	Use Type	PF	MDD (gpm)	Notes
Landfill MRF	Industrial	1	76	Outside City Bounds
Power Plant	Industrial	1	278	Outside City Bounds
Formica Company	Industrial	1	347	Outside City Bounds
Livingston Concrete	Industrial	1	35	Outside City Bounds
Twelve Bridges	Irrigation	1	750	Assumed to be out
Del Webb/ Lincoln Hills	Irrigation	3	1,250	Assumed to be out
Turkey Creek	Irrigation	1	381	Assumed to be out
65 Bypass	Irrigation	2	556	Assumed to be out
Total			**3,673**	

The City's 30% Reclamation Master Plan was developed for purposes of understanding potential reclamation system facility costs and considered all potential demands that could be converted to use recycled water within the City and its SOI, including those that exist outside of the revised recycled water service area. The recycled water service area was reduced to limit pumping requirements within the reclamation system and due the relative availability of other non-potable water sources to these areas. Potential recycled water demands within the City that had been considered in the 30% Master Plan but have been excluded herein are summarized in **Table 6-8**.

Table 6-8 Potential Demands Outside of the Recycled Water Service Area (Included in the 30% Reclamation Master Plan)

Recycled Water User	MMD (gpm)
School	130
Park	153
Facilities	24
Streetscape	135
Other Depts	8
Village 1	601
Village 2	575
Village 3	588
Total	**2,214**

6.6 SUMMARY OF RECYCLED WATER DEMANDS

The MMD estimate of each recycled water user considered in this Master Plan is presented in **Table 6-9**, under existing and future conditions.

Table 6-9 Summary of Existing and Future MMD

Recycled Water Demand	Use Type	PF	Existing Demand MMD (gpm)	Future Demand MMD (gpm)
Sierra Pacific Industries (SPI)	Industrial	1	130	280
Joiner Parkway Irrigation	City Irrigation	3	20	20
Foskett Regional Park	City Irrigation	3	190	280
Aitken Park	City Irrigation	3	10	10
Phase II Parks	City Irrigation	3	0	125
Lincoln Crossing	City Irrigation	3	0	350
Lincoln High School	City Irrigation	3	0	110
Cemeteries	City Irrigation	3	0	50
Schools	City Irrigation	3	0	50
Parks	City Irrigation	3	0	60
Facilities	City Irrigation	3	0	10
Streetscape	City Irrigation	3	0	60
Other Depts.	City Irrigation	3	0	40
Village 4	City Irrigation	3	0	405
Village 5/SUD-B	City Irrigation	3	0	1,140
Village 6	City Irrigation	3	0	605
Village 7	City Irrigation	3	0	700
SUD-A	City Irrigation	3	0	205
County Leased Reclamation Area	Agriculture	1	1,600	0
Machado Properties	Agriculture	1	2,800	0
Total			**4,750** (1)	**4,500**

1. The existing total demand includes those from entitled parks.

This Master Plan considers four scenarios which represent varying levels of development within the City's planning area. These scenarios are simulated within the hydraulic model. The model results are then used to evaluate the needs of the recycled water distribution system and associated facilities under various levels of development.

Existing City System: The existing system scenario considers existing recycled water demands (SPI, Joiner Parkway Irrigation, Machado, and County Leased Reclamation Area) and the existing state of the reclamation system.

Near-Term Development: The near-term development scenario considers near-term planned improvements to the recycled water distribution system. This scenario represents system conditions upon completion of the Phase II Reclamation Project. The demands of entitled parks and those associated with the Phase II Reclamation Project are added to the existing system simulation. Off-site agricultural demands are still included in this scenario.

Long-Term Development: The long-term development scenario considers the addition of demands and infrastructure to support the connection of potential recycled water users within city limits, referred to as "existing entities to convert to recycled water" and described in **Section 6.4.2**. Future user demands are also included for developing areas of within the SOI for which a specific plan has been drafted. These demands include those of Village 5/SUD-B and Village 7. It is assumed that off-site agricultural demands have been phased out under this scenario.

Buildout of the General Plan: This scenario considers full buildout of the City's General Plan area and reclamation system. The future demands of existing users, existing entities to convert to recycled water use, and future recycled water users are included. The results of this scenario are used as a basis for planning the future reclamation system.

A summary of PHDs for each development scenario is presented in **Table 6-10**.

Table 6-10 Development Scenarios and PHD

Recycled Water Demand	Existing City System PHD (gpm)	Near-Term Development PHD (gpm)	Long-Term Development PHD (gpm)	Buildout of General Plan PHD (gpm)
Sierra Pacific Industries (SPI)	130	280	280	280
Joiner Parkway Irrigation	60	60	60	60
Foskett Regional Park		840	840	840
Aitken Park		30	30	30
Phase II Parks		375	375	375
Cemeteries			150	150
Schools			150	150
Parks			180	180
Facilities			30	30
Streetscape			180	180
Other Depts			120	120
Lincoln Crossing			1,050	1,050
Lincoln High School			330	330
Village 4				1,215
Village 5/SUD-B			3,420	3,420
Village 6				1,815
Village 7			2,100	2,100
SUD-A				615
County Leased Reclamation Area	1,600 (1)	1,600 (1)		
Machado Properties	2,800 (1)	2,800 (1)		
Total	**4,590**	**5,985**	**9,295**	**12,940**

1. Existing agricultural users have a 24-hour supply cycle during MMD conditions.

7.0 RECYCLED WATER SUPPLY CHARACTERISTICS AND FACILITIES

7.1 PURPOSE

The purpose of this chapter is to identify the available recycled water supply and the associated storage capacity needs required to meet the projected water demands identified in **Chapter 6.0**. This chapter also provides discussion of recycled water delivery, WWTRF operations, and provides effluent management strategy recommendations.

This chapter is divided into the following sections:

- Recycled Water Supply Needs
- Recycled Water Supply Sources
- WWTRF Effluent Management
- Recycled Water Storage and Delivery
- Supply and Storage Recommendations

7.2 RECYCLED WATER SUPPLY NEEDS

The recycled water supply required to meet existing user demands is approximately 2.7 MGD for ADD and 6.8 MGD for MMD, including agricultural users. This results in approximately 3,065 acre-feet (AF) of recycled water required annually to meet demands under existing conditions. (Existing supply needed to support demands within the City are 0.2 MGD for AAD and 0.5 MGD for MMD).

The future reclamation system has been planned to supply potential demands that exist at an elevation of approximately 160 feet above sea level or less and are generally bounded by Lincoln Boulevard to the east, and the City's SOI boundary to the west. The recycled water distribution system has been planned to supply demands within the City (west of Lincoln Boulevard), SUD-A, Village 4, Village 5/ SUD-B, Village 6, and Village 7. This excludes the demands of potential users within the City located east of Lincoln Boulevard, and those within Village 1, Village 2, and Village 3. The future recycled water supply rate needed at buildout of the recycled water service area is estimated as 2.6 MGD for ADD and 6.5 MGD for MMD. Future supply needs include the potential future demands that were identified in **Chapter 6.0**. This results in approximately 2,900 AF of recycled water needed annually at buildout.

7.3 RECYCLED WATER SUPPLY SOURCES

Final effluent from the City's WWTRF is used to supply the reclamation system. The WWTRF is considered a regional wastewater treatment and reclamation facility, treating wastewater collected from within Lincoln's city limits and Placer County's SMD1 service area. The WWTRF is expected to provide service to future development within the City's SOI and accept additional wastewater flow from other regional entities, including the City of Auburn and Placer County's Bickford Ranch development. The existing agreement (COJA) between the City of Lincoln and Placer County entitles the County to claim a portion of the effluent produced at the WWTRF, but the County has yet to do so. Also described within the agreement is the City of Lincoln's right to receive a portion of WWTRF effluent flow proportional to its wastewater contribution. For purposes of this Master Plan, it has been assumed that the City can only rely on recycled water supplies derived from the wastewater collected from within the City's General Plan area. Additional details of this agreement between the City of Lincoln and Placer County have been described in **Section 3.4**.

Historically, the incoming ADWF at the WWTRF has been increasing and it is projected to continue to increase in the future[6] with development of the City's SOI. Estimates of future wastewater flows from undeveloped areas within the City's General Plan area are presented in the City's Wastewater Collection System Master Plan (Stantec, 2018). A wastewater generation rate of 250 gpd/EDU based on the City's Design Standards, is used to estimate base flow from undeveloped areas. This wastewater generation rate is much higher than what has been historically observed at the WWTRF. The rate is meant to provide a conservative estimate of flow in the collection system and provide a factor of safety in collection system design to account for added flow associated with rainfall dependent inflow and infiltration (RDII). Since 2005, the highest annual average wastewater generation rate observed at the WWTRF was approximately 175 gpd/EDU.

Drought conditions persisted in Lincoln, and much of California between 2011 and 2016. During this time the City's average wastewater generation rate fell to approximately 155 gpd/EDU. This wastewater generation rate has been used to scale the estimates (155 gpd/250 gpd) presented in the Collection System Master Plan and provide a conservative projection of future recycled water supplies that could become available with future development. The wastewater flow projections from the Collection System Master Plan and the scaled reclamation planning projections are presented in **Table 7-1**. Only estimates of future wastewater flow from City planning areas[7] have been scaled to reflect lower generation rates. Regional wastewater flow estimates reflect those outlined in existing agreements and are used directly.

[6] A flow reduction was observed through the 2011 to 2016 drought, but the upward trend has returned for 2017 and 2018.

[7] Estimates exclude regional entity flow projections

Table 7-1 Wastewater Collection System ADWF and Scaled Reclamation Supply Projections

Contributing Area	ADWF Estimate – Collection System Planning (MGD)	ADWF Estimate – Reclamation Planning (MGD)
Lincoln – Current ADWF (1)	2.8	2.8
SMD1 Flow – Current ADWF (1)	1.2	1.2
Future Additional SMD1 Flow (2)	3.0	3.0
Infill within city limits	3.0	1.8
Village 1	1.4	0.9
Village 2	1.2	0.7
Village 3	1.3	0.8
Village 4	1.4	0.9
Village 5/SUD-B	3.9	2.4
Village 6	1.3	0.8
Village 7	0.9	0.5
SUD-A	2.6	1.6
SUD-C	1.6	1.0
Additional Spaces	1.0	0.6
Bickford Ranch Development (2)	0.4	0.4
City of Auburn (2)	2.5	2.5
Lincoln Total	**22.3**	**14.9**
WWTRF Total	**29.4**	**22.0**

1. Estimate reflects existing dry weather flow conditions and is not scaled for use in reclamation planning.
2. Regional flow estimate outlined in the City's COJA and is not scaled for use in reclamation planning.

7.4 WWTRF EFFLUENT MANAGEMENT

The current WWTRF effluent management strategy is to discharge what is permissible to Auburn Ravine without effluent cooling facilities, to directly reuse the effluent for reclamation demands, and to store any remaining balance in the TSBs at the WWTRF. The WWTRF onsite TSBs provide seasonal storage of tertiary treated and disinfected wastewater until disposal is feasible or recycled water demand exists. The required volume of the TSBs is determined by the extent that effluent flows exceed allowable creek discharges throughout the fall, winter, and spring. In practice, the primary period of creek discharge occurs in winter months and main period of reclamation occurs in the summer months. A water balance is used to estimate and track all inflow and outflow from the system to determine the tertiary storage and land disposal capacities required. The water balance and overall effluent management strategy is highly dependent on receiving water limitations outlined by the WDR Order.

7.4.1 Ongoing Effluent Management Impacts

Time-Schedule Order – Auburn Ravine Creek Temperature Study

The most recently adopted WDR Order (R5-2018-0081) imposed more stringent temperature receiving water limitations. The revised temperature limitations will require the WWTRF to store more water that could have otherwise been discharged to the creek. The City indicated to the Regional Board that there may be insufficient storage capacity at the WWTRF to comply with the revised limitations. On January 14th, 2019 the City submitted a request for a compliance schedule supporting the infeasibility of complying with the revised limitations (Order R5-2019-1003).

The old permit (Order R5-2008-0156) used to read:

> **Temperature**. The temperature shall not be made to increase more than 5 °F compared to the ambient stream temperature.

The new permit (Order R5-2018-0081) includes the following additional temperature limitations:

> **Temperature**. The annual average temperature to increase more than 5 °F compared to the ambient stream temperature ***and* shall not cause the receiving stream temperature to rise above:**
>
> a. ***58 °F on a monthly average and weekly median basis from 1 October through 31 May.***
> b. ***64 °F at any time from 1 October through 31 May.***
> c. ***5 °F over the ambient background temperature as a daily average for the period from 1 June through 30 September.***

The City requested the interim use of a nearby Regional Stormwater Basin (RSB) as additional storage capacity, as well as time to study options including determining if the receiving water temperature limits are appropriate or need to be revised. Depending on the outcome of the Auburn Ravine Creek temperature study, the City may require additional storage beyond the total tertiary storage capacity, of approximately 330 MG or other facility upgrades, which would require additional time to plan, design, finance, and construct in order to comply with the receiving water limitations.

The time-schedule order R5-2019-1003 describes the steps that the City will take in order to correct potential violations of the receiving water limitations for temperature. The time-schedule order provides regulatory coverage for an interim solution to wastewater storage and disposal issues while a long-term solution is being developed. The revised receiving water limits were developed without conducting a site-specific study, so they are based on conservative assumptions. Before moving forward with costly upgrades to increase storage, the City plans to conduct a site-specific temperature study in consultation with state and federal fishery agencies to determine the appropriate temperature receiving water limitations for protection of salmon and steelhead migration and spawning.

If upon completion of the site-specific study on Auburn Ravine Creek, additional storage capacity or other facility upgrades are needed to meet the receiving water limits, the City plans to evaluate compliance options which include but are not limited to:

A. Building more tertiary storage facilities,
B. Increasing reclaimed water use; and/or
C. Building effluent cooling features.

The following time schedule and reporting provisions are outlined in time-schedule order (Order R5-2019-1003):

1. Ensure completion of the compliance project by submitting the following technical reports according to the time schedule outline below:

Task	Compliance Date
Submit Site Specific Temperature Study Work Plan The Work Plan shall be developed through consultation with the DFW and National Marine Fisheries Service staff to evaluate the appropriate temperature receiving water limitations for protection of salmon and steelhead migration/spawning in Auburn Ravine.	**1 June 2020**
Submit Final Temperature Study	**1 January 2022**
Submit Treatment Feasibility Study Work Plan and Schedule (If Necessary). Work plan and schedule shall consider alternatives to provide long-term compliance with temperature receiving water limitations.	**1 April 2022**

2. Discharger shall comply with the following interim receiving water limitation through 1 April 2023, or when the Discharger is able to come into compliance with the receiving water temperature limitations in Order R5-2018-0081.

   Receiving Water Limitations for Temperature. The discharge shall not cause the natural temperature in Auburn Ravine Creek to be increased by more than 5°F as a daily average between 1 October and 31 May. The site-specific receiving water limitations in Order R5-2018-0081 shall apply between 1 June and 30 September.

3. For the term of this Order, the Discharger shall manage the discharge of tertiary treated wastewater from the Facility to the Regional Stormwater Basin (RSB) in accordance with the Standard Operating Procedures (SOPs) and the following prohibitions and specifications:

a. The two existing TSBs, and planned third TSB, shall be used to the maximum extent possible before tertiary treated wastewater is end to the RSB for storage.

b. If tertiary treated wastewater is discharged to the RSB, all water (i.e., wastewater/storm water mixture) must be removed from the RSB prior to utilizing the RSB as a storm water retention basin.

c. The discharge of tertiary treated wastewater to surface waters other than authorized in Order R5-2018-0081 (NPDES Permit No. CA0084476), is prohibited.

d. When in use for storage of tertiary treated wastewater, the RSB shall be operated per the Operating Requirements as follows:

   i. Public contact with wastewater shall be precluded through such means as fences, signs, and other acceptable alternatives.

   ii. The RSB shall be managed to prevent breeding of mosquitos.

   iii. The discharge of wastes classified as "hazardous" or "designated" as to the Facility ponds, is prohibited.

   iv. Objectionable odors originating at the RSB shall not be perceivable beyond the limits of the wastewater treatment and disposal areas (property owned by the Discharger).

   v. A minimum of 2-feet of freeboard is required when storing tertiary effluent in the RSB. Freeboard shall be measured at the spillway thus the water level shall not be allowed to exceed 106.0-foot elevation, resulting in a reduced capacity of approximately 70 MG.

Loss of Effluent Disposal Area

The WWTRF currently leases an irrigation area owned by Placer County for purposes of effluent disposal. The site is approximately 192 acres of irrigatable area. It has been identified that the County intends to repurpose the area and will end its lease with the City within the next five years. The WWTRF currently utilizes approximately 942 acres of land as effluent disposal area (including the County Site). These areas include the Machado Farm, On-site Areas (Warm Springs), County Lease Site, and uses within the City (Sierra Pacific Industries, city parks, landscaping, etc.). City uses are not considered in the water balance calculations, due to inconsistent demand and on-going implementation. After the loss of the County Lease Site, the total land disposal area will be reduced to approximately 750 acres.

WWTRF Expansion Project

The City of Lincoln is currently in the process of expanding the capacity of its WWTRF. The WWTRF is currently permitted for an ADWF of 5.9 MGD, upon completion of the Phase I improvements the ADWF will increase to 7.1 MGD, and with the completion of Phase II the ADWF will increase to 8.0 MGD. The expansion project will be implemented in two phases.

- Phase I – The first phase of the expansion project will increase the WWTRF treatment capacity by 1.2 MGD with the addition of an additional oxidation ditch and related components. The project will also expand the reclaimed water storage capacity by 142 MG with the construction of an additional effluent storage basin.
- Phase II – The second phase of the expansion project will further expand the facility's treatment capacity by 0.9 MGD with the construction of an additional clarifier and related components.

The WWTRF currently has 190 MG of tertiary storage capacity. After Phase I is completed, the tertiary storage capacity will be increased to 332 MG. Discussion of either purchase or seasonal lease of a 70 MG stormwater basin located adjacent to the tertiary storage basins has been made to further expand storage capacity if required.

7.4.2 Recycled Water Delivery & WWTRF Operations

Figure 7-1 depicts the existing seasonal effluent management strategy. Monthly totals are presented for approximate wastewater influent volume, presented as the total of stacked bars by wastewater source. Overlaying the stacked bar chart are line graphs depicting the potential reclamation demand of existing use areas (maximum irrigation potential of existing agricultural users and on-site reclamation areas) and actual 2017 reclamation flow supplied is also shown. Wastewater sources reflect ADWF data collected at the WWTRF in July, August, and September of 2017. Estimates of monthly inflow and infiltration (I/I) volumes were calculated based on the annual influent flow pattern observed at the WWTRF from 2014 to 2017.

Currently the operation of the TSBs allows storage of significant amounts of effluent that could have otherwise been discharged to Auburn Ravine, with the objective of conservatively meeting receiving water limitations and maximizing the amount of recycled water available in the dry season. This is management strategy is currently possible because the plant operates at less than its existing ADWF capacity and the current TSB volume was designed to provide sufficient capacity at the design ADWF.

The required TSB storage volume is determined through the development of water balance scenarios that simulate various conditions by adjusting water balance inputs. A water balance update and evaluation of the storage volume required to accommodate the WWTRF Expansion Project was completed as part of the project design effort. The evaluation assesses the allowable effluent discharge volume to Auburn Ravine in drought years and in years with 100-yr return frequency precipitation, to determine the corresponding storage volume and land disposal (reclamation) area requirements. The impacts of the updated WWTRF WDR Order that limit effluent disposal, improvements of the WWTRF Expansion Project, and changes to existing effluent land disposal contracts were considered in the water balance update.

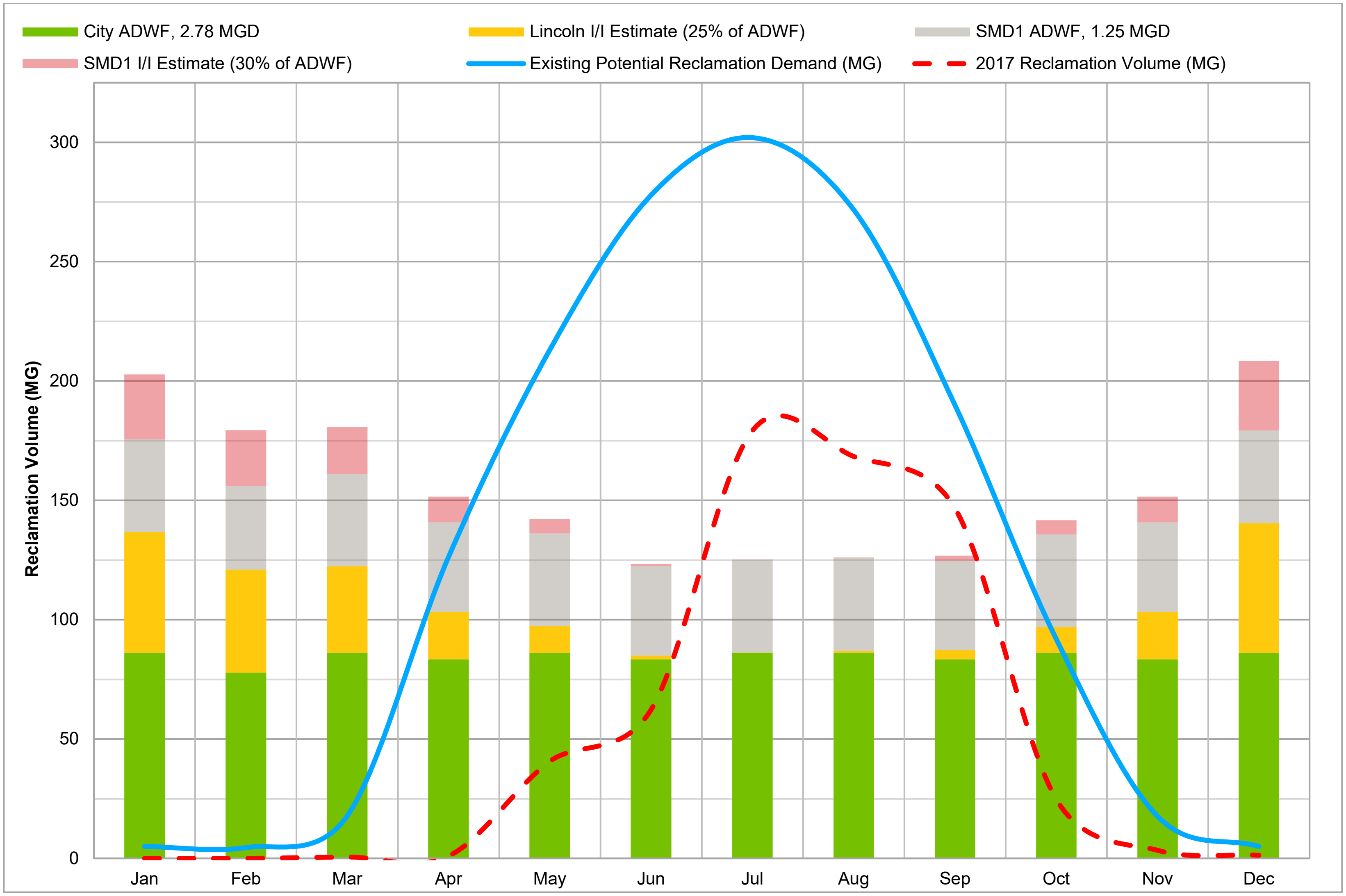


Figure 7-1 Existing Effluent Management

Further discussion of the water balance update and assessment is provided in the following section. The water balance assumes the maximum amount of effluent is discharged to Auburn Ravine and TSBs are emptied as soon as possible. Under this effluent management approach (as assumed in the water balances) the required storage volume is minimized at the expense of potentially leaving a portion of the existing reclamation demand unsatisfied. Having a higher potential reclamation demand than available supply ensures that all the City's effluent can be disposed of under the given conditions. This makes for effective effluent management approach but is in conflict with goals to provide a reliable reclamation supply that consistently meets demands, creating an operational challenge to meet both objectives.

Figure 7-2 includes reclamation demands supplied in 2017, the estimated potential demand (based on the City's current on-site reuse areas and agricultural use areas), and the estimate of future reclamation demands under future conditions. The total annual buildout reclamation demand estimate equates to 950 Mgal or 2,900 AF (presented in **Section 6.6**), which is less than the existing demands of the City's existing agricultural users and on-site reclamation areas (1,000 Mgal or 3,070 AF). The buildout reclamation demand estimate falls within the available reclamation supply of the limiting water balances. As large agricultural demands are phased out, they will be replaced by those of future users within the recycled water service area.

If the City wishes to supply the existing potential demands and those of future users under interim conditions, additional seasonal storage may be necessary. The water balance and tertiary storage requirements are further described in the following section. The water balance, storage requirements, and overall WWTRF effluent management strategy will be reassessed after the completion of the Auburn Ravine temperature study and should be continuously reconsidered as objectives change over time.

Figure 7-3 presents an estimate of the monthly effluent volume under buildout development conditions. The current estimate of future reclamation demands is projected to make up only a small portion of the total effluent volume produced at the WWTRF. Because the projected amount of effluent produced at the WWTRF will increase overtime and the total volume of reclamation demand will roughly remain the same, the City will need to pursue alternative effluent disposal methods and wastewater flow increases from future development.

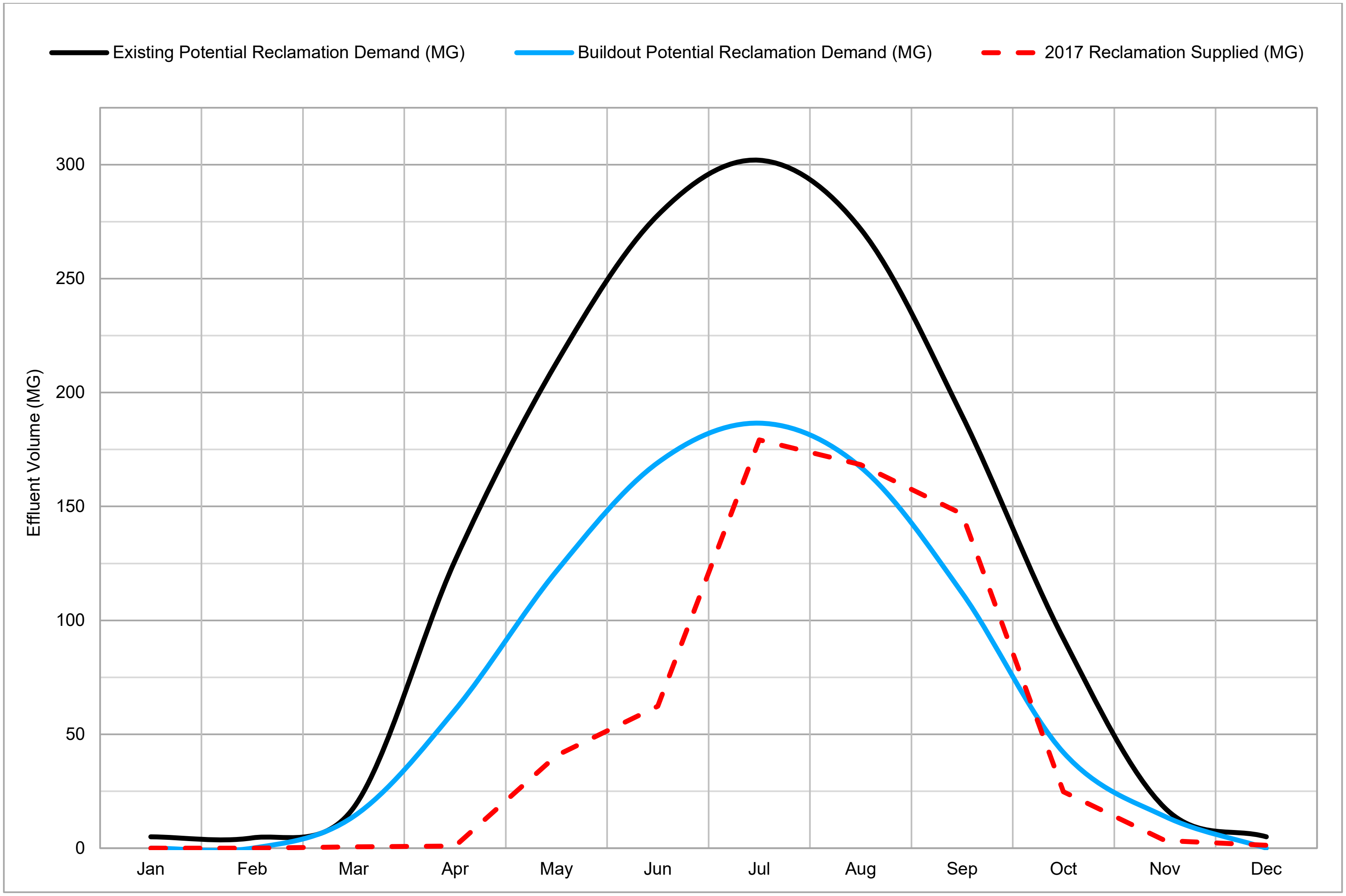


Figure 7-2 Reclamation Demands

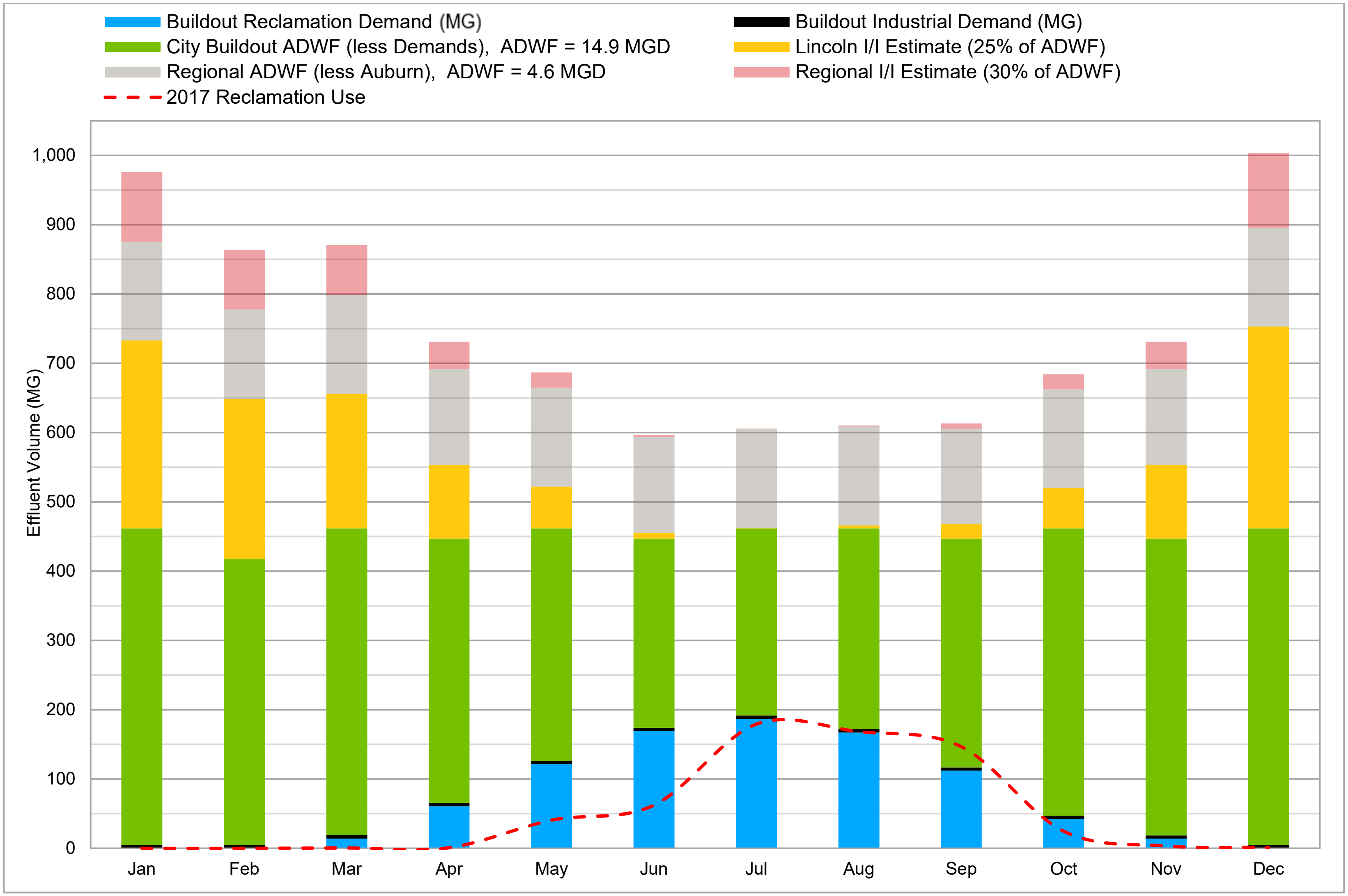


Figure 7-3 Future Effluent Management Need

7.5 RECYCLED WATER STORAGE AND DELIVERY

Two types of storage are required to operate the recycled water distribution system:

- Tertiary Storage
- Peak Hour Storage

Tertiary Storage is storage volume required to store off-season effluent on an annual basis for use during periods of high reclamation demand. High reclamation demand periods are projected based on an agronomic cycle in this Master Plan, which corresponds to summer irrigation. The existing TSBs have been designed to minimize volume and the associated costs while maximizing effluent discharge to Auburn Ravine. In an alternative effluent management approach which maximizes storage and reclamation supply, the storage volume would be calculated based on the ability to maximize reclamation demands as feasible with the available effluent and would theoretically, result in less discharge to Auburn Ravine and a higher storage volume than for the current effluent management approach.

However, to meet the projected peak reclamation demands projected in this Master Plan, the existing storage volume based on effluent management is enough to serve both objectives. This is demonstrated by the fact that the existing 190 MG of storage can supply the existing reclamation demands, which exceed the buildout demands established herein. Therefore, no new reclamation storage is required to fulfil the needs of this Master Plan at buildout.

Peak Hour Storage is needed to buffer demand fluctuations throughout the day. It provides the supply to meet demand under peak hour conditions. Peak hour storage provides reclaimed water to meet the difference between PHD of customers and the effluent supply flow from the WWTRF. The volume required for this storage component is dependent upon the hourly variation of the customer's demand and the diurnal variation in effluent flow from the WWTRF as it is currently operated. Effluent flow from the WWTRF is currently equalized in the facility's maturation ponds. Therefore, effluent diurnal variation is very small and approximately equal to the average daily flow rate entering the plant – in the summer, when most reclamation will occur, this is roughly equal to the ADWF rate. New peak hour storage facilities would likely be in the form of a covered storage pond with floating liner or above ground tank at the WWTRF.

7.5.1 WWTRF Water Balance and Tertiary Storage

To date, the TSB design volume has been minimized based on an effluent management strategy that maximizes discharge and disposal. This approach to design reduces costs associated with additional TSB volume. Water balance calculations are used to determine the required tertiary storage volume and land disposal area under various permutations of influent flow, effluent storage, discharge, and disposal conditions. The most recent WWTRF water balance update assessed the impacts of recent planning and regulatory developments on effluent management at the WWTRF.

The following conditions were simulated in the water balance to determine their impact on tertiary storage and effluent disposal area required:

1. **Increased WWTRF ADWF Capacity –** An increase in the permitted average dry weather flow (ADWF) associated with the WWTRF Expansion Project, and the anticipated wastewater flow into the facility in the near-term.
2. **Increased Tertiary Storage Capacity –** The construction of 142 MG of additional tertiary storage capacity at the WWTRF site as part of the WWTRF Expansion Project and the interim use of the 70 MG RSB.
3. **Creek Discharge Capacity – Increased Discharge Rate and Temperature Constraints:** Adjustments to the regulatory permit defining the WWTRF effluent discharge capacity, increasing the allowable discharge rate to 25 MGD but further restricting receiving water temperature limitations. The existing effluent pump capacity (20.4 MGD) was also considered.
4. **Disposal Area – County Leased Reclamation Area (Pivots):** The future loss of one of its existing effluent disposal areas (County Leased Area), reducing the available land disposal area by approximately 192 acres to 750 acres.

The following scenarios were developed to determine the impacts on effluent management based on the corresponding parameters. Each scenario and its corresponding parameters are shown in **Table 7-2**.

Table 7-2 Water Balance Scenarios and Parameters

Water Balance Scenarios	Influent Flow (MGD)	Storage Volume (MG)	Effluent Discharge Capacity (MGD)	Effluent Disposal Area (Acres)
Scenario 1 - Existing Conditions	5	190	20.4 (1)	942
Scenario 2 - Phase II Expansion Project	8	402	20.4 (1)	942
Scenario 3 - Phase II Expansion Project w/o County Site	8	402	20.4 (1)	750
Scenario 4 - Phase II Expansion Project w/ Higher Discharge	8	402	25.0 (2)	750

(1) Current effluent pump capacity to Auburn Ravine.
(2) Current permit limitation to Auburn Ravine.

The 100-year rainfall condition governs the amount of tertiary storage capacity required and was used in this assessment. The results of the water balance scenarios are summarized below:

Scenario 1 – The WWTRF has sufficient capacity under existing conditions and 176 MG of storage and 800 acres of land disposal area are required.

Scenario 2 – When ADWF increases to 8.0 MGD the WWTRF will need to expand storage capacity by 105 MG and land disposal area 458 acres, requiring 458 MG of total storage and 1,400 acres of land disposal area.

Scenario 3 – When ADWF increases to 8.0 MGD and the County Site can no longer be used, the WWTRF will need to replace the land disposal area lost.

Scenario 4 – Increasing the effluent pump capacity to 25 MGD when ADWF increases to 8.0 MGD and the County Site can no longer be used, would limit the additional storage required to 46 MG and the additional land disposal area to 250 acres. Reducing the total required storage to 453 MG and land disposal area to 1,000 acres.

The results of the water balance analysis indicated that improvements to effluent management, either additional tertiary storage or land disposal area, will be needed under Phase II conditions. The ADWF is projected to exceed 8.0 MGD upon development of Village 1, Village 7, Village5/SUD-B, and infill of existing service areas. Therefore, it assumed that Scenario 4 projects planning conditions on a long-term basis. The required amount of tertiary storage volume is approximated as 453 MG under 8.0 MGD ADWF conditions, respectively, when the maximum discharge to Auburn Ravine is maintained at the permit limit of 25.0 MGD and the revised temperature limitation is also considered. This projected volume also assumes that the City will maintain its land disposal area of approximately 942 acres. The WWTRF will soon have 332 MG of TSB volume, about 120 MG less than the total volume required to increase the ADWF to 8.0 MGD. After considering use of the RSB, which adds an additional 70 MG of storage capacity, 50 MG of storage are still required upon completion of the WWTRF Expansion Project.

It is assumed that the WWTRF will expand pumping capacity of the EPS and maintain or replace the land disposal area currently accounted for by the County Leased site. The TSB capacity will be expanded as part of the WWTRF Expansion project and the RSB will provide additional storage capacity in the interim before ADWF reaches 8.0 MGD. With the use of the RBS, the WWTRF currently has 260 MG of TSB capacity. After the completion of WWTRF Expansion Project, this capacity will be expanded to approximately 402 MG.

This amount of storage volume is considered acceptable under interim conditions because the actual ADWF is currently only half of the Phase II design capacity. The required amount of tertiary storage volume is ultimately dependent on maximizing effluent discharged to Auburn Ravine Creek while meeting the receiving water limits and maintaining permit compliance. Therefore, the amount of additional tertiary storage required will be revisited upon completion of the site-specific study on Auburn Ravine Creek and allow storage to be expanded prior to ADWF reaching 8 MGD.

The follow is recommended based on the results of the water balance update and assessment:

<u>Existing Conditions</u>

1. Retrofit effluent pumps to achieve higher discharge when permissible.
2. Operations should utilize the full five degrees of impact on Auburn Ravine Creek
3. Improve instrumentation to allow more accurate and definitive temperature averaging, to maintain compliance with permit limitations.

4. Utilize the RSB for effluent storage if needed.
5. Continue to expand reclamation wherever feasible.

Long-term (Phase II) Conditions

1. Expand WWTRF storage capacity on or off site.
2. Increased flow from growth in SMD1, Bickford Ranch, and Village 1, as currently planned, will not bring associated reclamation potential, but Village 5 and Village 7 should maximize reclamation.
3. Consider revising the recycled water service area to include currently excluded reclamation areas, including higher elevation areas (Village 1, Village 2, etc.).
4. Complete site-specific Auburn Ravine temperature study to refine the discharge limitations to Auburn Ravine Creek.
5. Complete an extensive and detailed effluent management plan for long-term planning upon permit adoption of final receiving water discharge limitations.

7.5.2 Daily Storage and Delivery

As previously described and depicted in **Figure 7-3**, the buildout effluent or reclaimed water supply is projected to exceed the estimate of future reclamation demand. Therefore, reclamation demands will be able to be met on a daily "on-demand" basis under future conditions. Effluent will be used to supply the reclamation system directly as it is produced, and only daily storage or operational adjustments will be needed to supply PHD.

The City's ability to supply recycled water to off-site use areas on-demand is limited by the capacity of the RBPS and upstream EPS. Assuming the capacities of these pump stations are increased to meet demand requirements (as they will be), the tertiary treatment capacity of the WWTRF will govern the ability of the system to supply recycled water on-demand. Treatment facilities downstream of the maturation ponds have a capacity roughly equivalent to peak month wastewater flow, which is estimated to exceed PHD for reclaimed water at buildout.

Peak hour storage volume is calculated based on the estimated recycled water demand of the potential users and their associated diurnal use patterns. Based on the assumption carried through this Master Plan that the majority of future reclamation uses will be for irrigation, only using recycled water over an 8-hour demand period (most likely to occur at night), it can be calculated that the peak hour storage needs to be sized for 30 percent of the maximum monthly demand (MMD). An additional consideration is whether the County claims their portion of effluent as it is produced[8]. If the county does not claim their portion of effluent, this effluent stream may be utilized by the City of Lincoln, limiting the capacity required for peak hour storage. The estimate of extra storage to meet PHD flow, in contrast to direct effluent

[8] The values presented here assume that the County claims their share of reclaimed water and that it is not available to meet City demands.

production at the WWTRF, includes a 10 percent allowance for operational flexibility. For example, if the peak irrigation rate is 18 MGD, Peak Hour Storage could be about 5 MG.

The need for peak hour storage capacity is also dependent WWTRF operations. Operations of the WWTRF could be adjusted to accommodate reclamation demands. The WWTRFs maturation ponds allow water to be stored ahead of tertiary treatment with almost 100 MG of wet weather flow equalization capacity that can be used for peak hour storage during the summer. Allowing daily storage in the maturation ponds and performing tertiary treatment on-demand would eliminate the need for daily storage facilities. The 5 MG identified above is if there are no operational adjustments and the existing tertiary facilities operate as they do currently, with a continuous 24-hour steady treatment of equalized flow. However, with operational adjustments, the 5 MG peak hour storage capacity can be provided by utilizing the available volume in the maturation ponds.

Alternatively, daily storage volume can be obtained within the TSBs but, these basins are very large and subject to algae growth in the summer. Utilizing TSB volume would require the use and expansion of retreatment facilities (DAFTs[9]) to remove algae, to accommodate the projected reclamation PHD. The use of DAFTs is the current practice for using TSB stored effluent for reclamation. Therefore, no new peak hour storage is anticipated to be needed to fulfil the needs of this Reclamation Master Plan at build out flows with the proper addition of DAFTs and/or operational adjustments as the WWTRF expands.

The preceding discussion aims to identify the reclamation storage and peak hour storage issues that must be considered in the development of this master plan. However, the results of the storage analysis indicate that no new storage requirements are required at buildout conditions than those that will be provided for effluent management or for the maturation ponds.

From current to buildout conditions, it is anticipated that effluent supply will increase in proportion to new reclamation demands as the City grows and that, therefore, the above storage conclusions hold true for interim levels of development. However, any accelerated development of reclaimed water demands in contrast to the rate of production of effluent could require additional reclamation storage. Supply and demand asymmetry is not anticipated, but the water balance and reclamation needs of the facility should be reassessed periodically to ensure that the City can always meet reclamation commitments.

7.6 SUPPLY AND STORAGE RECOMMENDATIONS

7.6.1 Available Supply

Based on the preceding discussion and existing water planning, the WWTRF will produce more than enough effluent to supply future reclamation demand projections. The planned TSB volume is adequate to provide seasonal storage of recycled water. Because future demands are projected to be less than the existing reclamation demand, additional storage may be

[9] DAFTs = Dissolved Air Floatation Tanks

needed under interim conditions if the City chooses to supply demands higher than those projected by the water balance evaluation. Higher demands were not considered as part of this master plan or water balance update.

7.6.2 Effluent Management

As previously discussed, the City's future reclamation demands are projected to account for only a portion of the WWTRF's total effluent volume. The City should pursue additional planning to ensure that effluent can be properly managed as additional development occurs. The existing storage and effluent management facilities can support interim conditions throughout the construction of the WWTRF Phase I and Phase II expansion projects assuming that the WWTRF takes fully utilizes its ability to discharge effluent to Auburn Ravine, utilizes the RSB as additional storage capacity, and reclamation demands are not reduced below current levels.

The City should consider additional disposal methods and/or increase the capacity of existing disposal methods. If temperature impacts to Auburn Ravine were not limited by the NPDES Permit, all excess effluent could be discharged to the creek, assuming compliance with other regulatory limitations (WW0066). The City should pursue improvements that allow a larger volume of discharge to Auburn Ravine, the installation of effluent cooling facilities to mitigate temperature impacts, and/or identify additional reclamation demands outside of the City SOI.

The City's existing regional wastewater treatment agreement with Placer County allows the County to claim their portion of reclaimed water. Any unclaimed recycled water further supports the redundancy of Lincoln's non-potable water supplies and increases the scale of effluent management facilities and the need for planning. Projecting the use patterns, demands, and infrastructure needs for regional entities to claim their portion of recycled water is outside the scope of this Master Plan. Although, the existing 24-inch pipeline in Fiddyment Road, currently supplying recycled water to the Machado Farm and the County Irrigation site, could be used to transmit water south to Placer County's Placer Ranch development or other industrial users in the area of Athens Avenue in the future.

7.6.3 Demand Prioritization

To further support effluent management efforts, the City should prioritize additional uses based on the service expansion cost and added rate of demand. The unit cost of building the required infrastructure to serve a new use area, expressed in capital dollars per acre-foot served, is a good basis for prioritizing system expansions. Typically, large users are more cost-effective to add than small users are, unless distance and/or elevation make service cost prohibitive.

The usage pattern of the proposed use should also be considered in prioritization. Customers with large consistent demands function as a reliable base for the recycled water system, smaller users located throughout the distribution system are typically added later. Non-irrigation customers, such as industrial uses, provide a baseload demand that can take supplies during times of otherwise minimal use. They can reduce the amount of storage needed to supply daily demand fluctuations. Baseload customers also improve the overall system hydraulics and reduce surges and large pressure fluctuations in the distribution system.

In summary, the City should prioritize additional users based on the associated cost per acre-foot served ($/AF), total reclaimed water demand, and demand usage pattern. Potential uses with low cost to provide service, high usage, and consistent demand usage patterns should be priorities for the City.

7.6.4 Interim Conditions, System Redundancy, and Reliability

The City has reliable and redundant water supplies, as described in **Chapter 4.0**. Water supply sources include groundwater, raw water, and recycled water supplies. To phase out agricultural uses and supply future demands as they develop, higher than projected recycled water demands may need to be supplied. It could also be the case that the demand for recycled water increases at a higher rate than the WWTRF's ADWF and effluent production rate. The City could supplement interim supply deficits with an alternative make-up water source for the purpose of maintaining system reliability. Maintaining a reliable system will allow the reclaimed water system to continue to grow and add customers. This approach would allow the City to maximize effluent flow from the WWTRF throughout the year and minimize the need for daily recycled water storage and retreatment facilities.

Providing an additional supply source to the system has the added benefit of ensuring a reliable water supply to customers. It eliminates the expense for each customer to have a backup water supply, which is required to be fitted with extensive cross-connection facilities. This would allow connection of users without fear of supply limitations and further reduces the risk of cross-connections between the City's potable and recycled water supplies. This could make recycled water a more attractive non-potable water supply source within the community when compared to other available sources.

There are a number of agricultural wells within the City's SOI that could potentially be used to augment the reclamation system in the future. These wells could be preserved as development occurs through strategic planning for use as non-potable supply wells. The reclamation system should be supplied primarily with recycled water and could be supplemented with raw water to enhance system reliability and supply peak demands.

The following is recommended to the City to ensure that effluent is properly managed as further growth occurs:

- The development of an Effluent Management Master Plan
- Encourage Placer County to retrieve their portion of effluent (COJA)
- Increase the allowable discharge to Auburn Ravine.
- Add industrial customers providing a larger baseload demand during times low irrigation.
- Expand reclamation demands (through Village 1, 2, and 3, or outside the SOI)

8.0 PLANNING AND EVALUATION CRITERIA

8.1 PURPOSE

The purpose of this chapter is to present the reclamation system planning approach, recommended system specifications, and the planning and evaluation criteria used to identify capacity deficiencies within the existing reclamation system. The evaluation criteria are also used to determine the layout and capacity needs of the future system and estimate buildout infrastructure requirements which are used to develop planning level opinions of probable cost. The system improvements and capital improvement projects (CIPs) presented in this Master Plan have been developed on the basis of providing sufficient system capacity and infrastructure performance to meet level of service (LOS) criteria.

This chapter is divided into the following sections:

- System Planning Approach
- Level of Service Criteria & Key Performance Indicators
- System Specifications and Considerations

8.2 SYSTEM PLANNING APPROACH

The approach to reclamation system planning is to supply the reclamation system without any remote storage or pumping facilities for future developments or pressure zones within the distribution system. This Master Plan assumes the distribution system will be supplied entirely by the RBPS and on-site storage and/or production at the WWTRF. Limiting storage and pumping to the WWTRF site provides economy of scale in operation and maintenance costs associated with the facilities. Onsite storage and booster pumping facilities can be implemented at use sites but at the expense and operation of the recycled water user.

The recycled water service area is limited to the western portion of the City planning area due to the relative availability of alternative non-potable water supplies in the area. In addition, the exclusion of relatively higher elevation areas in the east provides consistent system specifications and limits overall pumping requirements. System specifications and pumping requirements presented in this Master Plan should be revisited should the City choose to expand this service area beyond the bounds identified herein.

8.3 LEVEL OF SERVICE CRITERIA & KEY PERFORMANCE INDICATORS

Key performance indicators are used to define the level of service (LOS) that the future reclamation system must achieve. The key performance indicators used to define the required LOS of the reclamation system include distribution system pressures, pipeline velocity and headloss, as well as RBPS pumping capacity.

8.3.1 System Pressures

Th recycled water system pressure is ideally designed to operate at a slightly lower pressure than the potable water system. This pressure differential reduces the risk of contaminating the potable water system in the event that a cross-connection exists between the two systems or an adjacent recycled water main is broken.

However, this requirement often cannot be met due to:

- Water system pressure variance geographically and as system demands fluctuate,
- The fact that water treatment plants are typically located at high points within the community and wastewater treatment plants are typically located at low points; and
- The need for a minimum pressure of 60 psi to meet the operating requirements of most sprinkler systems on the reclamation system.

The risk of a cross-connection between the recycled water and potable water systems is minimized by maintaining a minimum horizontal separation standard of 10-feet and installing backflow prevention devices, swivel-el connections, and/or pressure reducing valves at connections to the large transmission mains as required. At locations of use downstream from the reclamation mains and pressure reducing stations, pressures will ideally be lower than nearby potable systems. Cross connection prevention tests are also required as part of the City's reclaimed water permitting process.

Therefore, the layout of the future recycled water system is not coordinated with the existing potable water system layout and pressure ranges. The minimum system pressure used to size a new system pipeline is 60 psi under peak hour demand (PHD) conditions, with a target system operating range of between 60 and 100 psi. Due to limitations with the existing reclamation system, a minimum pressure of 50 psi is allowed for services off the existing system. Customers who need a higher pressure can install booster pumping systems at their own expense

8.3.2 Pipeline Sizing Criteria

Pipeline sizing is based on the following key performance indicators:

- Demand Conditions
- Pipeline Velocity
- Pipeline Headloss

Pipe sizes are selected so that they do not exceed velocity and headloss criteria under PHD conditions. When a pipeline is projected in the model to exceed the velocity or headloss criteria it is upsized to the next standard size, even if this means the selected pipe size operates at less than the pressure criteria. The focus of the system evaluation and planning presented in this Master Plan is on recycled water transmission mains. Any pipeline 8-inches in diameter or larger is considered to be a transmission pipeline, while pipelines that are 6-inches in diameter or less are considered distribution pipelines. Distribution pipelines within the system are considered on a case by case basis.

Pipeline Velocities

The maximum velocity within new pipelines should not exceed 4 feet per second (fps) under PHD conditions in transmission mains. The maximum pipeline velocity in existing distribution mains, should not exceed 6 fps under PHD.

Pipeline Headloss

Pipeline headloss should not exceed 0.005 ft/ft under PHD conditions. A summary of pipeline evaluation criteria for PHD conditions is provided in **Table 8-1**.

Table 8-1 Reclamation System Pipeline Evalation Criteria

Criteria	Existing Pipelines	Proposed Pipelines
Pipe Sizes (in)	4, 6, 8, 12, 14, 16, 18, 24	8, 12, 14, 16, 18, 24, 27, 30, 36
Maximum Design Velocity	6 fps	4 fps (pipelines 8-inches and larger)
Delivery Pressure	60 (50 off existing system) – 100 ± psi	
Headloss	< 0.005 (ft/ft)	
C (Hazen-Williams Friction Factor)	150 (PVC)	

8.3.3 Pump Station Sizing Criteria

The reliable pumping capacity of the RBPS needs to be sufficient to serve the PHD with the largest pump out of service, so that one pump unit can be designated as a spare to accommodate repairs and maintenance activities without interruption of system operations.

The existing RBPS is arranged to accommodate six pumps and five currently installed. The site arrangement accommodates the construction of a parallel wet-well of the same capacity. Long term, to meet PHDs, the existing RBPS pumps may need to be replaced with pumps having approximately 30% higher pumping capacity. Ideally demands will increase over many years and pump capacity requirements can be reevaluated and expanded at the time that each existing pump reaches the end of its useful life and needs replacement, making the upsizing a standard event with no through-away equipment.

An additional element of pump station expansion is to provide sufficient wet-well operating volume to allow the pump station to respond to changes in demand quickly without having an equally rapid change in the effluent treatment rate. The wet-well volume will need to be adequate to accommodate the operational requirements of the overall reclamation system.

One option to expand wet well capacity is to tie-in the pump station influent piping directly to the plant clear well in addition to the existing connection to the effluent pump station wet-well.

This will allow the operating volume of the clear well and unused reaeration basin to be used by the RBPS. Design details and timing should be considered as expansion of the reclamation system and WWTRF occurs.

8.4 SYSTEM SPECIFICATIONS AND CONSIDERATIONS

8.4.1 Pipelines

Pressure Class

New pipelines should consist of purple C900/C905 PVC with restraints and cathodic protection on buried metal fittings. The dimension ratio and pressure class is recommended to be DR 14 – 305 psi. Although DR 18 – 235 psi was determined to be acceptable and used for the Phase I Reclamation project, a higher pressure class is recommended for pipelines at lower elevations. Using a higher pressure class on these pipelines will allow the City to install much larger head pumps at the RBPS in the future if they choose to supply demands at higher elevations.

Converted Wastewater Forcemains

Portions of the distribution system consist of converted wastewater forcemains that were abandoned when the associated wastewater pump station was decommissioned. These portions of the system can be identified within the record drawings of the Phase I Reclamation Project. The portions of the system consisting of converted wastewater forcemain should be replaced first as part of an overall repair and replacement program for the reclamation system. These portions of the system are the oldest and the materials are inconsistent with the remaining system.

8.4.2 Valves and Surge Protection

Slow Close Valves

Water hammer is the result of a pressure surge, or high-pressure shockwave that propagates through a piping system when a fluid in motion is forced to change direction or stop abruptly. This can occur when large demands come on and off within the system. To reduce water hammer and provide surge protection it is recommended that slow-close valves are specified along transmission mains (≥ 10-inches) within the distribution system.

Pneumatic Tank

The existing RBPS includes a 10,000-gallon pneumatic tank to regulate pressure within the recycled water distribution system. The operation of this pneumatic tank should be considered as the distribution system is expanded and new demands are added to the system. Capacity of the pneumatic tank should be evaluated as part of future RBPS improvement projects.

8.4.3 Use Area Considerations

The customer or owner shall be responsible for the safe and efficient operation, maintenance and upkeep of their on-site facilities. All recycled water users should refer to the *City of Lincoln – Rules and Regulations for Recycled Water Use and Distribution* (included as **Appendix A**) which establishes procedures, specifications, and limitations for the safe and orderly development and operation of recycled water facilities and systems in the City of Lincoln.

Any off-site recycled water distribution facilities, to the extent determined by the City, required to serve developments in the City service area shall be provided by the applicant, owner, or customer at their expense, unless the City determines it is appropriate to construct these capital facilities. Plans and specifications for all recycled water distribution facilities shall be submitted to and approved by the City in advance of construction. The City will assume responsibility for providing recycled water service to the point of connection of such development upon transfer to the City the title to all off-site recycled water systems and any necessary easements. All easements shall be in a form acceptable to the City and not subject to outstanding obligations to relocate such facilities or any deeds of trust, except as approved by the City.

Off-site facilities for use areas may include the recycled water meter, filter, pressure reducing valve, and swivel-ell connection. These improvements were required at Parks included as part of the Phase II Reclamation Project. An inline filter was needed to help protect and minimize maintenance of onsite irrigation systems, which have small emitters which can easily become clogged. The Phase II improvements included the installation of a valve vault and spool for the future installation of a pressure reducing valve depending on future pressure conditions within the recycled water distribution system.

To ensure consistent irrigation of these large parks within the City, a potable water connection was required to provide an auxiliary water supply. The potable water connection required air-gap separation and the use of a swivel-ell connection. As described in **Section 3.3**, the *City of Lincoln Code Section: 13.05.030 – Protection Required*, describes the City's potable water protection facilities required for use areas that use potable water as a backup water supply. A swivel-ell connection is authorized air gap cross-connection control for non-dual plumbed systems. A swivel-ell connection shall be designed to preclude the simultaneous use of both potable and reclaimed water sources to supply a distribution system. The swivel-ell may be manually switched between the reclaimed water source connection and the potable water source connection to supply the use area's distribution system. An example of the swivel-ell air gap connection is shown as **Figure 8-1**.

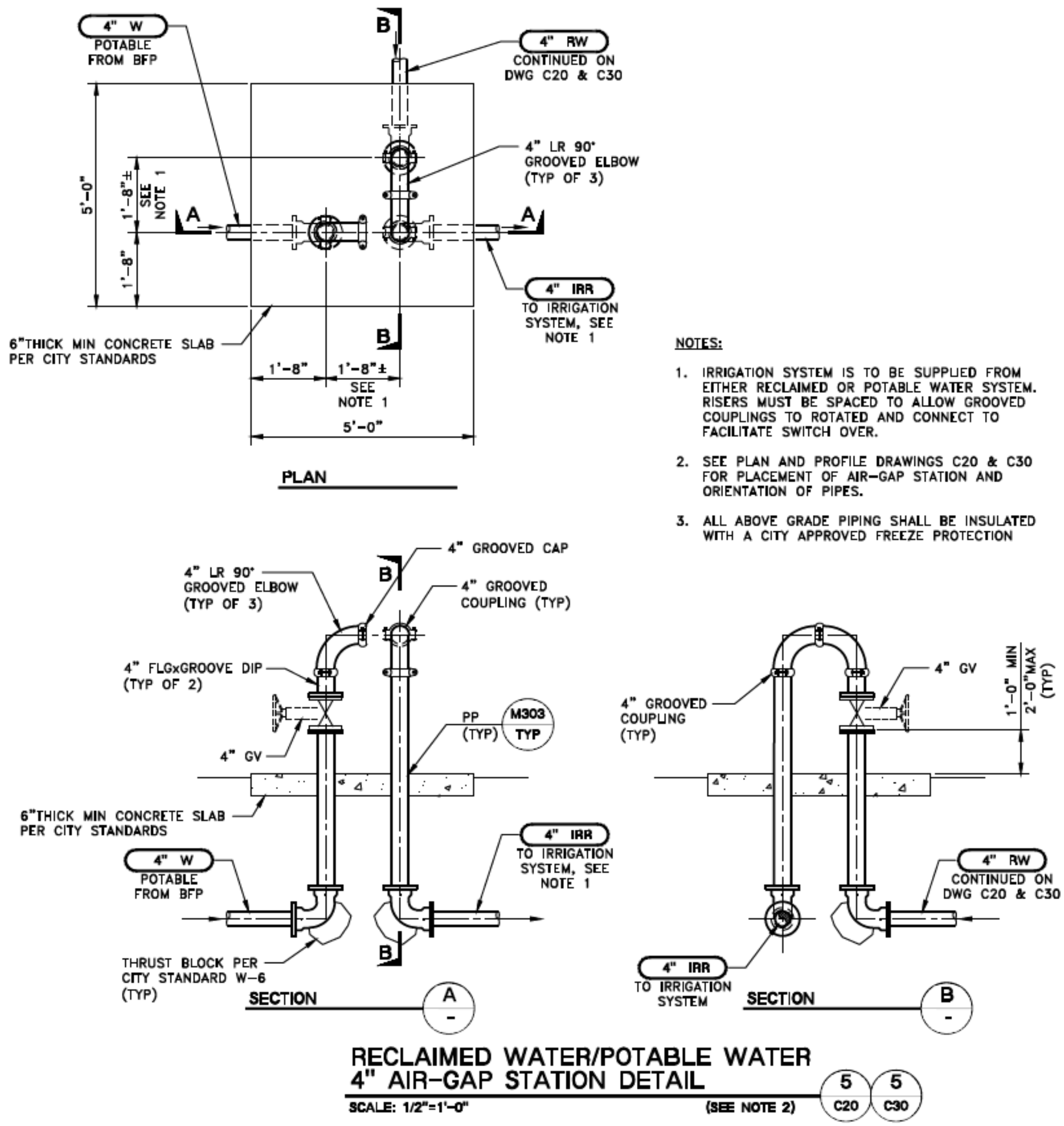


Figure 8-1 Swivel-Ell Air Gap Connection Detail