Brown AND Caldwell

Prepared for The City of Boise

FINAL DRAFT

City of Boise Water Renewal Utility Plan

AUGUST 31, 2020

BOISE CITY OF TREES

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City of Boise Water Renewal Utility Plan

Prepared for
City of Boise
Boise, Idaho
September 1, 2020

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950 West Bannock, Suite 350

Boise, Idaho 83702

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List of Abbreviations

µg/L	micrograms per liter
µW-sec/cm^2	microwatt seconds per square centimeter
AACE	Advancement of Cost Engineering
AC	alternating-current
ac-ft	acre-feet
AML	average monthly limit
ASD	adjustable speed drive
BC	Brown and Caldwell
BCE	business case evaluation
BMP	best management practices
BOD	biological oxygen demand
BOD_5	biological oxygen demand, 5-day
BTU	British Thermal Units
CAA	Clean Air Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIP	capital improvement plan
CNG	compressed natural gas
CMU	cement masonry unit
CO_2	carbon dioxide
city	City of Boise
COMPASS	Community Planning Association of Southwest Idaho
dBA	A-weighted decibels
DC	direct-current
d/D	depth over diameter
DGE	diesel-equivalent gallons
EPA	Environmental Protection Agency
FOG	fats, oils, and grease
ft	foot
ft/sec	feet per second
GAC	granular activated carbon
gal	gallons
GEE	gallon ethanol equivalent
gpd	gallons per day
gpd/ft^2	gallons per day per square foot
gph	gallons per hour
gpm	gallons per minute
H_2O	moisture
H_2S	hydrogen sulfide
ha	hectare
hr	hour
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IPC	Idaho Power Company
IPDES	Idaho Pollution Discharge Elimination System
kg	kilograms
KWhr	kilowatt hour
lbs	pounds
lb/ft^2	pounds per square foot
Lander Street WRF	Lander Street Water Renewal Facility
LCFS	low carbon fuel standard
MBtu	one thousand British Thermal Units
MDL	method detection limit
mg	milligrams
mg Al/L	milligrams of aluminum per liter.
mg-min/L	milligrams per minute per liter
mgd	million gallons per day
min	minutes
MMBtu	one million British Thermal Units
MW	megawatt
MWh	megawatt hour
NAAQS	National Ambient Air Quality Standards
NH_3	ammonia
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NREL	National Renewable Energy Laboratory
NTU	nephelometric turbidity unit
O&M	operations and maintenance
PFAS	per- and polyfluoroalkyl substances
PPDU	people per dwelling unit
PRF	phosphorus removal facility
PSA	pressure swing adsorption
PTAC	PTAC potential total cost of assets

PTC	Permit to Construct
PURPA	Public Utilities Regulatory Policies Act
PV	photovoltaic
R&R	repair and replacement
RIN	Renewable Identification Number
RNG	renewable natural gas
scf	standard cubic feet
scfm	standard cubic feet per minute
sec^{-1}	per second
SIU	significant industrial user
SPORE	System Planning, Operations, Rehabilitation, and Evaluation
STEP	Secondary Treatment Enhancement Project
S.U.	standard unit
SVI	sludge volume index
TAZ	Traffic Analysis Zones
TDH	total dynamic head
TMDL	total maximum daily load
TMSBAS	Twenty Mile South Biosolids Application Site
TP	total phosphorus
TSS	total suspended solids
USGS	United States Geological Survey
UV	ultraviolet
VOC	volatile organic compound
West Boise WRF	West Boise Water Renewal Facility
WRF	water renewal facility
WRS	Water Renewal Services
Utility Plan	Water Renewal Utility Plan
WSE	water surface elevation
WWTF	wastewater treatment facility
yr	year

Executive Summary

Water, public health, and protecting quality of life in Boise are central to the City of Boise's (city's) mission of "Creating a City for Everyone." Water Renewal Services, the utility within the city's Public Works Department that collects and renews used water, currently oversees approximately $2 billion in assets to help deliver these objectives. At its core, WRS protects public and environmental health in the city and the Lower Boise River watershed. These efforts have helped make the Boise River a keystone for the community and central to the city's identity.

The Water Renewal Utility Plan (Utility Plan) represents a significant evolution in resource management for our community. The water renewal industry is fundamentally shifting from one focused solely on disposing of byproducts and meeting compliance requirements to focusing on managing, recovering, and reusing resources. This mindset shift is fundamental to the development of the Utility Plan and Water Renewal Services' vision moving forward. Water Renewal Services is uniquely positioned within Boise to affect positive change at the community-scale through the products and services it can provide. The goal of the Utility Plan is to identify which of these potential products align with community interests and develop strategies for creating these products, which will allow Water Renewal Services to reinforce itself as a leader and innovator in the water renewal industry.

The Utility Plan will establish the vision for Water Renewal Services for the next several decades. At a fundamental level, its purpose is to describe how Water Renewal intends to meet its requirement to provide acceptable used water management for its service area, which includes meeting the needs of the federal Clean Water Act, Idaho's water pollution control legislation, local environmental protection and land use management covenants and agreements, and the generally held values of the public the city serves. Beyond these required minimums, the Utility Plan will establish the strategy for Water Renewal Services to meet the expectations of the community. As vocalized consistently in feedback, our community seeks more from its water. Boiseans want to use their water again, in different applications.

Planning Drivers

Planning drivers describe the primary inputs and constraints to the Utility Plan. These planning drivers establish the boundary conditions, both internal and external, that guided the planning effort. The mention of boundary conditions implies some sort of constraint. A successful long-range plan will comprehensively identify potential, actual, and perceived boundary conditions to enable developing more durable and sustainable solutions. The boundary conditions are organized into four categories: external demands, asset performance, financial capacity, and community interests.

External Demands

Boise's Water Renewal Services renews approximately 10 billion gallons of water every year. This amount is expected to increase by nearly 20 percent over the next 20 years in response to community growth. As this growth occurs, expectations for renewed water continue to become more stringent both due to regulatory requirements and from community expectations. Significant public outreach and community survey results consistently indicate that protecting and enhancing the Boise River water quality and habitat should continue to be a top priority for the city. For Water

Renewal Services, these requirements and community expectations drive capital investments and require diligent operational oversight.

Boise is also facing increasing pressures due to climate change, including greater stresses on water resources in the Treasure Valley. The city expects to see changing precipitation patterns, growing use of irrigation water and increasing drought frequency. When looked at in combination, these pressures will place an increasing value on reliable water supplies within the Treasure Valley. Water Renewal Services is uniquely positioned to support the community in continued improvement of the Boise River and in combating climate change impacts.

Asset Performance

Boise's Water Renewal Services manages approximately $2 billion in water renewal infrastructure, including five facilities and approximately 1,000 miles of collection system pipelines, making the system the largest municipal asset. This infrastructure provides collection and conveyance of used water where it can be treated and reintroduced into the environment while also allowing resource recovery. While the city has historically kept steady investment in and maintenance of the overall system, the condition and capacity of the infrastructure necessitates further investment to continue to meet the expectations of our community. Stakeholder feedback has consistently shown that providing reliable water renewal services and providing sufficient capacity for growth are baseline expectations for our community.

The city's water renewal facilities have varying levels of remaining useful life expectancy, with some requiring repair and replacement today, while others have 20 years or more of useful life remaining. To support future population growth, future economic opportunities and achieve increasingly stringent water quality regulations, the city estimates needing to increase overall system capacity by approximately 20 percent over the next 20 years. Significant investment is needed in existing infrastructure to maintain system performance and provide capacity for the future. Where and how we elect to build this capacity will have a significant influence on how we manage our renewed water in the future.

Financial Capacity

Financial capacity describes Water Renewal Services' ability to generate revenue to support ongoing operational costs and expected capital expenditures. Water Renewal Services operates as an enterprise fund within the city meaning revenues from user rates and user fees are collected to cover the cost of operations and capital funding. In 2019, the utility generated over $65 million in revenue and had capital and operating expenses of just over $60 million. The difference in these funds went to pay for future, planned expenses. Implementing the actions recommended in the plan will require further significant investment. These additional investments may drive the city to consider additional approaches to generating revenue to balance affordability and generational equity concerns with anticipated needs.

Maintaining the affordability of services while also meeting the needs of an aging and growing system requires careful planning and execution. While Boise's current water renewal rates are affordable per EPA guidelines, the impact on lower income groups cannot be overlooked. Understanding this impact and identifying potential strategies for mitigating these impacts is a key concern.

Community Interests

As our community has grown, evolved and come to expect more from the services they pay for, we determined a plan for Boise's long-term future could only be successful if it was truly representative of the unique, diverse fabric of our community. The decisions contemplated throughout the course of the Utility Plan are generational decisions that will require significant investment by the community. Therefore, it is critically important to both understand and align with community interests and expectations with the future investment and actions for Water Renewal Services. The approach the Water Renewal Services took to building the Utility Plan was unique in that the public took an active, front-seat role to developing the solutions from the very beginning. Our community expects the Water Renewal Utility Plan to address the following:

- Prioritize the health of the Boise River
- Maximize the environmental benefits of water use and recycling
- Decentralize assets to provide system resiliency
- Develop localized solutions that maximize resource recovery
- Create solutions for future generations

Recommended Approach

The water renewal industry is fundamentally shifting from one focused solely on disposing of byproducts and meeting compliance requirements to focusing on managing, recovering, and reusing resources. This mindset shift is fundamental to the development of the Utility Plan and Water Renewal Service's vision moving forward.

Water

The planning effort encompassed in the Utility Plan considered a wide range of potential approaches to manage renewed water in our community. After years of technical analysis and community feedback, Water Renewal Services is proposing a shift in how renewed water is managed in Boise. The Recommended Approach from the Utility Plan focuses new capacity on recycled water applications, specifically industrial recycled water and aquifer recharge. Additionally, community expectations suggest that investments should continue to be made that enhance the quality and use of the Boise River and go beyond meeting regulatory requirements. Figure ES-1 visually depicts the Recommended Approach with the emphasis on enhancing the Boise River, developing an industrial recycled water program, and pursuing aquifer recharge.

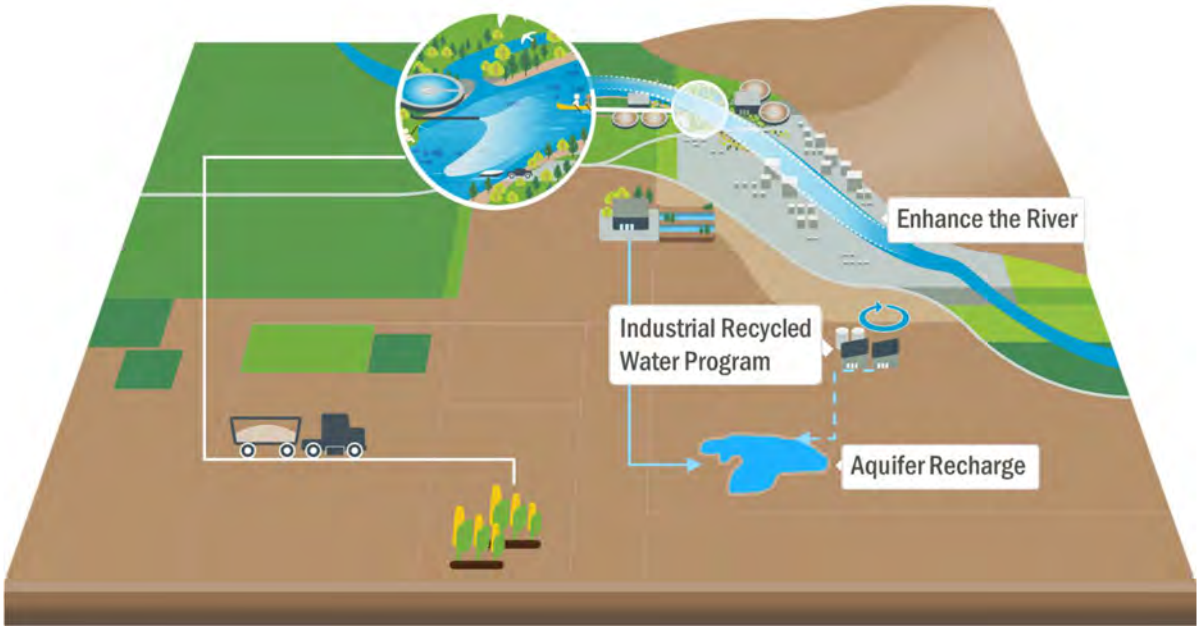

Figure ES-1. Recommended approach overview

The Recommended Approach will manage and leverage growth in new ways. It is expected that proposed new water renewal facilities would be built closer to where growth is projected to occur and closer to areas for aquifer recharge and industrial reuse (see Figure ES-1). This decentralized approach to water renewal management satisfies public concerns around centralized risk, makes better use of our water resources, and lowers the cost to transport recycled water to areas where it can be beneficially used. Utilizing the existing infrastructure at the Lander Street and West Boise Water Renewal Facilities also allows the city to maximize previous investments.

The Recommended Approach also positions the city to respond to future water challenges by diversifying what the city does with its renewed water. The results of the business case evaluation demonstrated that this approach is the best option to manage near and long-term risks. It also allows the city to be flexible to best manage water resources in the future as conditions continue to change. This plan can be viewed as a steppingstone that positions Boise to address future challenges without overinvesting in the near-term.

Inherent with the Recommended Approach is the commitment by the city to continue to be guided by community values. The development of the Utility Plan was built with over 2,700 interactions with the community. These efforts highlighted the community's expectations to protect the Boise River, diversify our uses of renewed water, and find economic solutions to our challenges. The recommended approach is the embodiment of these expectations.

Energy

WRS has an important role in the implementation of Boise's Energy Future. The WRS utility is the largest energy user operated by the city, but it may also be the user with the most potential clean and renewable energy production. By capitalizing on resources recovered during treatment processes (e.g., digester gas) and investing in solar energy generation and/or clean energy purchase, WRS can become a net zero energy utility, leading the way in meeting Boise's Energy Future's electricity and thermal energy goals. Through collaboration with community energy suppliers such as Intermountain Gas Company and Idaho Power Company, Water Renewal Services seeks to develop innovative solutions to achieve thermal and electrical energy goals. Continued engagement with the community and investment in sustainable energy solutions will contribute to a resilient utility that is economically viable and environmentally responsible, reducing greenhouse gas emissions and protecting the health of the community and conserving natural resources.

Other Products

The city has been proactive in identifying and investing in approaches to manage solids products created by Water Renewal Services. Since the 1990s the city has used biosolids as the primary fertilizer source at the city-owned and operated Twenty Mile South Biosolids Application Site. More recently, the West Boise Water Renewal Facility began producing struvite, a valuable byproduct of the phosphorus removal process. This product is sold to a third-party for incorporating in commercial fertilizers. Given the successful history of these programs, the city intends to continue on the current path for biosolids and struvite production.

Summary

The Utility Plan’s Recommended Approach is a plan for Boise, built by Boise. It includes diversifying the uses of our water and enhancing the health and quality of the Boise River. This approach offers flexibility for the city to adapt its strategy as conditions change in the future. It allows for a scalable approach toward recycled water that will allow the city to efficiently expand its recycled water options as the value of water increases. Further, the approach includes further investments by Water Renewal Services to support Boise’s Energy Future and continued production of existing solids products.

Implementation

The Utility Plan is different from historical Water Renewal Services plans. The Utility Plan recognizes Water Renewal Services now operates in a more dynamic set of external and internal conditions. The Utility Plan describes long-term goals and how those are founded on community interests and values. However, the Utility Plan recognizes the precise investments Water Renewal Services will need to undertake will require adapting to changing community needs.

The Utility Plan is a programmatic versus prescriptive plan. Consequently, the preferred alternative relies on continual monitoring and planning with smaller, incremental additions of new capacity and asset replacement. This approach provides ample opportunity to adapt the program to match actual demands and more easily advance product management. Utility Plan implementation will require WRS to adapt some of its current business practices and will drive different staffing and operational considerations.

Section 1

Introduction

Water, public health, and protecting quality of life in Boise are central to the City of Boise's (city's) mission of "Creating a City for Everyone." Water Renewal Services (WRS), the utility within the city's Public Works Department that collects and renews used water, currently oversees approximately $2 billion in assets to help deliver these objectives. At its core, WRS protects public and environmental health in the city and the Lower Boise River watershed. These efforts have helped make the Boise River a keystone for the community and central to the city's identity.

WRS manages five facilities and over 900 miles of buried pipelines to renew more than 10 billion gallons of used water per year. The system was built throughout the twentieth century, and large portions of the $2 billion in assets need to be repaired, refurbished, or replaced over the next several decades. These investments, in combination with the impacts of climate change and community expectations, create an ideal nexus for strategically looking forward and best leveraging upcoming infrastructure investments and operational practices to meet emerging utility drivers.

With these things in mind, in 2015 the city embarked on a planning effort to best align these future investments with community goals. This deliberate 5-year effort took a strategic approach to first understanding needs and then identifying innovative solutions to meet them. The approach is rooted in a multifaceted community engagement strategy executed to allow the city to best understand community expectations and align future actions within the Water Renewal Utility Plan (the Utility Plan). The Utility Plan creates the long-term strategic direction for WRS and will reinforce the city's position as a national environmental leader and innovator.

1.1 City of Boise Background

The Boise River, and the city that bears its name, has a long and rich history. For thousands of years Indigenous people in the Great Basin and Treasure Valley sustained themselves from the plants, animals, and fish supported by the rivers. The river is and has long been the center of the Treasure Valley. Outside of Native Americans and fur trappers, not many people lived along the banks of the Boise River until the 1800s following Lewis and Clark's expedition west when gold was found. Many of the settlers made their way towards the river hoping to find a better life. While many found nothing, the French-Canadian fur trappers dominated the area and grew prosperous.

Much has been contested with the river over the years, even its name. The Boise River was also historically known by British fur traders as The Wooded River, Wood River, or Reed's (Reid's) River in memory of John Reid's failed post in 1813. The French insisted the "the wooded river," La rivière boisée, best represented the river. Legend has it the name was in dispute until 1833 when French Captain B. L. E. Bonneville arrived during an information-gathering expedition and upon reaching the river exclaimed, "Les bois! Les bois!" or, "The trees! The trees!"[1]

The original Fort Boise was 40 miles (64 kilometers) west of the current city, near the confluence of the Boise River with the Snake River at the Oregon border. This fort was erected by the Hudson's Bay Company in the 1830s. It was abandoned in the 1850s but later re-established during the Civil War.

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[1] Machie, Raven. *The History of the Boise River*. Boise State University, 1 Jul. 2018, https://www.theodysseyonline.com/history-boise-river.

The new location was selected because it was near the intersection of the Oregon Trail and a major road connecting the Boise Basin (Idaho City) and the Owyhee mining areas, both booming at the time. The area is now the Boise VA Medical Center and Military Reserve.[2]

The Boise River and its multiple resources has often made it the center of controversy—and even its demise. Prior to the early 1900s and the construction of the Arrowrock Dam, the Boise River was free flowing and meandered widely through the Treasure Valley. Highly seasonal flows from storm and snowmelt runoff led to frequent severe flooding. Consequently, most of the pre-twentieth century development occurred south of the river in "the Bench" area (Figure 1-1).

Figure 1-1. Historical Boise

Business and government leaders completed large-scale irrigation systems like the New York Canal to foster agriculture in the late nineteenth century. In Boise's early years, the river was used to dispose of garbage, sewage, detergents, and processing plant waste. These wastes included grease, potato peelings, beet pulp, manure, blood, and other pollutants that reportedly caused "mountains of foam" in the river. Such that by the 1940s these practices posed major public and environmental health hazards. The community responded, and, through a combination of local, state, and federal initiatives, the city began to reclaim the river. The Federal Water Pollution Control Act of 1948 authorized federal assistance for building the Lander Street sewage treatment plant, and in 1949 the city banned all trash disposals except at designated landfills. Consequently, river contamination slowly subsided. Congressional approval of Public Law 92-500 (the Clean Water Act) in 1972 officially put the United States on record as recognizing that nearly everyone is downstream from someone else, and the public's interest is served by making the waters of the nation "fishable and swimmable." Prudent management of human waste in the United States is today a generally accepted norm. While costly, this approach is clearly effective in protecting public health and environmental quality, provided it is properly planned and implemented.

With the river becoming less of a sewer and more of an attraction, the city initiated the greenbelt trail along the Boise River in the 1960s. By 1982, 6 miles of development had been completed, connecting all of Boise's river-area parks. By the end of the 1970s, critical estuary habitat for fish and wildlife also improved with the Idaho Minimum Stream Program approved by the Idaho Legislature in 1978.[3] Since then the city and the community have continued to rally around the river, enhancing water quality and increasing public access while preserving the water resources for agricultural, industrial, and recreational use. The Boise River is a prized environmental asset for our community (Figure 1-2).

[2] Shallat, Todd. *Boise's Beginnings*. Boise State University, https://northend.org/boises-beginnings/.

[3] *History of Boise*. Boise Unitarian Universalist Fellowship, http://www.boiseuu.org/msearch/brochures/HistoryOfBoise.pdf, pp 4-5.

Figure 1-2. Boise residents floating the Boise River

1.2 Water Renewal Services Background

In order to understand the current state of WRS and water renewal, it is important to understand their history. The first sewers in Boise were installed during the 1890s, and from then until 1948 untreated sewage was discharged directly to the Boise River. In the late 1940s, the League of Women Voters championed an effort to build the city's first water renewal facility (WRF). This facility, the Lander Street WRF (Lander Street WRF), was commissioned in 1948 and has been a cornerstone of the city's water renewal system for decades. The Bench Sewer District, the Northwest Boise Sewer District, and the West Boise Sewer District were also formed during this time to provide used water conveyance services in the city's expanding areas.

The city's water renewal service continued to expand in the following decades to meet the demands of the growing city. The city commissioned the second WRF, the West Boise WRF (West Boise WRF), in 1976. The new facility treated used water from the growing, western portion of the city. In conjunction with the West Boise WRF construction, the Garden City WRF was abandoned, and its used water was conveyed to the West Boise WRF for treatment. In 1992, the city extended sewers into the Southwest Ada County Alliance region, to the south and west of the Boise city limits, at the request of the Ada County Board of County Commissioners. In 1997, Eagle Sewer District connected to the city's system.

WRS also has a long history of innovative solutions. In the mid-1990s, the city purchased 2,400 acres approximately 20 miles south of the city for managing biosolids from the WRFs. This area, known as the Twenty Mile South Biosolids Application Site (TMSBAS), is a fully functioning farming operation. Since the original purchase, the city has added another 1,900 acres for future use. Building on this innovative mindset, the city constructed the Dixie Drain Phosphorus Removal Facility (PRF) in the mid-2010s. This facility, the first of its kind in the country, enhances the water quality of the Boise and Snake Rivers by removing up to 140 pounds of phosphorus per day from water flowing downstream. During this period, WRS also constructed one of the first struvite nutrient recovery facilities in North America at the West Boise WRF, which allows the city to capture and beneficially remove phosphorus from the water renewal process.

For over 70 years the city has been a leader in the water renewal (i.e., wastewater) industry. In 2017 the city renamed the sewer utility as WRS. With this renaming came the tagline for WRS, "We give new life to used water." This renaming is meant to embody the city's commitment to using used water as a resource. The Utility Plan sets the vision for this commitment for WRS moving forward.

1.3 Purpose of the Utility Plan

The Utility Plan will establish the vision for WRS for the next several decades. At a fundamental level, its purpose is to describe how WRS intends to meet its requirement to provide acceptable used water management for its service area, which includes meeting the needs of the federal Clean Water Act, Idaho's water pollution control legislation, local environmental protection and land use management covenants and agreements, and the generally held values of the public the city serves. Beyond these required minimums, the Utility Plan will establish the strategy for WRS to meet the expectations of the community.

Even without the forward-looking and innovative spirit of WRS, planning is a required activity for all water renewal utilities. Failure to plan can have many negative consequences for the city. Most directly, failure to plan would result in violation of the National Pollutant Discharge Elimination System (NPDES) permits issued to each of the WRFs. Such a violation carries with it a suite of penalties, including no additional connections to the sewers' tributaries to city facilities, no new issuances of service agreements to large employers, and fines of up to $10,000 per day. These penalties may remain in force until an acceptable facilities plan is prepared and its elements are implemented in a timely fashion. A potential effect of these penalties could be a moratorium on all growth at the city. In the face of a moratorium on growth in Boise's service area, desperation may eclipse the opportunity for thoughtful public dialogue concerning long-term water renewal management possibilities. Expediency has the potential to replace care and effectiveness, and environmental stewardship could take a back seat to economic concerns. Timely preparation of a reasoned plan is safer for the environment, less damaging to the local economy, and more conducive to predictable and managed growth.

1.4 Programmatic Planning Approach

Water renewal planning is simple—and complicated. System performance can be assessed and predicted to generate a capital improvement program (CIP), but the investment road map must be adaptable to changing conditions while working within available organizational and financial capacity. Regulations establish minimum performance requirements—satisfying permit requirements is critical. But these requirements continually change and may not meet the community's performance expectations. Technology offers many potential solutions, but understanding the community's interests first helps to set the additional criteria necessary to select the best approaches to strategically achieve Boise's goals.

The city has taken a straightforward, but innovative, approach to executing its planning effort. The backbone of this planning effort was a robust stakeholder engagement effort focused on testing ideas throughout the planning process, shown on the outside of Figure 1-3. Developing the technical plan, shown on the interior of Figure 1-3, followed a three-step process:

1. Define the current state of the utility: challenges and opportunities, treatment capacity, financial capacity, ratepayer expectations, and external demands
2. Develop and select the preferred outcomes for the 20-year capital planning horizon
3. Prepare the strategy and implementation plan to achieve the preferred outcome

This stepwise approach to planning provides an opportunity to define the challenge prior to developing solutions. Deliberately defining the current conditions and challenges prior to developing solutions confirms solutions meet the city's goals. Each of the phases was rooted in a robust stakeholder engagement effort allowing the city to focus on solutions with community interest.

Figure 1-3. Boundary conditions and programmatic planning

1.5 Moving from Compliance to Product Management

The water renewal industry is fundamentally shifting from one focused solely on disposing of byproducts and meeting compliance requirements to focusing on managing, recovering, and reusing resources. This shift is embodied in the *Utility of the Future Program* developed by the Water Environment Federation, the National Association of Clean Water Agencies, the Water Research Foundation, and the WaterReuse Association. In developing this program, these agencies placed a high priority on recognizing utilities that recover and reuse a full range of resources. These forward-thinking utilities are leaders and innovators in the industry and the city wants to continue to serve in this leadership role.

This mindset shift is fundamental to the development of the Utility Plan and WRS's vision moving forward. WRS is uniquely positioned within Boise to affect positive change at the community-scale through the products and services it can provide. The goal of the Utility Plan is to identify which of these potential products align with community interests and develop strategies for creating these products, which will allow WRS to reinforce itself as a leader and innovator in the water renewal industry.

1.6 Overview of the Utility Plan

The Utility Plan documents the results of nearly 5 years of work by WRS. This document is intended to summarize the work completed over this period to better understand the existing system, determine stakeholder expectations, identify potential solutions, and ultimately implement these solutions. To this end, the Utility Plan is organized into the following sections:

- **Section 1—Introduction**: Factors such as population growth and increasing regulatory constraints on river discharge have changed the water renewal landscape in Boise. Section 1 provides context for the water renewal planning effort captured in the Utility Plan.
- **Section 2—Planning Drivers:** The Utility Plan must work within several constraints, including external demands/drivers, asset condition and capacity, organizational and financial capacity, and stakeholder expectations. Section 2 describes the primary constraints used to guide the planning effort.
- **Section 3—Water Products:** The Utility Plan recommends WRS pursue several new water products, including the production of recycled water. Section 3 describes the expectations for each of these water products, including discussions of the people, projects, and pricing required to carry out recycled water production.
- **Section 4—Energy Products:** The city recently adopted Boise's Energy Future, which describes the city-wide approach to achieving renewable energy goals. Section 4 describes how WRS will align and contribute to meeting these goals.
- **Section 5—Other Products:** Beyond water and energy, WRS also produces solids products, such as biosolids and struvite. Section 5 outlines the expectations for managing these products moving forward.
- **Section 6—Policies**: Achieving the goals and outcomes described in the Utility Plan will require a shift in the business processes and policies for WRS. Section 6 identifies several key policy considerations the city may need to revisit and/or develop as the Utility Plan is implemented.
- **Section 7—Implementation:** Realizing the vision described in the Utility Plan will require changes to the WRS organization, business processes, revenue generation approach, and interaction with stakeholders. Section 7 describes how various aspects of the WRS business model will need to change to sustain the direction described in the Utility Plan.

The Utility Plan is supported by many additional documents developed throughout the course of this planning effort, and there are references to the supporting technical memorandums developed around specific issues. These technical memorandums contain detailed information on specific assessments, analyses, and approaches completed during the planning process. The outcomes from these documents are summarized in the Utility Plan.

The Utility Plan is also supported by eight planning documents specific to current and planned, major facilities or assets within the water renewal system. These documents more closely match the "traditional" facility and master plans prepared by utilities. The Utility Plan is meant to describe system-level constraints and expected outcomes for WRS. It also describes how each of the major assets will be leveraged to achieve the outcomes described in the Utility Plan. Using this information, each of the planning documents identify how these expectations will be achieved for each of the system assets. This includes a discussion of current design conditions, future design expectations, and capital and operating investments to achieve the future expectations. The information developed in the planning documents related to implementation approaches from each of the planning documents was used to develop Section 7 of the Utility Plan. Figure 1-4. below depicts the relationship between the documents.

Figure 1-4. Relationship between Utility Plan and planning documents

Section 2

Planning Drivers

The Planning Drivers section of the Utility Plan introduces the primary inputs and constraints to the Utility Plan. These planning drivers establish the boundary conditions, both internal and external, that guided the planning effort. The mention of boundary conditions implies some sort of constraint. A successful long-range plan will comprehensively identify potential, actual, and perceived boundary conditions to enable developing more durable and sustainable solutions. As described previously in the planning approach, the boundary conditions are organized into four categories:

- **External demands** describe external factors directly or indirectly affecting system performance including population, flow and load forecasts, and regulatory requirements. The city may have little or no direct control over these factors but will need to respond to them.
- **Asset performance** explains the condition, age, and capacity of different parts of the system. This condition includes both physical system components as well as organizational considerations.
- **Financial capacity** depicts the utility's ability to generate revenue to cover operational and capital commitments within the current financial policy framework.
- **Community interests** describes the community expectations related to direct and/or indirect consequences of the utility's activities.

The most viable solutions will develop strategies to remain within these boundaries (Figure 2-1). The following sections summarize the constraints imposed by these boundary conditions.

Figure 2-1. Planning boundary conditions

2.1 Planning Area and Population Forecasts

The planning area defines the service area for WRS for the purpose of planning population growth and used water flow forecasts. The separate planning areas have different rates of development which are considered when projecting flows.

2.1.1 Planning Area

The utility planning boundary is generally defined by the city's area of impact boundaries. Population and employment numbers are included for the cities of Eagle and Garden City, both of which contribute used water to the City of Boise under existing agreements. The West Boise Sewer District is located within city limits but is a separate sewer district that sends used water to the City of Boise for treatment.

Several areas to the south of Boise's area of impact are defined as potential expansion areas, including East Columbia and Ten Mile Creek. Figure 2-2 shows the utility planning boundary and surrounding areas that are summarized in this report.

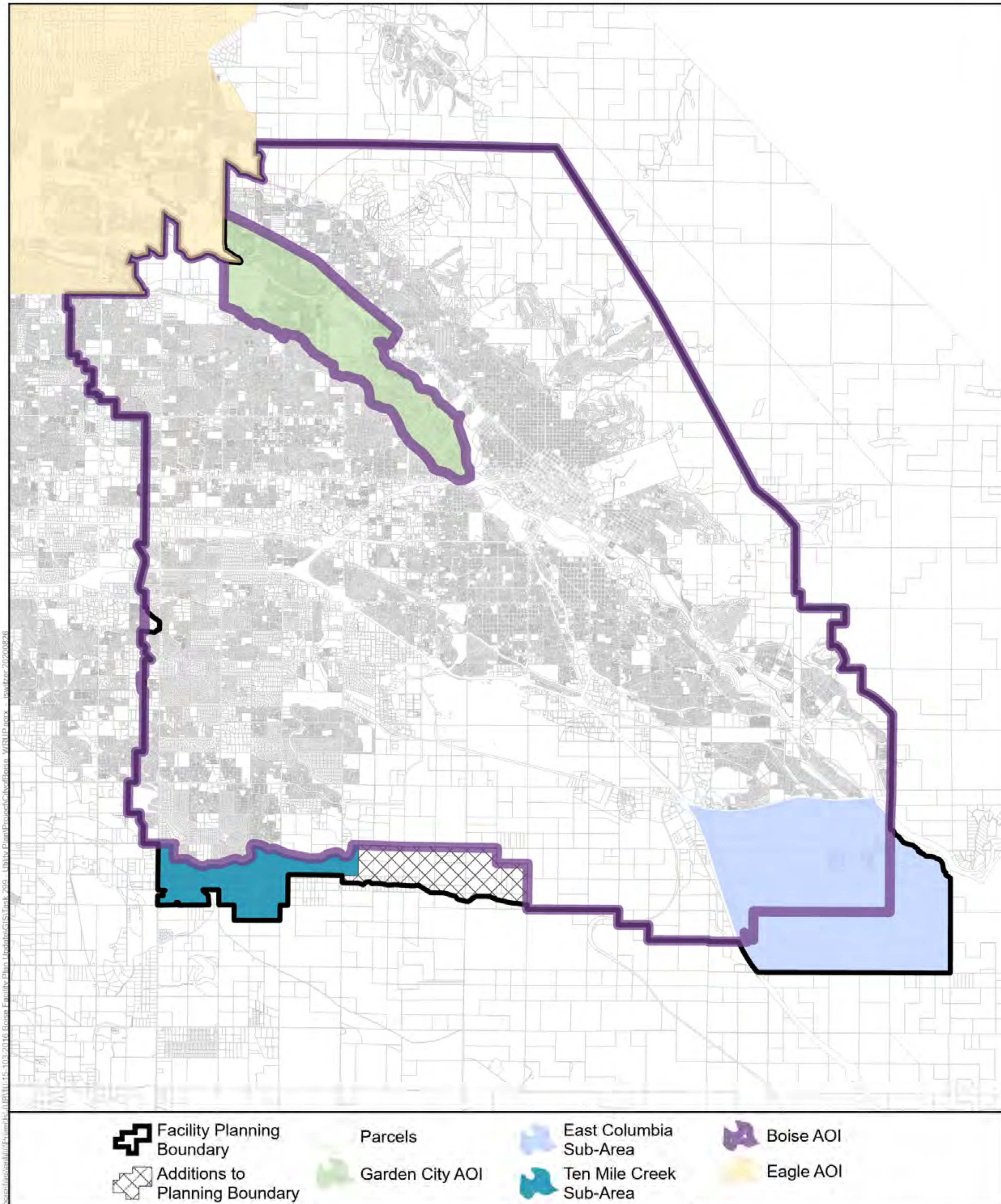
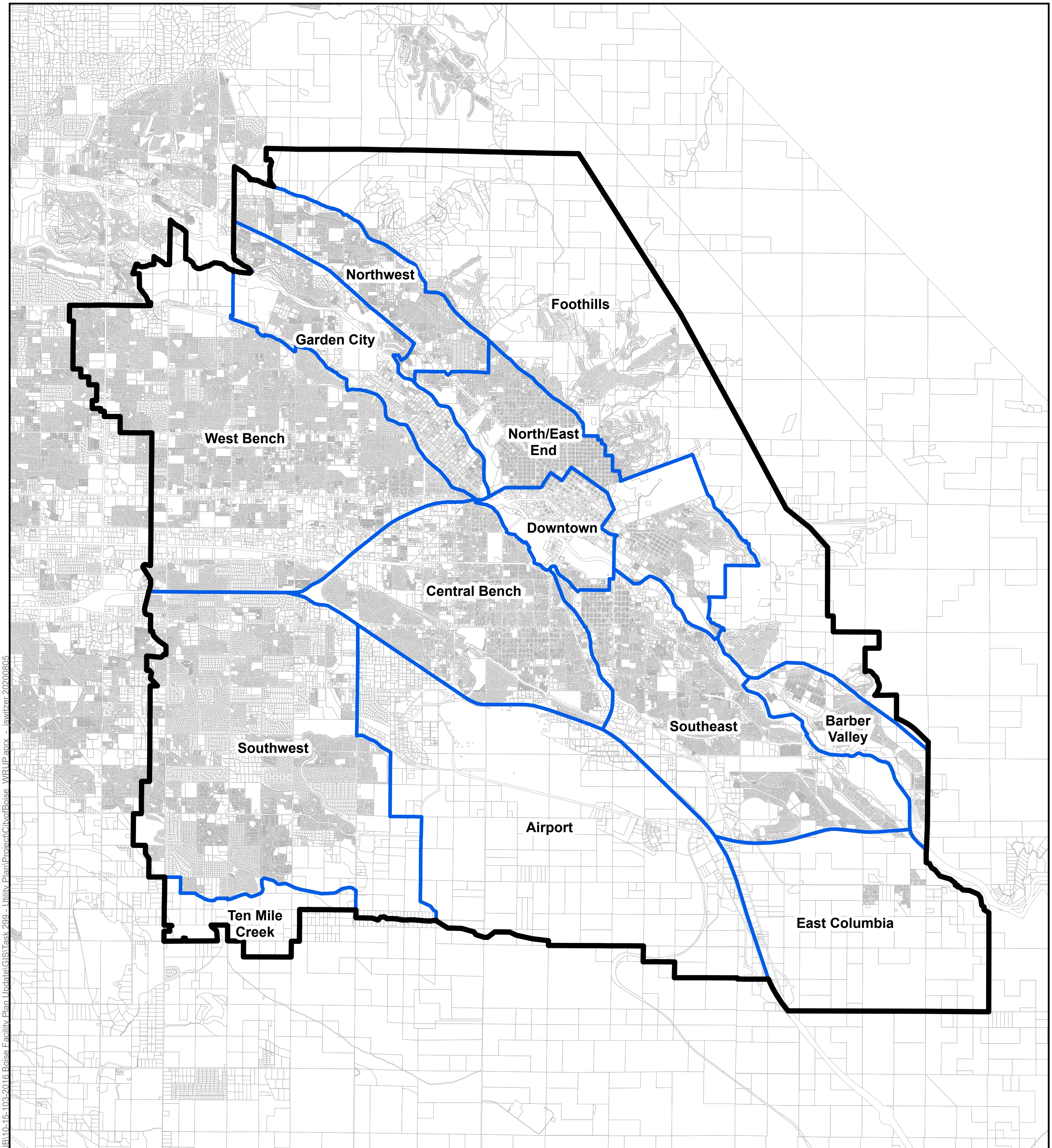


Figure #2-2
Utility Planning Boundary
Water Renewal Utility Plan

2.1.2 Population and Employment Forecasts

The Community Planning Association of Southwest Idaho (COMPASS) prepares current and future population and employment forecasts for the Treasure Valley each year. Its current forecasts for 2015 and 2040 population and employment numbers are summarized by Traffic Analysis Zones (TAZs). In areas where the TAZ boundaries overlapped or fell outside of the facility planning boundary, the TAZs were split to match the facility planning boundary as well as the city planning areas (see Figure 2-3) contained in Blueprint Boise, a city-wide planning document.



Facility Planning Boundary

City Planning Areas

Parcels

CITY OF BOISE WATER RENEWAL UTILITY PLAN

Brown AND Caldwell

JACOBS JUB ATLAS FCS GROUP

0 0.5 1 2 3 4

Miles

Figure #2-3
City Planning Areas
Water Renewal Utility Plan

The population and employment forecasts were distributed amongst the split TAZs based on area, existing development, land use type, and other parcel data. Population and employment forecasts were initially developed in 2015 at the start of the planning process. The estimated 2015 population in the facility planning boundary is 261,123. The estimated 2015 employment number is 172,763. The 2015 and 2040 population and employment data are summarized below in Table 2-1. and Table 2-2, respectively.

Buildout projections do not have a defined timeframe and do not include employment numbers. Buildout population estimates were based on recommended future land use densities and projected 2040 people per dwelling unit (PPDU) estimates.

Table 2-1. 2015 COMPASS population and employment forecasts

City Planning Area [a]	Acres	PPDU [b]	Population [c]	Households	Employment
Airport	11,115	2.53	953	376	12,378
Barber Valley	1,735	2.51	4,934	1,966	572
Central Bench	6,106	2.28	39,655	17,406	26,469
Downtown	1,556	1.58	6,217	3,926	31,368
Foothills	14,861	2.41	9,850	4,083	1,679
North/East End	4,682	2.12	25,555	12,071	17,092
Northwest	2,673	2.31	15,240	6,610	3,869
Southeast	6,869	2.28	34,335	15,081	14,255
Southwest	10,896	2.90	43,555	15,044	13,732
West Bench	11,808	2.64	80,446	30,492	44,770
Ten Mile Creek	1,416	2.74	63	23	13
East Columbia	6,204	2.29	320	140	6,566
Total	79,921	2.44	261,123	107,218	172,763

[a] *City planning areas correspond to Blueprint Boise.*

[b] *PPDU values are not provided by COMPASS. They are calculated from COMPASS-provided population and household data.*

[c] *The City's draft NPDES permit application contains a higher population estimate based on updated information.*

Table 2-2. 2040 COMPASS population and employment forecasts

City Planning Area [a]	Acres	PPDU [b]	Population	Household	Employment
Airport	11,115	2.43	830	341	28,827
Barber Valley	1,735	2.39	7,865	3,297	827
Central Bench	6,106	2.09	48,665	23,300	32,970
Downtown	1,556	1.58	14,344	9,081	52,351
Foothills	14,861	2.31	11,006	4,763	1,732
North/East End	4,682	2.00	28,330	14,195	22,006
Northwest	2,673	2.13	23,285	10,917	5,737
Southeast	6,869	2.11	38,074	18,058	23,345
Southwest	10,896	2.63	52,979	20,170	19,277
West Bench	11,808	2.41	89,783	37,298	56,574
Ten Mile Creek	1,416	2.68	67	25	14
East Columbia	6,204	2.34	9,800	4,193	9,593
Total	**79,921**	**2.23**	**325,028**	**145,638**	**253,253**

[a] *City planning areas correspond to Blueprint Boise.*

[b] *PPDU values are not provided by COMPASS. They are calculated from COMPASS-provided population and household data.*

Table 2-3. Buildout population and employment forecasts

City Planning Area [a]	Acres	PPDU [b]	Population	Household
Airport	11,115	2.43	1,447	594
Barber Valley	1,735	2.39	12,343	5,174
Central Bench	6,106	2.09	48,665	23,300
Downtown	1,556	1.58	14,344	9,081
Foothills	14,861	2.31	24,848	10,753
North/East End	4,682	2.00	28,330	14,195
Northwest	2,673	2.13	23,285	10,917
Southeast	6,869	2.11	40,371	19,148
Southwest	10,896	2.63	76,967	29,303
West Bench	11,808	2.41	89,783	37,298
Ten Mile Creek	1,416	2.68	14,789	5,518
East Columbia	6,204	2.34	49,625	21,232
Total	**79,921**	**2.28**	**424,797**	**186,514**

[a] *City planning areas correspond to Blueprint Boise.*

[b] *PPDU values are not provided by COMPASS. They are calculated from COMPASS-provided population and household data.*

Population and employment numbers for the cities of Eagle and Garden City and expansion areas outside of the current facility planning boundary are summarized in Table 2-5 and Table 2-6.

The populations summarized in Table 2-2 include those not currently connected to the city's sewer system. Table 2-4 summarizes the households and related populations currently on septic systems.

The number of septic systems was determined using the city's database of those who have city sewer available (within 80 feet of the parcel) but have not yet connected.

Table 2-4. Population with septic systems

City Planning Area	Population	Household
Airport	867	342
Barber Valley	188	75
Central Bench	178	78
Downtown	2	1
Foothills	376	156
North/East End	49	23
Northwest	376	163
Southeast	127	56
Southwest	10,981	3,793
West Bench	1,348	511
Ten Mile Creek	93	34
East Columbia	37	16
Boise area of impact total	**14,622**	**5,248**

The city receives and renews used water for both the Eagle Sewer District and Garden City under current agreements with each utility.

TAZ data from COMPASS and the Eagle Sewer District Facility Plan (January 2016 Draft) were used to forecast the 2015 and 2040 population and employment numbers for the Eagle Sewer District. However, buildout projections were not established for the Eagle Sewer District. Table 2-5 summarizes current forecasts.

Table 2-5. Population and employment—Eagle Sewer District

Estimate/Projection	Acres	PPDU [a]	Population	Households	Employment
2015 total [b]	20,975	2.84	26,690	9,403	9,917
2015 connected [c]		2.34	18,500	7,900	–
2040		2.63	50,656	19,291	19,655

[a] *PPDU values are not provided by COMPASS. They are calculated from COMPASS-provided population and household data.*

[b] *2015 total estimates were derived from COMPASS TAZ data for the approximate service area of the Eagle Sewer District.*

[c] *2015 connected estimates are from the Eagle Sewer District Facility Plan (January 2016 Draft). Employment numbers were not defined in the Draft Facility Plan.*

TAZ data from COMPASS and the 2006 Garden City Comprehensive Plan were used to forecast population and employment numbers for Garden City. COMPASS estimated Garden City's population to be 12,325 in 2015. Table 2-6 summarizes the current forecasts.

Table 2-6. Population and employment—Garden City					
Estimate/Projection	Acres	PPDU [a]	Population	Households	Employment
2015	3,359	2.26	12,325	5,457	9,324
2040		2.10	18,546	8,849	15,038
Buildout		2.35	28,325	12,057	–

[a] PPDU values are not provided by COMPASS. They are calculated from COMPASS-provided population and household data.

Table 2-7 provides a summary of the population and employment forecasts for the City of Boise, Eagle Sewer District, and Garden City.

Table 2-7. Population and employment—summary						
City	Estimate/Projection	Acres	PPDU	Population	Households	Employment
Boise	2015	79,921	2.44	261,123	107,218	172,763
	2040		2.23	325,028	145,638	253,253
	Buildout		2.28	424,797	186,514	–
Eagle Sewer District	2015 total	20,975	2.84	26,690	9,403	9,917
	2015 connected		2.34	18,500	7,900	–
	2040		2.63	50,656	19,291	19,655
Garden City	2015	3,359	2.26	12,325	5,457	9,324
	2040		2.10	18,546	8,849	15,038
	Buildout		2.35	28,325	12,057	–

2.2 External Demands

The external demands on the WRFs can be broken down into two categories: what is coming into the city's WRFs (flows and loads) and what is coming out of the WRFs (renewed water that meets regulatory requirements). These two demands dictate when WRFs will be expanded to manage incoming flows and loads and the type of treatment needs to be installed at the WRFs in order to meet regulatory requirements.

2.2.1 Flows and Loads

The following sections summarize the flows and loads for both of the city's existing WRF and two potential future WRFs being proposed in the Utility Plan. The future WRFs include a 5-million gallons per day (mgd) industrial-focused facility and a 3-mgd municipal facility. Reference Section 3.2 Future Water Products for further information on the future WRFs. The data include existing conditions and projections for 2030, 2035, 2040, and buildout of the facility planning boundary (see Table 2-4). The original flow and load projections were completed in February 2017 and subsequently updated in 2018 and 2020.

The 2018 update to the projections incorporated new information including capturing the effects of the 2017 peak flow events. The following changes were included:

- Updated peak infiltration assumptions based on additional flow monitoring completed in April and May of 2017 with the Boise River running above flood stage.

- A revised future design flow for Lander Street WRF of 17 mgd, compared to the previous 15 mgd target.
- Assumptions for future growth from the Eagle Sewer District (2016), compared to limiting the Eagle Sewer District to its current permit limit.
- Updated permit limits for significant industrial users (SIU).
- Additional flows and loads estimated for redevelopment of existing areas of the city.
- Minor adjustments to the study area boundary.

The final flow and load projections, completed in 2020 and included in the tables below, incorporated the following changes:

- Revisions to reflect the preferred approach, including the addition of two future facilities (Third and Fourth WRFs).
- Modified future design limits for the Lander Street WRF to a peak month flow of 17.0 mgd and/or a peak month biological oxygen demand (BOD) loading of 33,150 lbs/day.
- Peak month design flow of 25.5 mgd set for the West Boise WRF.
- SIU data updated and future industrial SIU flows and loads beyond current SIU permit limits allocated.

2.2.1.1 Flow and Load Components

Used water can be summarized by the various components that make up the total flows and loads. These components include sanitary flows (residential, commercial, light industrial), contracted utilities (Eagle Sewer District, Garden City), permitted SIUs, infiltration, and other miscellaneous flows.

Current flows and loads were projected using sewer billing data and monthly reports in the initial phase of the planning process (2015). Infiltration estimates were based on flow monitoring data collected through numerous projects in the past, with the most recent in 2017.

Unit flows were also calculated from sewer billing data. Residential single-family unit flows were determined to be an average of 150 gallons per day per dwelling unit. The previous Facility Plan (2010) determined this unit flow to be 170 gallons per dwelling unit. The reduction is attributed to an increase of low flow/high efficiency fixtures and appliances. The reduced residential unit flows also explain why WRF flows remain relatively stable while the population has continued to rise.

The city is currently contracted to accept used water from the Eagle Sewer District and Garden City. Garden City future flows and loads were projected using its comprehensive plan as a guide, with growth coming from infill. Future flows and loads for the Eagle Sewer District were based on its 2016 Facility Plan. Because these projections were taken from an external document, they are presented separately from others and summarized in Table 2-8.

Table 2-8. Flow and loads—Eagle Sewer District					
Date	Flow (gpd [a])	BOD (lbs/day)	TSS [b] (lbs/day)	Ammonia (lbs/day)	TP [c] (lbs/day)
Current	2,269,000	1,300	1,700	480	94 [d]
2030 [c]	3,500,000	2,100	2,600	740	150
2035 [c]	4,300,000	2,500	3,200	910	180
2040 [c]	5,300,000	3,100	4,000	1,100	220

[a] *gpd = gallons per day.*

[b] *TSS = total suspended solids.*

[c] *TP = total phosphorus.*

[d] *Estimated flow/load limit.*

Permitted SIUs were set to their permitted limits for all future flow and load projections. Table 2-9 shows each permitted SIU and the associated flow and loading limits used in these projections. If permitted limits were not included for a SIU, estimates were developed using maximum monthly average flows and average loading concentrations. The flow and loadings from breweries are also included in Table 2-9 as they are contracted dischargers.

Table 2-9. Flow and loads—permitted SIUs and contracted dischargers					
SIU	Flow (gpd)	BOD (lbs/day)	TSS (lbs/day)	Ammonia (lbs/day)	TP (lbs/day)
Technology industries	4,755,000	1,120	1,250	980	140
Food processing industries	515,000	4,580	2,240	30	130
Breweries	8,000	910	500	0	10
Other industries	193,000	320	440	90	20

2.2.1.2 Flows

Table 2-10 summarizes current flows and projections for 2030, 2035, 2040, and buildout conditions for the entire system. Table 2-11 and Table 2-12 provide similar flow projections for the West Boise and Lander Street WRFs, respectively. The projections are based on targeting the design peak month flow of 15.7 mgd and/or peak month BOD loading of 33,150 lbs/day at the Lander Street WRF. The target design peak month capacity at the West Boise WRF in 2040 is approximately 25 mgd, which represents a slight increase from the current capacity. Adjusting the design flow to the Lander Street WRF and West Boise WRF can be accomplished by modifying the Lander Street and/or Americana diversions. The city's approach to managing capacity is further described in Section 7.

Table 2-10. Flow projections—combined WRFs					
Flow Description	Current (mgd)	2030 (mgd)	2035 (mgd)	2040 (mgd)	Buildout (mgd)
Average annual	27.6	35.6	37.7	39.7	54.6
Peak month	35.8	43.9	46.0	47.9	62.8
Peak week	36.4	44.5	46.5	48.5	63.4
Peak day	41.4	49.4	51.5	53.4	68.4

Table 2-11. Flow projections—West Boise WRF					
Flow Description	Current (mgd)	2030 (mgd)	2035 (mgd)	2040 (mgd)	Buildout (mgd)
Average annual	17.5	18.4	19.7	20.1	22.5
Peak month	22.8	23.6	24.9	25.0	26.6
Peak week	23.1	23.9	25.2	25.3	26.9
Peak day	26.3	27.0	28.3	28.2	29.4
Peak hour	34.5	34.6	37.1	37.7	41.9

Table 2-12. Flow projections—Lander Street WRF					
Flow Description	Current (mgd)	2030 (mgd)	2035 (mgd)	2040 (mgd)	Buildout (mgd)
Average annual	10.1	12.6	12.6	12.5	12.6
Peak month	13.1	15.7	15.5	15.3	14.8
Peak week	13.3	15.9	15.7	15.4	14.9
Peak day	15.1	17.8	17.4	17.1	16.2
Peak hour	19.8	22.6	22.6	22.6	23.1

These projections assume the addition of a Third WRF that accommodates flow and loadings from southeast Boise. The Third WRF is planned to be operational by 2030 (see Table 2-13 for flow projections). For planning purposes, the initial capacity for the Third WRF was set to match existing industrial user commitments. This facility is anticipated to initially accept only industrial used water. In the future, it will need to be able to accommodate increased industrial customer demand in the area and potentially domestic used water. The approach to meeting these requirements is further contemplated in the Third WRF Facility Plan.

Table 2-13. Flow projections—Third WRF [a]					
Flow Description	Current (mgd)	2030 (mgd)	2035 (mgd)	2040 (mgd)	Buildout (mgd)
Average annual	–	4.6	4.6	4.6	10.0

[a] *Average flows. Peaking factors will be developed during the Third WRF's design phase.*

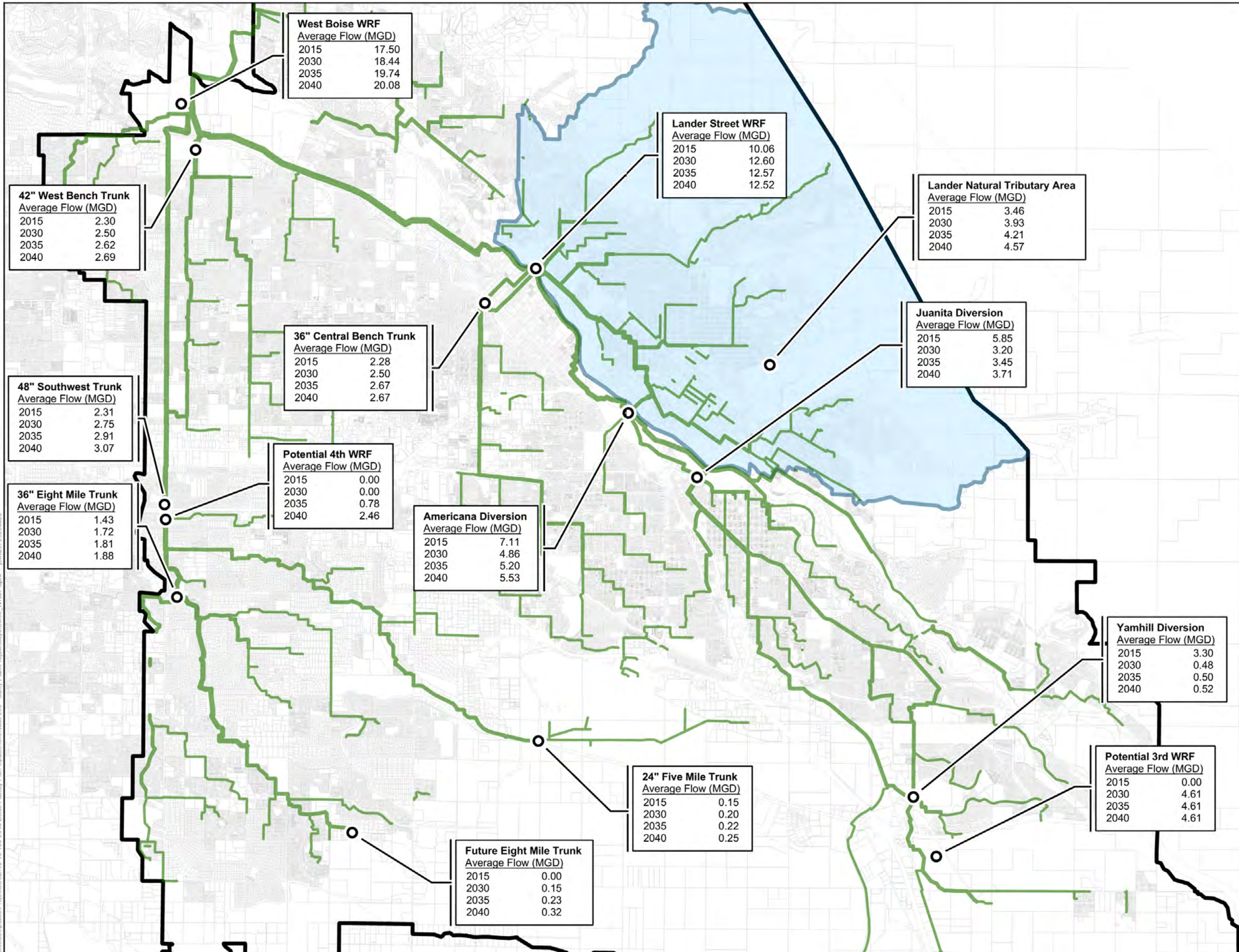
The Utility Plan also identified the potential for a future satellite WRF south of Interstate I-84 to offset improvements at the West Boise WRF needed to increase capacity beyond 25 mgd. The construction of the Fourth WRF will need to be timed to keep peak month flows at West Boise below 25 mgd and is currently anticipated to be needed by 2035. Table 2-14 shows the flow projections for the Fourth WRF.

Table 2-14. Flow projections—Fourth WRF					
Flow Description	Current (mgd)	2030 (mgd)	2035 (mgd)	2040 (mgd)	Buildout (mgd)
Average annual	–	–	0.8	1.5	9.5
Peak month	–	–	1.0	1.9	11.5
Peak week	–	–	1.0	2.0	11.6
Peak day	–	–	1.1	2.2	12.8
Peak hour	–	–	2.0	3.6	19.0

Figure 2-4. Flow summary shows average annual flows projections at several key locations throughout the collection system. The majority of the growth is projected for areas south of Boise's city center. The Eight Mile Trunk and Five Mile Trunk show growth between now and 2040, which corresponds to the new subdivisions planned for those areas. The Yamhill Diversion area southeast of the Boise is also projecting a large increase in flows between now and 2040. A large part of this flow increase is from permitted industrial users fulfilling their entire permitted limit. This other contributing factor in this area is the continued residential growth in southeast Boise. The areas surrounding the existing WRFs are not projected to grow substantially between now and 2040.

As discussed in Section 2.2.1.1 and shown in Table 2-8, the Eagle Sewer District's flow and loads are projected to more than double by 2040. This increase accounts for a large portion of future flows and loads treated at the West Boise WRF.

Figure #2-4
Flow Summary
Water Renewal Utility Plan



Sewerlines (in)
- 10 - 18
- 21 - 33
- 36 - 48
- 54 - 72
- Key Locations
- Lander Street WRF Natural Tributary Area
- Facility Planning Boundary
- Parcels

Note: Flows summarized in this figure are annual average flows

0 3,000 6,000 9,000 12,000
Feet

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2.2.1.3 Loads

Table 2-15 summarizes loads for current, 2030, 2035, 2040, and buildout conditions for the entire system. Table 2-16, Table 2-17, Table 2-18, and Table 2-19 provide similar load projections for the West Boise, Lander Street, Third, and Fourth WRFs, respectively.

The loading projections for the West Boise and Lander Street WRFs account for flow diversion to the Third and Fourth facilities, which causes decreases in some constituents after 2030.

Table 2-15. Load projections—combined WRFs

Constituent	Description	Current (lbs/day)	2030 (lbs/day)	2035 (lbs/day)	2040 (lbs/day)	Buildout (lbs/day)
BOD	Average annual	48,990	61,180	64,670	67,720	89,740
	Peak month	57,490	69,690	73,180	76,220	98,250
	Peak week	61,340	73,530	77,020	80,060	102,090
	Peak day	65,060	77,250	80,740	83,780	105,810
TSS	Average annual	50,940	63,200	66,840	69,590	93,130
	Peak month	57,430	69,690	73,330	76,080	99,620
	Peak week	68,370	80,630	84,270	87,020	110,560
	Peak day	76,800	89,060	92,700	95,450	118,990
Ammonia	Average annual	6,220	8,320	8,880	9,460	13,560
	Peak month	7,090	9,180	9,750	10,330	14,430
	Peak week	7,410	9,500	10,070	10,650	14,740
	Peak day	8,400	10,500	11,060	11,640	15,740
TP	Average annual	1,400	1,790	1,910	2,010	2,770
	Peak month	1,590	1,990	2,100	2,210	2,960
	Peak week	1,680	2,080	2,190	2,290	3,050
	Peak day	1,840	2,240	2,350	2,460	3,210

Table 2-16. Load projections—West Boise WRF						
Constituent	Description	Current (lbs/day)	2030 (lbs/day)	2035 (lbs/day)	2040 (lbs/day)	Buildout (lbs/day)
BOD	Average annual	29,890	31,260	33,130	32,960	40,380
	Peak month	35,080	35,880	37,730	37,300	44,320
	Peak week	37,430	37,970	39,810	39,260	46,100
	Peak day	39,700	39,990	41,820	41,150	47,820
TSS	Average annual	32,310	35,200	37,100	36,530	43,400
	Peak month	36,430	38,870	40,750	39,960	46,420
	Peak week	43,370	45,060	46,890	45,740	51,520
	Peak day	48,710	49,820	51,630	50,190	55,450
Ammonia	Average annual	3,970	4,520	4,870	4,960	5,920
	Peak month	4,530	5,050	5,390	5,460	6,350
	Peak week	4,730	5,240	5,580	5,640	6,500
	Peak day	5,370	5,850	6,190	6,220	7,000
TP	Average annual	920	1,030	1,100	1,110	1,290
	Peak month	1,050	1,150	1,210	1,220	1,390
	Peak week	1,110	1,200	1,270	1,270	1,430
	Peak day	1,220	1,300	1,370	1,370	1,510

Table 2-17. Load projections—Lander Street WRF						
Constituent	Description	Current (lbs/day)	2030 (lbs/day)	2035 (lbs/day)	2040 (lbs/day)	Buildout (lbs/day)
BOD	Average annual	19,090	29,270	29,460	29,610	30,400
	Peak month	22,410	33,150	33,150	33,150	33,150
	Peak week	23,910	34,910	34,820	34,750	34,390
	Peak day	25,360	36,610	36,440	36,300	35,600
TSS	Average annual	18,630	27,390	27,480	27,310	28,930
	Peak month	21,000	30,210	30,150	29,860	30,960
	Peak week	25,000	34,960	34,660	34,160	34,390
	Peak day	28,090	38,620	38,130	37,470	37,020
Ammonia	Average annual	2,250	3,020	3,040	3,070	3,020
	Peak month	2,560	3,360	3,350	3,370	3,230
	Peak week	2,680	3,490	3,470	3,480	3,310
	Peak day	3,040	3,870	3,840	3,820	3,560
TP	Average annual	470	630	640	640	650
	Peak month	540	710	710	710	700
	Peak week	570	740	740	740	720
	Peak day	620	810	800	790	770

Table 2-18. Load projections—Third WRF [a]						
Constituent	Description	Current (lbs/day)	2030 (lbs/day)	2035 (lbs/day)	2040 (lbs/day)	Buildout (lbs/day)
BOD	Average annual	–	660	660	660	1,450
TSS	Average annual	–	620	620	620	1,360
Ammonia	Average annual	–	780	780	780	1,700
TP	Average annual	–	130	130	130	290

[a] *Loading projections based on permit limits. Peaking factors will be developed during the Third WRF's design phase.*

Table 2-19. Load projections—Fourth WRF						
Constituent	Description	Current (lbs/day)	2030 (lbs/day)	2035 (lbs/day)	2040 (lbs/day)	Buildout (lbs/day)
BOD	Average annual	–	–	1,430	2,790	17,520
	Peak month	–	–	1,640	3,180	19,330
	Peak week	–	–	1,730	3,350	20,150
	Peak day	–	–	1,820	3,520	20,950
TSS	Average annual	–	–	1,650	3,190	19,440
	Peak month	–	–	1,820	3,510	20,870
	Peak week	–	–	2,110	4,040	23,290
	Peak day	–	–	2,330	4,460	25,150
Ammonia	Average annual	–	–	200	410	2,930
	Peak month	–	–	230	450	3,150
	Peak week	–	–	240	470	3,230
	Peak day	–	–	260	520	3,480
TP	Average annual	–	–	40	80	540
	Peak month	–	–	45	90	580
	Peak week	–	–	50	95	600
	Peak day	–	–	55	100	640

2.2.2 Regulatory Requirements

The Clean Water Act prohibits anybody or any entity from discharging pollutants (treated used water) through a point source, such as a pipeline, into waters of the United States unless they have an NPDES permit. The NPDES permit contains limits for the amount and concentration of certain constituents deemed necessary to protect public health, requirements for monitoring and reporting, and other provisions to ensure that the discharge protects the quality of the receiving water body or public health.

In 2014, the Idaho Legislature directed the Idaho Department of Environmental Quality (IDEQ) to pursue Environmental Protection Agency (EPA) approval of a state operated pollutant discharge elimination system permitting program. Approval from the EPA was granted in June 2018, creating the Idaho Pollution Discharge Elimination System (IPDES). The goals of the IPDES are similar to those of the NPDES, regulating point sources that discharge pollutants into waters of the United States.

2.2.2.1 NPDES Permit Requirements

The NPDES permit requirements for the Lander Street and West Boise WRFs are shown below in Table 2-20 and Table 2-21, respectively. NPDES permits for both WRFs were issued in 2012, and both permits expired on July 31, 2017. Although Idaho took over the IPDES permitting authority from the EPA, the city’s current permits are still under the federal NPDES program. The city reapplied and is in an administrative extension while it awaits the issuance of the next permit.

Table 2-20. Lander Street WRF NPDES requirements [a]				
Parameter	Unit	Effluent Limitations		
		Average Monthly	Average Weekly	Maximum Daily
BOD_5 [b]				
April 1–September 30	mg/L [c]	20	30	–
	lbs/day	2,200	3,400	
October 1–March 31	mg/L	20	30	
	lbs/day	1,700	2,500	
TSS [d]				
April 1–September 30	mg/L	27	40	–
	lbs/day	3,400	5,000	
October 1–March 31	mg/L	20	30	
	lbs/day	2,500	3,750	
Total ammonia as nitrogen				
May 1–September 30	µg/L [e]	1,098	–	3,718
	lbs/day	137		465
October 1–April 30	µg/L	1,027		3,479
	lbs/day	129		435
TP				
May 1–September 30	µg/L	70	93.1	–
	lbs/day	8.7	11.6	
Minimum dissolved oxygen				
October	mg/L	–	–	3.0
November–April				3.6
Mercury, total recoverable	µg/L	0.009		0.019
	lbs/day	0.001		0.002
E. coli bacteria	# colonies/100 mL		126	406
Temperature [f, g]				
Nov–Apr 30	Degrees Celsius (°C)	–	15.8	NA
May			16.4	NA
Jul 16–Sep 30			19.0	22.0
Oct			22.2	27.3
pH	S.U. [h]	Between 6.4 and 9.0		

[a] *The new permit is currently under development and is expected to contain winter phosphorus discharge limits.*

[b] *BOD_5 = biochemical oxygen demand, 5-day.*

[c] *mg/L = milligrams per liter.*

[d] *For any month, the monthly average effluent concentration shall not exceed 15 percent of the monthly average influent concentration.*

[e] *µg/L = micrograms per liter.*

[f] *The mean of the daily maximum temperatures measured over a consecutive 7-day period ending on the day of calculation.*

[fg] *Average daily limit, not maximum day limit.*

[h] *S.U. = standard unit.*

Table 2-21. West Boise WRF NPDES requirements				
Parameter	Unit	Effluent limitations		
		Average monthly	Average weekly	Maximum daily
BOD_5	lbs/day	2,000	3,000	–
	mg/L	20	30	–
TSS	lbs/day	3,000	4,500	–
	mg/L	30	45	–
Ammonia-N	May–September, lbs/day	157.5	–	487
	May–September, mg/L	0.788	–	2.435
	October–April, lbs/day	80	–	299
	October–April, mg/L	0.398	–	1.493
TP	May–September, lbs/day	14	16.8	–
	May–September, mg/L	0.07	0.084	–
Mercury	lbs/day	0.002	–	0.004
	µg/L	0.009	–	0.019
E. coli	# colonies/100 mL	126 [a]	–	406 [b]
pH	S.U.	Between 6.5 and 9.0		
Temperature	November–March °C	–	13.5 [c]	–
	April, °C	–	13.3 [c]	–
	May, °C	–	13.5 [c]	–
	June 1–July 15, °C	–	–	22.6/26.1 [d]
	July 16–September, °C	–	–	19.0/22.0 [d]
	October, °C	–	–	20.3/24.2 [d]

[a] *Monthly geometric mean limit.*

[b] *Instantaneous maximum limit.*

[c] *Mean week maximum temperature.*

[d] *Values represent average daily limit/instantaneous maximum limit.*

2.2.2.2 Anticipated Future IPDES Permit Requirements

The city's two existing NPDES permits for the West Boise and Lander Street WRFs expired in 2017. The city is currently working with IDEQ to develop new IPDES permits, which may modify current permit requirements. The following tables and paragraphs describe potential limits for total phosphorus (TP), ammonia, BOD/total suspended solids (TSS) removal rates, temperature, and emerging constituents based on ongoing conversations with IDEQ.

The city is working with IDEQ to develop a total combined mass loading approach for TP discharges to the Lower Boise River that would satisfy the requirements of the *Lower Boise River Total Maximum Daily Load: 2015 Total Phosphorus Addendum* (IDEQ, 2015). The combined mass loading for TP for the West Boise WRF, Lander Street WRF, and Dixie Drain PRF is shown in Table 2-22. A combined mass load permit limit for all facilities would allow the city to distribute TP reductions among all three facilities to achieve greater environmental benefit, provide greater operation flexibility, meet environmental requirements, and reduce overall costs. The benefit to this approach would be if, for example, West Boise WRF could not meet its TP limits, the city could operate Lander

Street WRF more efficiently to ensure the total mass loading between West Boise, Lander Street, and Dixie Drain doesn't exceed the TP limit. This would allow the ci

Table 2-22. Proposed combined mass loading total phosphorus [a]

Season	Combined Limit [b]	Compliance Evaluation
May–September	32.5 lbs/day	(Lander Street WRF + West Boise WRF) – (Dixie Drain PRF/1.5) ≤ 32.5
October–April	113.9 lbs/day	(Lander Street WRF + West Boise WRF) – (Dixie Drain PRF/1.5) ≤ 113.9

[a] *Based on ongoing development with IDEQ.*

[b] *Average monthly loading.*

The ammonia limits listed in Table 2-23 are the limits listed in the Lander Street and West Boise WRFs' permits. The city is currently working with IDEQ to establish new ammonia limits for the WRFs' new permits. The city anticipates less stringent limits than are listed in Table 2-23; however, it is currently anticipated that the new limits will not be high enough to affect operations. The existing limits will continue to be a long-term performance target for the city and maintaining facility operations is critical to meeting the current limits.

Table 2-23. Current ammonia limits

Facility	Parameter	Timeframe	Effluent Limitations			
			MDL [a] (mg/L)	AML [b] (mg/L)	MDL (lbs/day)	AML (lbs/day)
Lander Street WRF	Ammonia	May–September	3.718	1.098	465	137
		October–April	3.479	1.027	435	129
West Boise WRF		May–September	2.435	0.788	487	157.5
		October–April	1.493	0.398	299	80

[a] *MDL = method detection limit.*

[b] *AML = average monthly limit.*

The BOD/TSS removal rates will remain the same at 85 percent. The city anticipates changes in the methodology to match current permitting standards.

Renewed water discharged from WRFs has higher temperature levels than the receiving water body (Boise River). In order to protect the species in the river that depend on the cooler temperatures, the city is working with IDEQ to set temperature limits on discharges to the Boise River. Thermal Variance §316(a) of the Clean Water Act authorizes alternative thermal effluent limits when effluent limitations are more stringent that necessary to ensure protection in a body of water receiving a thermal discharge. Using the opportunities provided through thermal variances, the city is working to address temperature challenges more holistically in the Boise River. This approach, much like this planning effort, focuses on better environmental outcomes for capital investments. The city has completed projects to demonstrate temperature reduction in the river through projects other than capital investments at the WRFs. These demonstration projects are currently under review by outside parties. The city anticipates these alternative river projects to satisfy the temperature limits listed in the permits and expects to receive an extension on the current schedule of compliance to complete additional river restoration projects.

The city is currently working on a plan to propose source reduction and control of emerging constituents. Although emerging constituents will most likely not be included in the next permit, the city knows these are an area of acute focus in the wastewater industry. The city is taking a proactive approach to understand the local nature of these constituents. For example, the city is presently evaluating levels of per- and polyfluoroalkyl substances throughout the water renewal system to determine the relative presence within the system and potential long-term treatment/removal options to gain a better understanding of this emerging issue.

2.2.2.3 Biosolids Permit Requirements

Biosolids management is subject to national standards under 40 Code of Federal Regulations (CFR) Part 503 and Idaho standards under Idaho Administrative Procedures Act (IDAPA) 58.01.16. These standards are described in Table 2-24.

The city submitted an updated best management practices report to IDEQ in January 2019. The TMSBAS has always worked diligently to meet the self-implementing regulations described below and will continue to do so in the future.

Table 2-24. Pollutant limits for land application of sewage sludge

Pollutant	Concentration Limits			
	Ceiling Concentrations (Table 1 of 40 CFR 503.13) (mg/kg [a], dry weight)		Pollutant Concentrations Monthly Average (Table 3 of 40 CFR 503.13) (mg/kg, dry weight)	
Arsenic	75		41	
Cadmium	85		39	
Copper	4,300		1,500	
Lead	840		300	
Mercury	57		17	
Molybdenum [b]	75		–	
Nickel	420		420	
Selenium	100		36	
Zinc	7,500		2,800	
Pollutant	Loading Rates			
	Cumulative Pollutant Loading Rates (Table 2 of 40 CFR 503.13)		Annual Pollutant Loading Rates (Table 4 of 40 CFR 503.13)	
	(kg/ha [c], dry weight)	(lbs/acre, dry weight)	(kg/ha per 365-day period, dry weight)	(lbs/acre per 365-day period, dry weight)
Arsenic	41	37	2	1.8
Cadmium	39	35	1.9	1.7
Copper	1,500	1,339	75	67
Lead	300	368	15	13
Mercury	17	15	0.85	0.76
Molybdenum [b]	–	–	–	–
Nickel	420	375	21	19
Selenium	100	89	5	4.5
Zinc	2,800	2,500	140	125

[a] *kg = kilograms.*

[b] *The pollutant concentration limit, cumulative pollutant loading rate, and annual pollutant loading rate for molybdenum were deleted from Part 503 effective February 19, 1994. The EPA will reconsider establishing these limits at a later date.*

[c] *ha = hectare.*

2.2.2.4 Air Permit Requirements

WRFs typically generate measurable quantities of volatile organic compounds (VOCs) as a constituent of biogas created during biosolid processing. Biogas and its VOC components are often controlled by combustion at WRFs as fuel for process boilers or through flaring. VOCs are one of six federal Criteria Air Pollutants that have set concentration thresholds called National Ambient Air Quality Standards (NAAQS) that all airsheds must meet. The creation of these standard is mandated by the Clean Air Act (CAA). In order to comply with the NAAQS, the CAA requires certain sources of air pollution to obtain air quality permits. In most cases, including Idaho, individual states have primacy to issue and enforce these air quality permits.

In Idaho, the IDEQ is tasked with issuing and enforcing air quality permits. Currently, multiple wastewater facilities in Idaho have air quality permits, including the cities of Meridian and Nampa. Each of these facilities has been found to emit air pollutants in quantities that trigger the need to obtain what is called a Permit to Construct (PTC). The triggering thresholds for obtaining a PTC vary from pollutant to pollutant but primarily include the six Criteria Air Pollutants, Hazardous Air Pollutants, and Toxic Air Pollutants. Idaho's air quality regulations also lay out specific and detailed criteria for facilities that are exempt from obtaining a PTC. This exemption process can be done through a coordinated review with IDEQ called an exemption concurrence, or through a self-exemption process without IDEQ's involvement. Facilities that self-exempt operate under the assumption that they have the supporting documentation to justify their self-exemption.

The city currently has an exemption at both facilities but is in the process of evaluating the need for air permits at the Lander Street and West Boise WRFs. The need for these permits largely focuses on the flared and reused biogas produced from the anaerobic digestions process at both facilities. The hydrogen sulfide (H_2S) concentration within the biogas can trigger the need for a permit based on its use within process heating boilers and the waste gas flare.

2.2.3 Climate Change

Boise is in a high-desert region that experiences low annual precipitation and hot summer temperatures. As the climate changes, experts forecast that water sources will become less dependable, increasing the chance of severe droughts. A 2016 Climate Adaptation Assessment specific to Boise found that out of eight anticipated climate change impacts to the city and region, six of them were related to water including those listed below:

- **Heavy precipitation days:** The occurrence of heavy precipitation events is projected to increase in Boise by approximately 50 percent by the early twenty-first century and nearly 100 percent by the mid-twenty-first century. This will cause WRS to design infrastructure to accommodate these changing precipitation patterns.
- **Irrigation demands:** Climate change will increase evaporative demand and irrigation requirements during the warm season. An increase of approximately 2 inches of irrigation is projected by the early twenty-first century and 4 inches of irrigation by the mid-twenty-first century. As a result, there may be additional demand to use recycled water as an irrigation supplement.
- **Drought frequency:** Moderate drought, which currently occurs in 1 of every 4 years, on average, is projected to occur in 1 of every 2 years, on average, by the mid-twenty-first century. Likewise, exceptional drought that historically occurs, on average, 1 out of every 12 years, is projected to occur in nearly 1 of every 3 to 4 years by the mid-twenty-first century. Increasing drought will place increasing pressures on water resources in the Treasure Valley.
- **Seasonal stream flows:** Seasonal shifts in river levels for the Boise River are projected, resulting in more runoff in the winter and spring months and less during the summer months. Shifting the seasonality of flow may alter future regulatory requirements for discharges to the Boise River.
- **Flooding danger:** No overall change in river flooding is projected. However, a greater proportion of high streamflow events is projected to occur during the fall through winter months as a result of changes in snow and snowmelt timing on upstream watersheds. Additionally, more winter precipitation is predicted to fall as rain and result in direct runoff. The Lander Street and West Boise WRFs are located on the Boise River, which will place them at increased risk for flooding.
- **Water quality:** The advancement in the timing of mountain snowmelt, increased evaporative demand, and extended period of warm and dry conditions during the summer months are projected to result in further declines in low flows in the Boise River. Conditions that are

detrimental to water quality and aquatic life are expected to increase substantially, with a 400 percent increase in frequency of what are historically considered low flow levels by the mid-twenty-first century. This change will result in increased regulatory pressures to ensure sensitive species are protected during these periods.

The city is aware of the future threat climate change poses to Boise and sought to address and strengthen Boise's resiliency to climate change in the utility planning process. Section 3 discusses the future projects the city is planning to bolster climate resiliency with its water products.

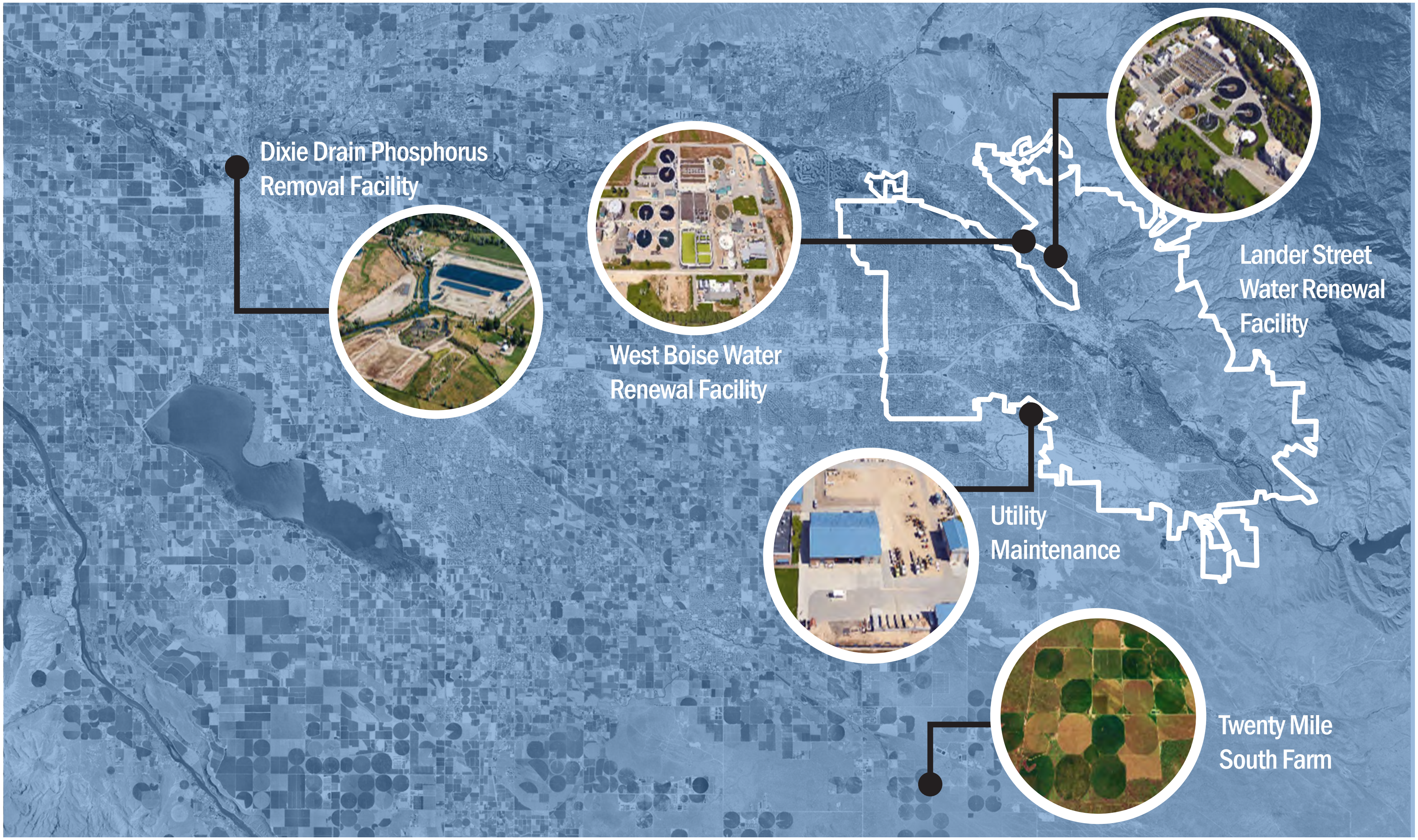
2.2.4 Boise's Energy Future Plan

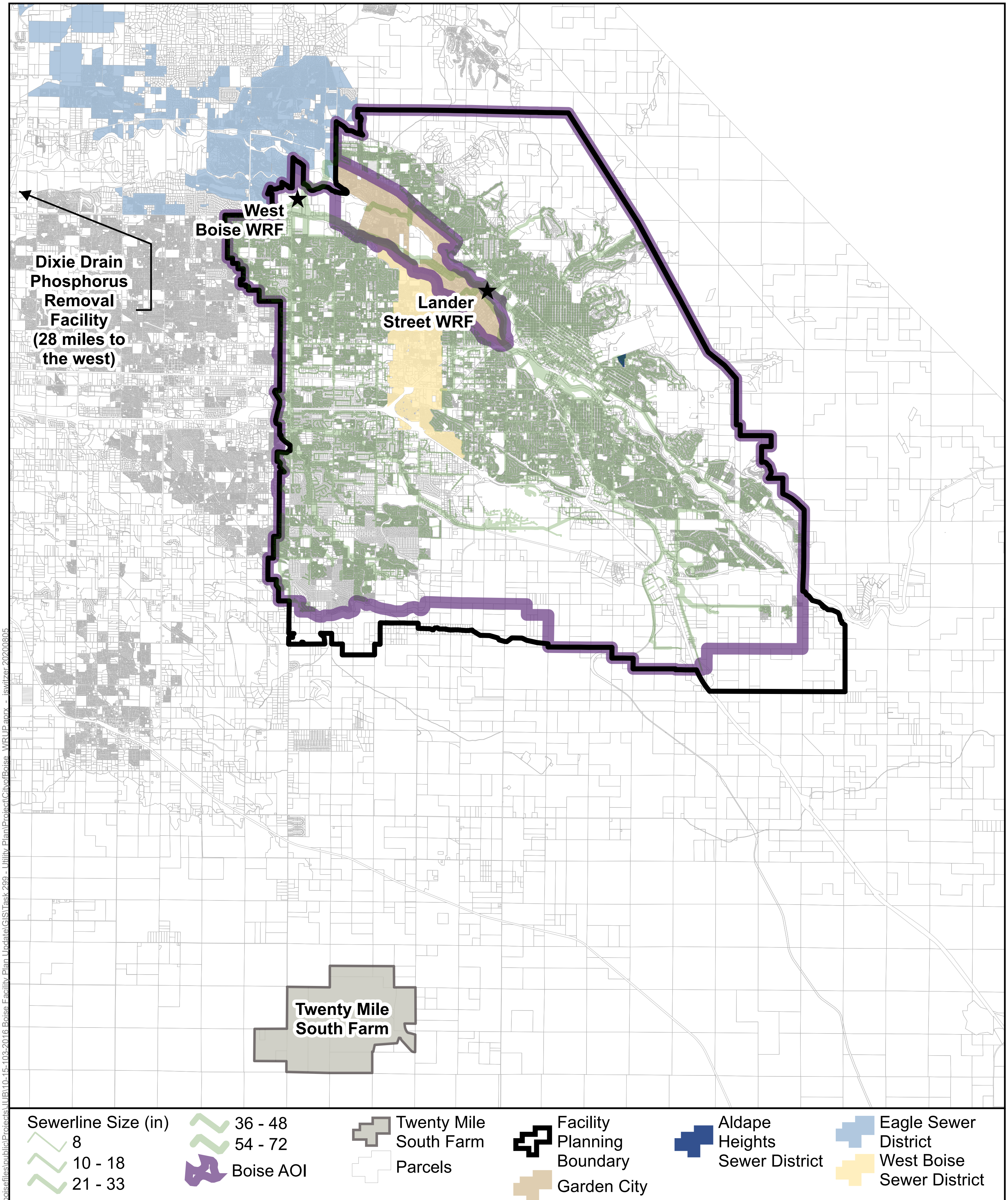
Boise's Energy Future plan encompasses the whole community with the vision of generating 100 percent of the electricity used by residents and businesses from clean energy sources by the year 2035. To lead this effort, the city's own facilities and operations will be powered by 100 percent clean energy by the year 2030. The WRS utility makes up approximately 40 percent of the electricity consumed by city operations and facilities. As the city's population continues to grow, and WRF renewed water quality standards continue to increase, power consumption for WRFs will also increase. To meet the objectives of Boise's Energy Future plan, resources from both treatment byproducts and facility land area may be used to generate renewable, clean, and affordable energy.

Energy products and the increased demand produced by each new WRF are further addressed in Section 4.

2.3 Existing System Overview and Performance

This section provides an overview of WRS's existing collection system, two WRFs, the Dixie Drain PRF, and the TMSBAS (Figure 2-5 and Figure 2-6). This section also discusses the condition and capacity of WRS's existing assets.


Dixie Drain Phosphorus Removal Facility
West Boise Water Renewal Facility
Lander Street Water Renewal Facility
Utility Maintenance
Twenty Mile South Farm



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Feet

Figure #2-6
Existing Services
Water Renewal Utility Plan

2.3.1 Collection System

WRS has a program to inspect and track all of its collection system assets on a regular schedule. The condition assessment program, combined with flow projections, provides the city with information needed to rehabilitate degrading pipes and plan for growth in a timely manner. The following sections discuss the condition and capacity of the existing collection system.

2.3.1.1 Overview of the System

The city currently provides sewer collection service to more than 227,000 users through a network of pipelines totaling over 900 miles in length and 28 lift stations. The collection system is composed of gravity mains, force mains, lift stations, and manholes that convey used water to the two WRFs for treatment. This information is provided in Table 2-25 below.

Table 2-25. Collection system characteristics

Component	Total
Small diameter (< 21 inches) gravity sewer pipe length	825 miles
Large diameter (21–72 inches) gravity sewer pipe length	84 miles
Pressure sewer pipe length	14 miles
Manholes	> 22,000
Service connections	> 78,000
Lift stations	28
Population served [a]	> 285,000
Service area [a]	163 square miles

[a] *Includes the cities of Boise, Eagle, and Garden City.*

There are two diversions, or structures, within the collection system that the city uses to manage flow distribution between the Lander Street WRF and the West Boise WRF: Americana and Lander Street diversions. The existing Lander Street diversion is located in the South Boise Interceptor and consists of a large vault with stop logs. Flow is currently diverted from the South Boise Interceptor across the Lander Street siphon to the Lander Street WRF. The city has been using both diversions to send more flow to the West Boise WRF and less to the Lander Street WRF.

The current operation of the diversions has been in place since January 2015 and results in an average of approximately 10 mgd at the Lander Street WRF. All other flow is diverted to the West Boise WRF. As of 2020, the Americana diversion is not in use due to its condition. In order to divert 17 mgd to the Lander Street WRF, the city will either improve the Lander Street siphon or rehab the Americana diversion. One or both of these projects will be completed by 2030.

The city also owns and operates 28 lift stations. The *Collection System Master Plan* provides summary information for each of the lift stations. The diversions and size and extent of the collection system are shown in Figure 2-7.

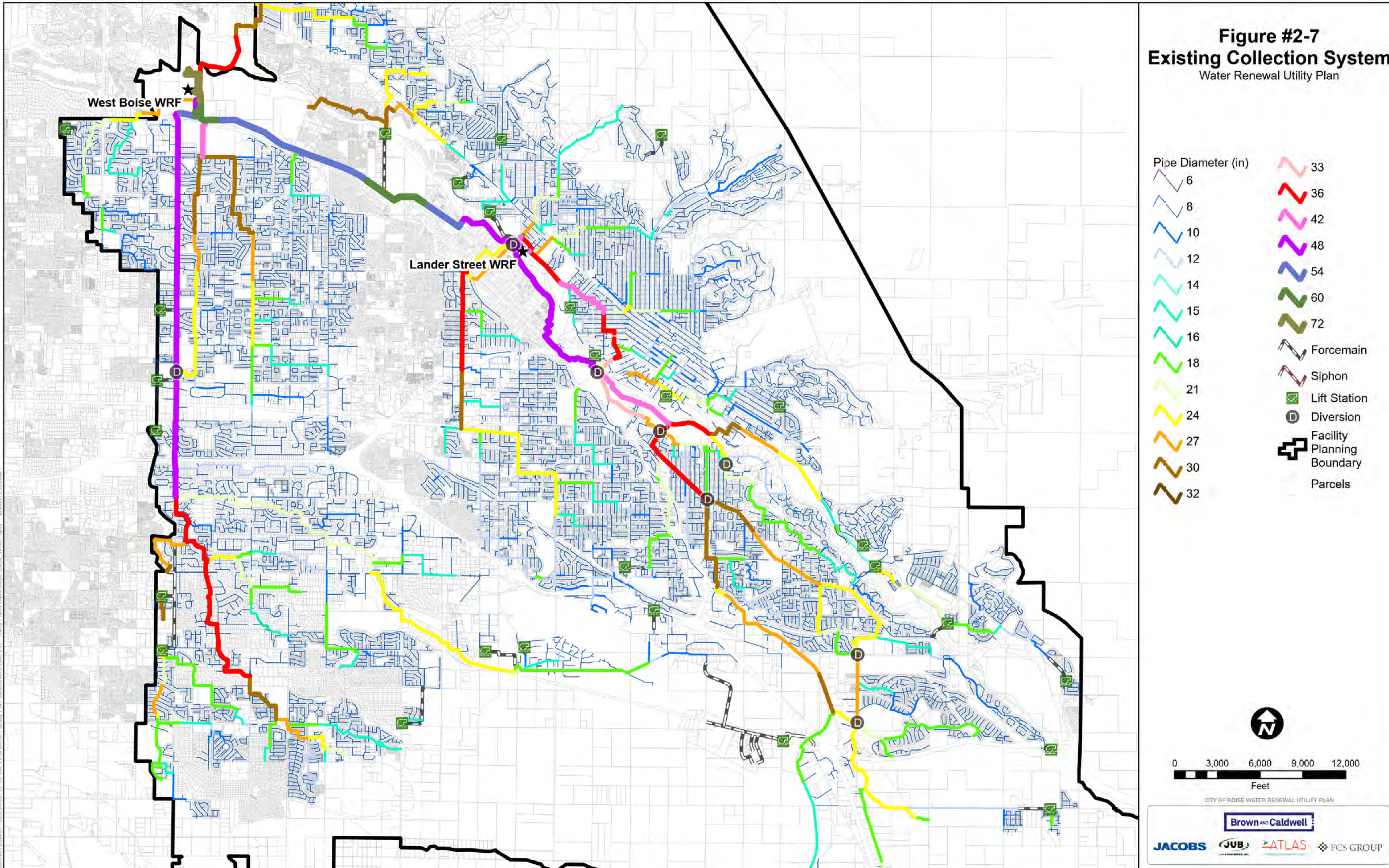

Figure #2-7
Existing Collection System
Water Renewal Utility Plan

2.3.1.2 System Condition

The city uses a program known as the System Planning, Operations, Rehabilitation, and Evaluation (SPORE) to keep track of its collection system assets. SPORE is driven by data, including a catalog of system assets (manholes, pipes, services, etc.) mapped in geographical information systems. The city established guidelines for the management, operation, and maintenance of the city's collection system through SPORE.

SPORE follows the same asset management strategy as the vertical assets: risk = consequence of failure x likelihood of failure. Pipeline defects and assessments are done in accordance with the National Association of Sewer Service Companies Pipeline Assessment and Certification by using frequently completed closed circuit television inspections. Consequence of failure values are assigned to every pipeline within SPORE based on several factors but primarily focused on the impact that a failure would have on social, economic, and environmental activities (triple bottom line).

SPORE is a relatively new program/tool that the city is using, but the concepts of asset management, condition assessment, and rehabilitation/replacement have been used within the collection system for the past two decades. These past efforts, along with the fact that the majority of the collection system is considered new (constructed over the last 30 years), has resulted in a collection system that is in good condition. It is estimated that approximately 1 percent of the system is in less than desirable condition.

The small diameter rehabilitation and replacement program uses consequence and likelihood of failure scores along with several other factors, including maintenance history, backup history, root issues, and opportunities for joint projects with Ada County Highway District to prioritize which pipes get replaced each year. The large diameter program uses a more traditional project-by-project approach in which condition assessments are completed, consequence and likelihood values are used to develop risk profile scores, projects are prioritized, and alternatives are considered to determine which alternative results in a cost-effective method to minimize the overall risk.

2.3.1.3 System Capacity

The existing flow capacity assessment shows no surcharging (depth over diameter [d/D] > 1.0) in the entire system and only three potential bottleneck areas with possible capacity issues (reserve capacity < 0.0). Figure 2-8 and Figure 2-9 show the capacity constraints and locations of the potential bottleneck areas. There are several other lines scattered throughout the system that are near or over capacity. These are "flat" pipes that have very low slopes and show little or no reserve capacity. However, each flat pipe has significant reserve capacity both upstream and downstream. These isolated flat pipes do not result in any surcharging and are not considered potential bottlenecks.

The future flow capacity assessment shows two locations with surcharging (d/D > 1.0) and six more potential bottleneck areas with possible capacity issues (reserve capacity < 0.0). The bottleneck locations and solutions are discussed in greater detail in *TM UM-06 Collection System Capacity Assessment*.

Figure #2-8
Reserve Capacity
Existing Flows

Water Renewal Utility Plan

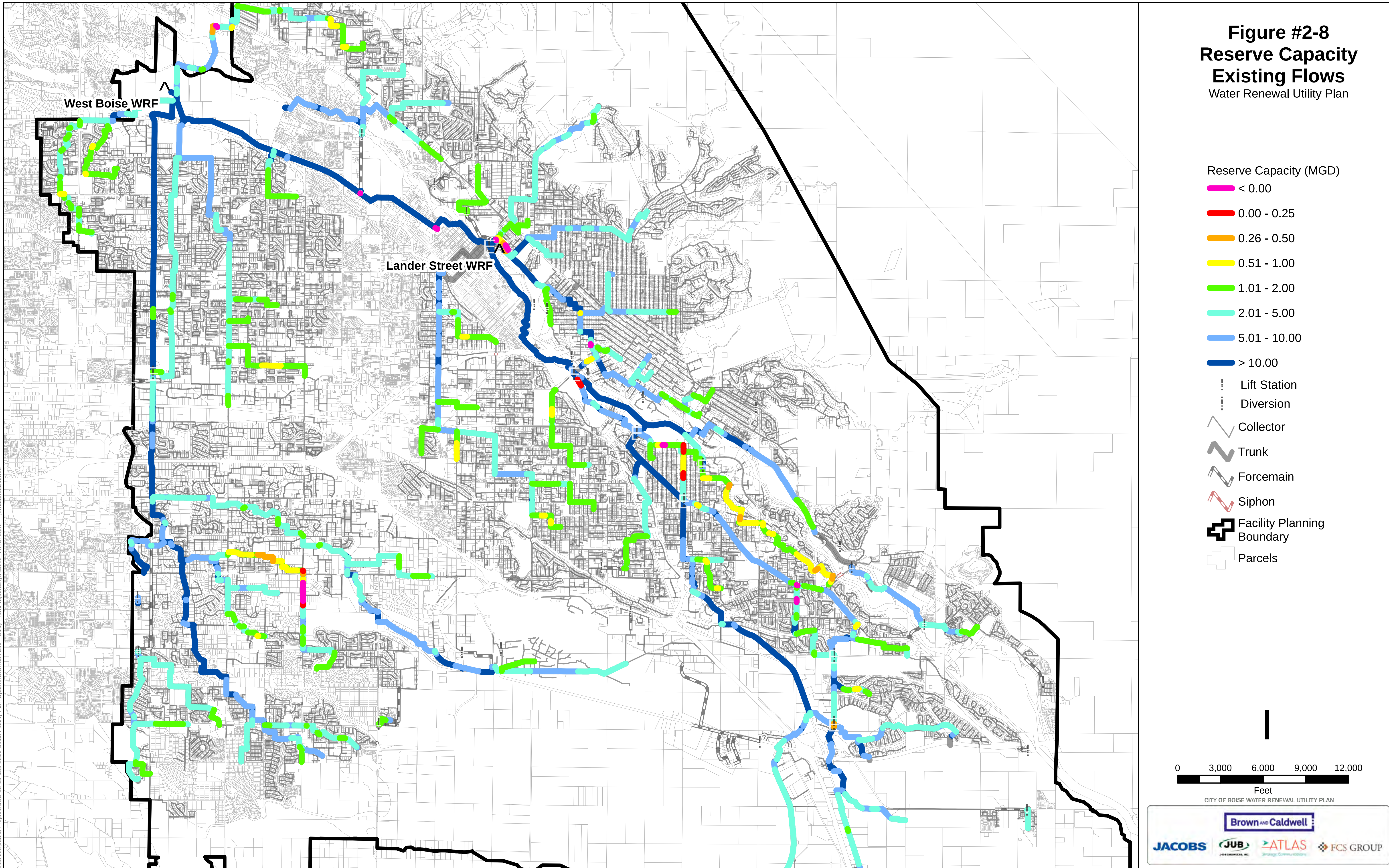

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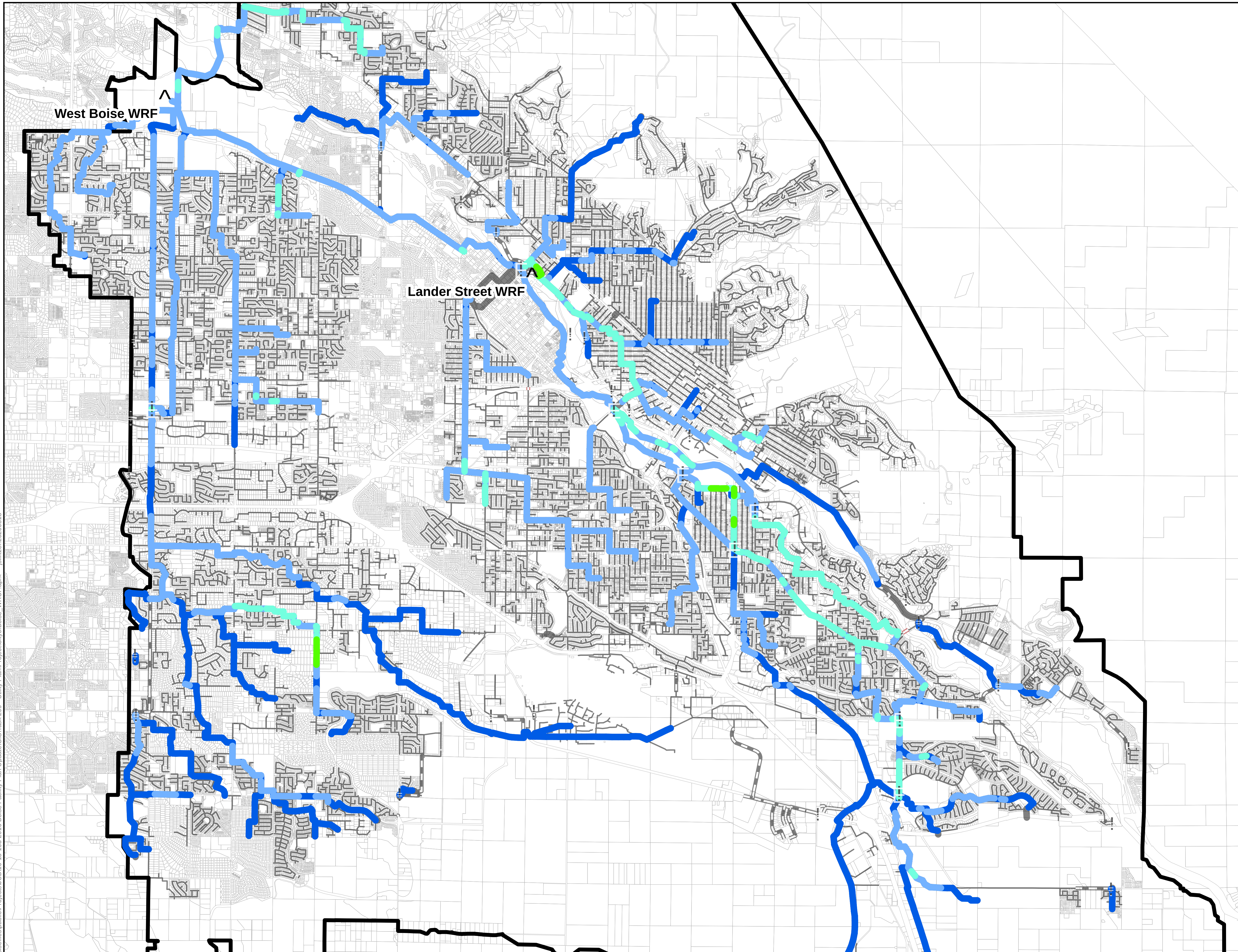
Figure #2-9
Depth Over Diameter Existing Flows

Water Renewal Utility Plan



Depth Over Diameter
- 0.01 - 0.25
- 0.26 - 0.50
- 0.51 - 0.75
- 0.76 - 1.00
- 1.01 - 1.25
- 1.26 - 2.00
- 2.01 - 5.00
- > 5.00
- LiftStation
- Diversion
- Collector
- Trunk
- Forcemain
- Siphon
- Facility Planning Boundary
- Parcels

0 3,000 6,000 9,000 12,000
Feet

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2.3.2 Lander Street Water Renewal Facility

The Lander Street WRF, constructed in 1948, is a secondary treatment WRF located in Boise along the north bank of the Boise River. The Lander Street WRF is located between three physical barriers: Farmers Union Canal to the northeast, Veterans Memorial Parkway to the southeast, and the Boise River to the south. The Lander Street WRF has undergone multiple renovations throughout its life. In 2015, the city analyzed the implications of retaining treatment operations at the Lander Street location compared to consolidating all services at the West Boise WRF. The results of this evaluation indicated the benefits of retaining the Lander Street WRF outweigh the costs despite requiring renovations and additions to meet upcoming NPDES permit requirements.

The Lander Street WRF is a conventional aerated activated sludge secondary treatment facility designed for biological nutrient removal. The facility currently renews an average of 10 mgd, removing both nitrogen and phosphorus in the biological process. Figure 2-10 shows the layout of the facility and Figure 2-11 shows the process schematic for the existing treatment facility. Both figures reflect the upgrades to the headworks and ultraviolet (UV) treatment facilities currently under construction and scheduled to be online by 2022.

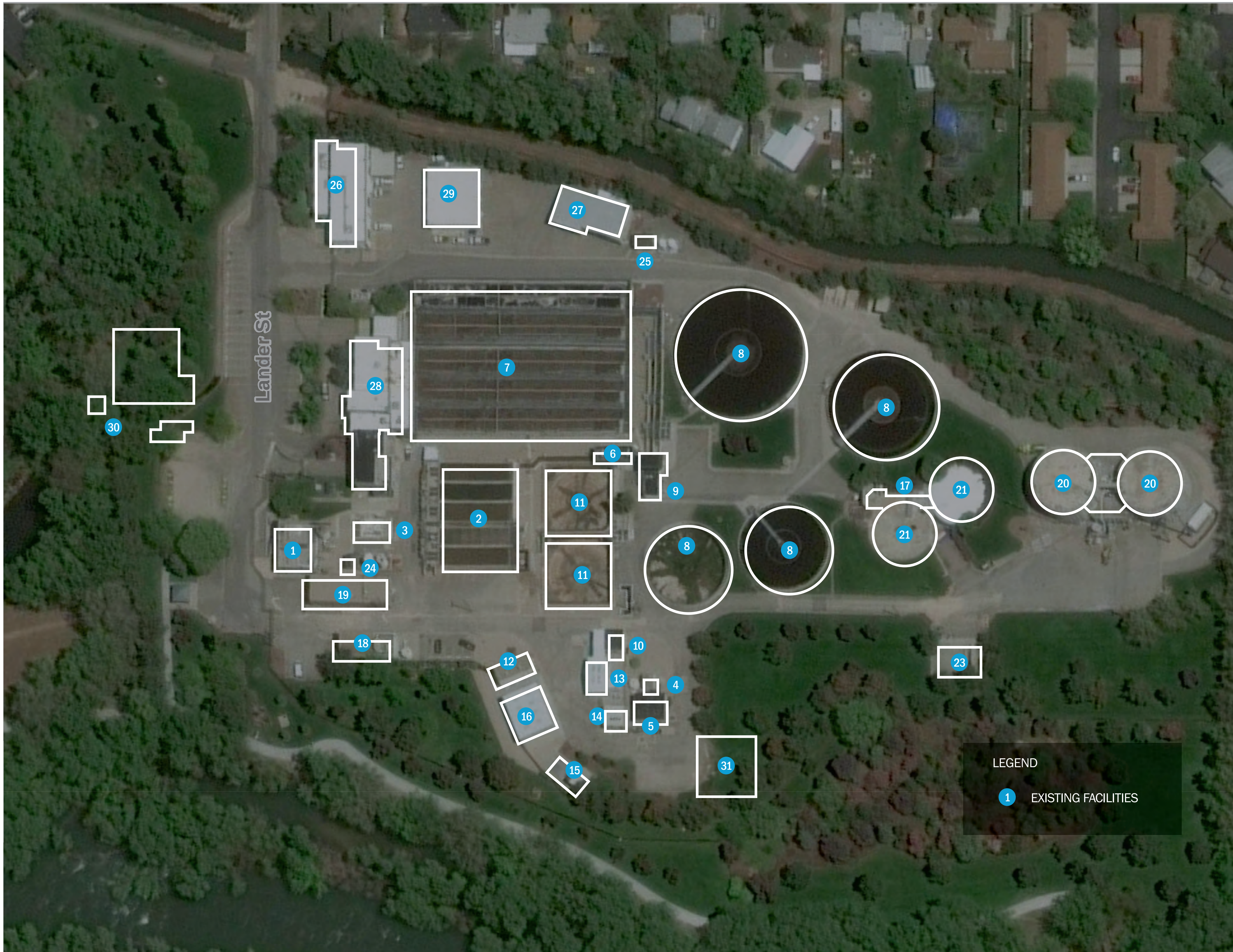
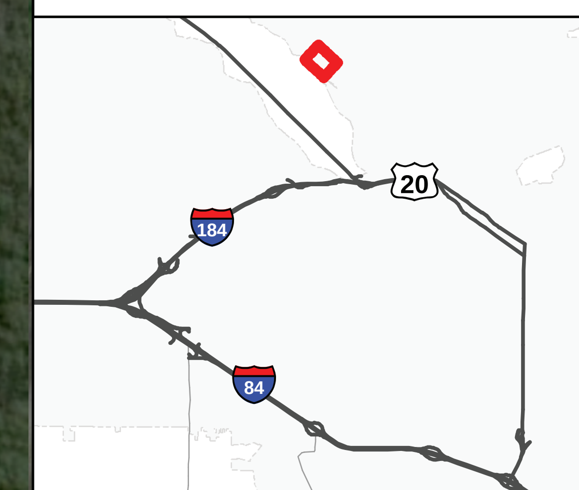


Figure 2-10
Lander Street Water Renewal Facility
Water Renewal Utility Plan

LEGEND

Existing Facilities

1	Aerated Grit Chambers
2	Primary Clarifiers
3	Primary Sludge Pump Station
4	Septage Facility
5	Pretreatment
6	Intermediate Pump Station
7	Aeration Basins
8	Secondary Clarifiers
9	RAS Pump Station
10	Chlorine Building
11	Chlorine Contact Basins
12	Dechlorination Building
13	UV Disinfection
14	Water Pump Building
15	Post Aeration/Reaeration Basin
16	Post Aeration Blowers/Alkalinity
17	Gravity Belt Thickener
18	DAFT
19	Thickener Control Building
20	Primary Digesters
21	Secondary Digesters
22	Digester Control Building
23	Sludge Pump Station
24	Ferric Chloride
25	Alum
26	Administration Building
27	Shop
28	Operations/Control Building
29	Parts Shop
30	New Headworks Building, Raw Sewage Pump Station and Foul Air Treatment (Under Construction, 2020)
31	UV Building (Under Construction, 2020)



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CITY OF BOISE WATER RENEWAL UTILITY PLAN

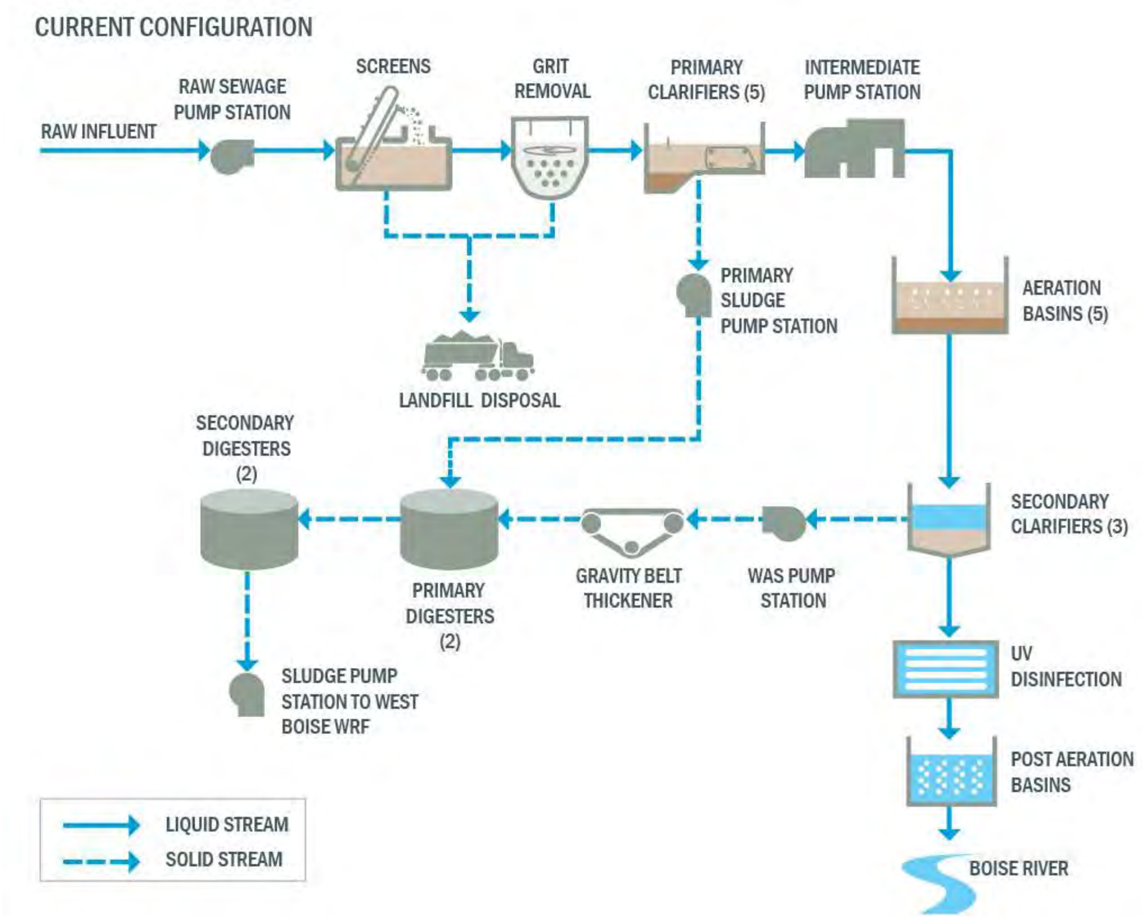


Figure 2-11. Lander Street WRF process flow diagram

2.3.2.1 Lander Street WRF Condition

The Lander Street WRF is nearly 70 years old, and much of the existing infrastructure is reaching the end of its useful life. With the decision to retain the Lander Street WRF, the city started a program to systematically replace this facility. This program is founded in asset management and risk mitigation principles and focused on identifying and mitigating risks associated with ongoing infrastructure degradation

A desktop risk assessment performed at the Lander Street WRF included meeting with the facility's staff to understand the condition of the assets and determine a consequence of failure, likelihood of failure, and redundancy for each process. Based on these factors, several processes were determined to be high risk and are described below.

The risk assessment confirmed that UV disinfection represents the highest risk unit process at Lander Street WRF. The headworks processes, which include influent pumping, screening, and grit removal, were are also identified as high-risk unit processes. The high consequence and likelihood of failure of these processes, coupled with the physical condition of the processes, led the city to begin asset replacement projects for these facilities. Construction for a new headworks and UV disinfection system began in 2020 and is expected to be completed in 2022. Once the replacements have been put into service, the desktop risk assessment should be revised to reflect the improvements.

Other processes that were determined to have the highest risk are noted in the following text to describe the criticality and/or condition issues that require prioritization for future plant rehabilitation efforts or CIPs. These processes will require attention within the current planning window. To this end, the city will continue to assess and prioritize replacing this infrastructure to maintain the performance of the Lander Street WRF.

Biosolids Pumping and Piping to the West Boise WRF

- Were the biosolids pumping and piping system to fail, there is a potential for biosolids to be discharged into the environment and potentially the Boise River resulting in potential permit excursions and presenting a risk to public and employee health.
- The likelihood of the biosolids pipeline to the West Boise WRF failing is increasing since it is deteriorating and has seen a failure in the recent past.
- There are two biosolids pumps, but the pipeline does not have redundancy, so the overall system risk is not reduced to account for redundancy.

Medium-Voltage Electrical Distribution System (Primary Electrical Loop)

- Should this system fail, it will result in the inability to fully treat used water, resulting in a high potential for permit violations, public exposure to partially treated used water, and loss of public confidence.
- A single feed from Idaho Power Company (IPC) serves the facility, which creates one failure point for the entire system, increasing the likelihood of complete system failure risk. Although there is not a redundant feed to the facility, there are backup generators for some parts of the facility.
- Some of this system is being replaced in the current improvements.

Aerations Blowers

- Aeration blower failure will result in an inability to treat used water and will lead to permit violations. There is a risk of failure in this system due to the current blower's poor condition and performance. Two blower motors are currently being repaired to reduce the risk of this failure.

Biogas Treatment and Flare

- The current biogas system is in poor condition, and a failure will result in odor complaints and the potential to prohibit the ability to process digested solids. Failure in this system will be a high employee and public safety risk.
- The current system has been exempted from requiring an air permit, but a major system repair will likely result in an air permit being required.

Secondary Clarification

- A potential failure scenario for mechanism replacement poses a severe financial risk.
- Obsolete equipment increases the likelihood of failure risk.
- Loss of a secondary clarifier would limit treatment capacity at the Lander Street WRF.

Return Activated Sludge Pumping and Piping

- This system has a high risk of failure due to its loss of ability to remove sludge from clarifiers, resulting in sludge entering the Boise River, permit violations, and public exposure to sludge.
- Poor physical condition increases the likelihood of failure.

Primary Clarification

- Were this process to fail, the financial risk to repair, or more likely replace, is high. The current clarifiers have structural risks that raise the risk of failure.

Administration Workspace

- This space has a high consequence of failure risk due to its timber construction and not having fire sprinklers. A failure of the building burning down would have a high financial impact.
- The current space is not adequate for the current staffing needs, including restroom, training, and meeting facilities.

Maintenance Workspace

- The current workspace represents a high likelihood of failure resulting from the facilities not being constructed for maintenance work but being converted from garages. The welding bay needs to be improved to meet ventilation requirements.
- The space was sufficient in the past, but due to the increase in staff necessary to maintain additional facilities and processes, it is no longer adequate.

Primary Digestion

- Should this process fail, there is a high risk that employee and public health will be impacted.
- The likelihood of failure is a higher risk from the physical condition and frequent repairs to the system.

2.3.2.2 Lander Street WRF Capacity

The capacity of a WRF is defined by hydraulic and treatment capacities, in other words, the ability of the facility to physically hold all incoming flow and treat it to the standards defined in the NPDES permit. This section discusses hydraulic and treatment capacity limits at the Lander Street WRF.

2.3.2.2.1 Hydraulic Capacity

The headworks screens and disinfection processes were identified as hydraulic bottlenecks prior to this planning effort, and those limitations are currently being addressed as part of Phase 1 of the Lander Street Improvements Project. Projected limitations with the influent pumps are also being addressed as part of that effort. The only remaining near-term limitation is the hydraulic constriction associated with the intermediate pump station. This limitation is projected to occur at a peak month flow of 12.9 mgd and would result in reduced ability to manage the Lander Street WRF Secondary Treatment Enhancement Project (STEP) feed flow split across the aeration basins, which would reduce overall performance. This limitation is planned to be addressed during upcoming capacity-related projects.

2.3.2.2.2 Treatment Capacity

The Lander Street WRF's treatment capacity is mainly limited by a combination of BOD loading and the ammonia effluent limitation. The ammonia permit regulation forces the WRF to operate at a long solids retention time. At a long solids retention time, the facility generates a large volume of biomass due to the BOD load, which causes the capacity limitation in the secondary clarifiers.

The capacity chart based on a cold weather, peak month flow, and peak month load scenario is presented in Figure 2-12. Cold weather typically represents the worst-case scenario for nutrient removal. The capacity chart depicts when components or unit processes of the Lander Street WRF are expected to reach their limits.

- The x-axis represents the peak month used water flow.
- The y-axis expresses raw influent BOD concentration at the Lander Street WRF.
- The loading curve, represented as a solid black line, demonstrates the change in influent BOD concentration with increasing total system flow. This line is used to identify when the capacity limits are reached.

The colored lines represent capacity curves for each controlling parameter. The point where each of the colored curves crosses the black line represents the capacity limitation for each corresponding component.

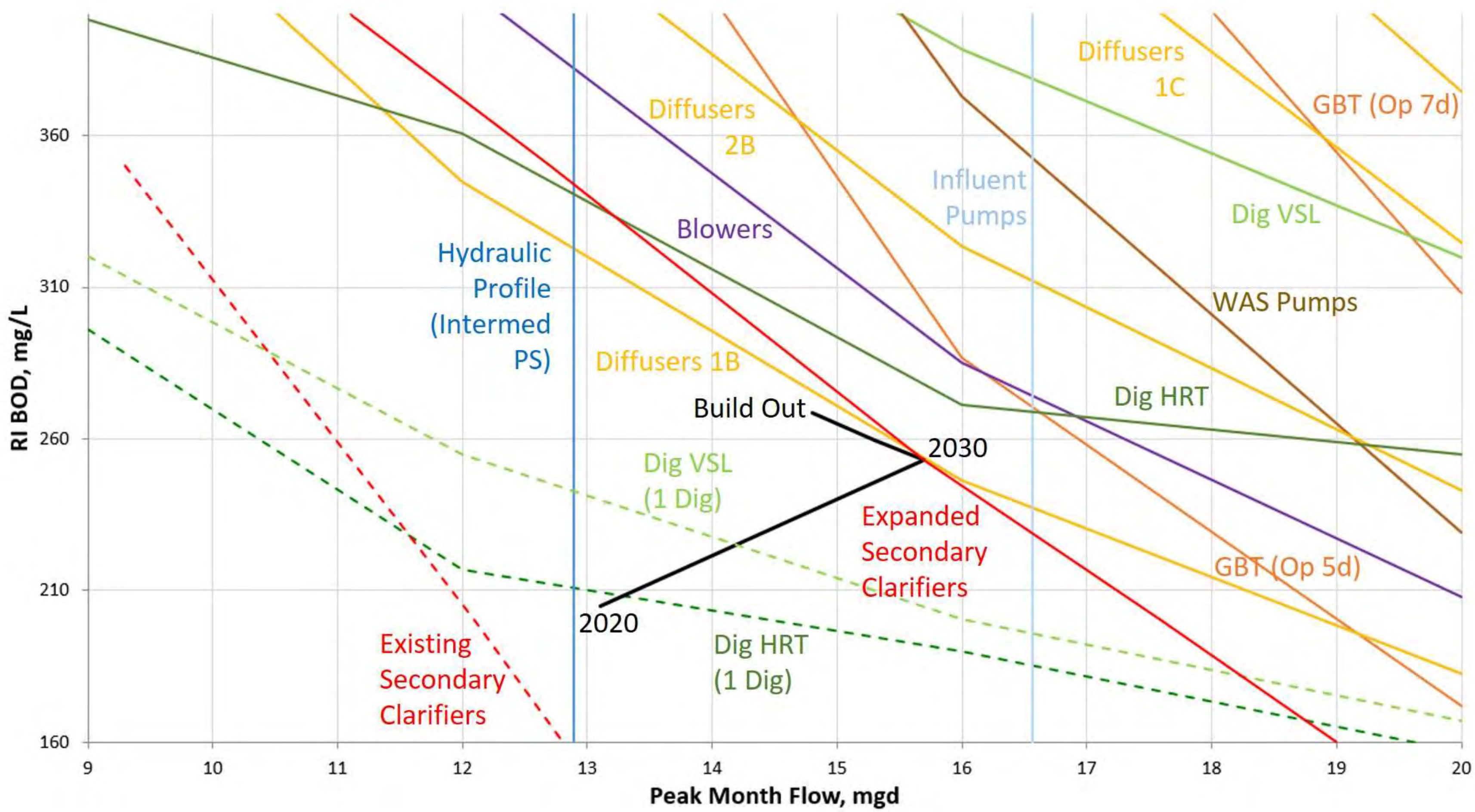


Figure 2-12. Winter peak flow and load capacity chart

The capacity-limiting unit processes, those crossing the black loading curve in Figure 2-12, are listed in Table 2-26. The unit processes shown to the right of the loading curve are not projected to become capacity limited. For context, current peak month flows average approximately 10.8 mgd, and 2030 peak month flows are projected to average 15.7 mgd. All processes are existing with the exception of the secondary clarification, which is shown twice to illustrate current and future planned capacity.

Table 2-26. Capacity limitations

Constraining Process	Maximum Month Flow (mgd)
Secondary clarifiers (smallest out of service, SVI [a] = 178 mL/g)	<10
Secondary clarifiers (smallest out of service, SVI = 178 mL/g, with STEP [b])	12.4
Hydraulic profile limit (Intermediate Pump Station)	12.9
Expanded [c] secondary clarifiers (smallest out of service, SVI = 178 mL/g, with STEP [c])	15.7
Aeration diffusers (Cell 1B)	15.7

[a] SVI = sludge volume index.

[b] STEP refers to the Lander Street WRF STEP improvements which will be implemented in Phase 2

[c] With the addition of two 135-ft diameter clarifiers and the removal of one 90-ft diameter clarifier

The secondary clarifier limitation is scheduled to be resolved through the combination of the Lander Street WRF STEP and the addition of two more clarifiers. This will result in a secondary clarifier capacity of 15.7 mgd, which matches the maximum projected flow to the WRF. The limitation associated with the intermediate pump station should be addressed during planned upgrades to the primary clarification system. Firm capacity limitations of the digester are shown on Figure 2-12, but are not included in Table 2-26, as the service condition selected for capacity rating allows both digesters to be in service. The city may manage digester redundancy by shifting influent flows between the Lander Street and West Boise WRFs, as needed, to allow for scheduled maintenance activities.

2.3.2.3 Connection to the West Boise WRF

As previously mentioned, primary sludge, waste activated sludge, and secondary clarifier scum is thickened and digested at the Lander Street WRF. The solid stream from the secondary digester is pumped from the biosolids pump station at the Lander Street WRF through a dedicated solids pipeline to the West Boise WRF for further solids handling. The existing biosolid pipeline for pumping digested biosolids to the West Boise WRF is over 30 years old and is experiencing physical defects, struvite accumulation/obstructions, and unsustainable pressure increases/flow loss. Section 5 discusses alternatives for replacing the pipeline.

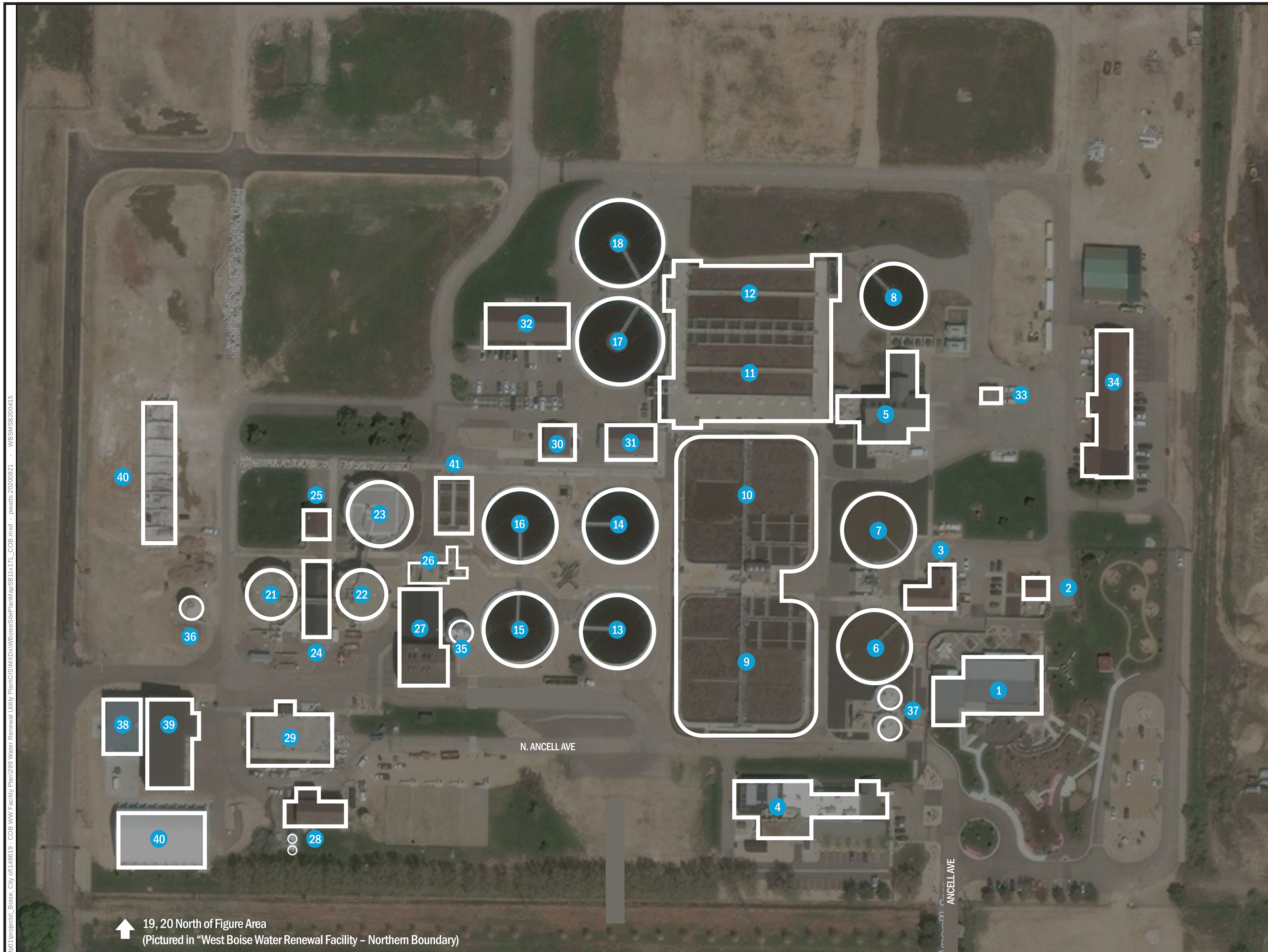
2.3.3 West Boise Water Renewal Facility

The West Boise WRF was commissioned in 1976 and provides advanced secondary treatment with ammonia and phosphorus removal. All renewed water is disinfected with UV disinfection, then discharged to the south channel of the Boise River. In 2015, WRS upgraded the West Boise WRF to an enhanced biological phosphorus removal process, aided by primary sludge fermentation. The West Boise WRF has also been recovering struvite from a recycle stream to sell on the commercial market.

The West Boise WRF was formerly divided into two separate primary and secondary treatment trains, referred to as the North Plant and the South Plant. Modifications to the West Boise WRF have been made to combine primary effluent and return activated sludge from the North and South unit processes. The internal mixed liquor returns are not combined at this time. Figure 2-13 and Figure 2-14 show the facility layout with the unit operations and processes labeled on the map. Figure 2-15 shows the process flow diagram through the facility.

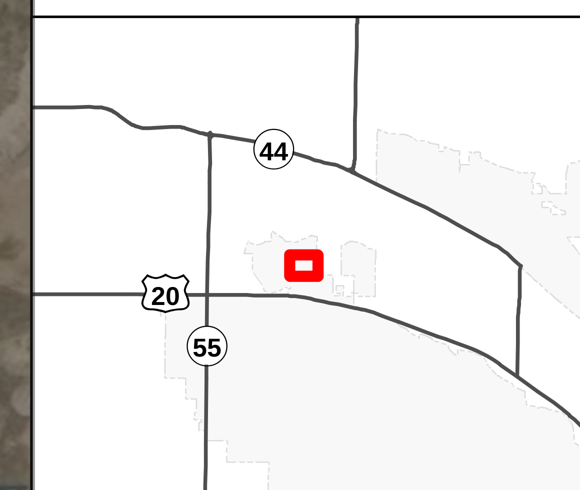
The West Boise WRF is currently rated by its NPDES permit for a design flow of 24 mgd annual average month flow. The plant is operated by a nitrification mode to meet water quality standards and effluent toxicity requirements. In December 2014, the city made an operational decision to shift the flow split between the West Boise and Lander Street WRFs resulting in a 2-mgd increase in flow to the West Boise WRF, bringing the average flow near 18 mgd. Growth in the Boise area has also contributed to the increase in total flow to the West Boise WRF. Seasonal changes in flow do occur, with increases occurring during the spring and summer months due to infiltration of irrigation water and elevated river stage water.

Figure 2-13
West Boise Water Renewal Facility Southern Boundary
Water Renewal Utility Plan



LEGEND

1 Watershed Building
2 Plant Drain Pump Station
3 Pretreatment Building
4 Laboratory
5 Headworks Building
6 Primary Clarifier #1
7 Primary Clarifier #2
8 Primary Clarifier #3
9 Aeration Basin #1
10 Aeration Basin #2
11 Aeration Basin #5
12 Aeration Basin #6
13 Secondary Clarifier #1
14 Secondary Clarifier #2
15 Secondary Clarifier #3
16 Secondary Clarifier #4
17 Secondary Clarifier #5
18 Secondary Clarifier #6
19 Post Aeration Basin
20 UV Disinfection Building
21 Digester #1
22 Digester #2
23 Digester #3
24 Digester Control Building #1
25 Digester Control Building #2
26 Sludge Pumping Station
27 Dewatering Building (Contains Belt Presses)
28 Struvite Building
29 Filtrate Storage Building
30 T-Chlorine Building
31 Grounds Maintenance Building
32 Operations Building
33 Instrument Building
34 Maintenance Building
35 Lander Street WWTP Digested Sludge Blend Tank
36. Digester Gas Storage Tank
37. Gravity Thickeners
38. Primary Sludge Fermenters
39. Thickening Building (Contains Primary Sludge, and WAS RSTs)
40. Struvite Storage
41. WAS Phosphate Release Tank



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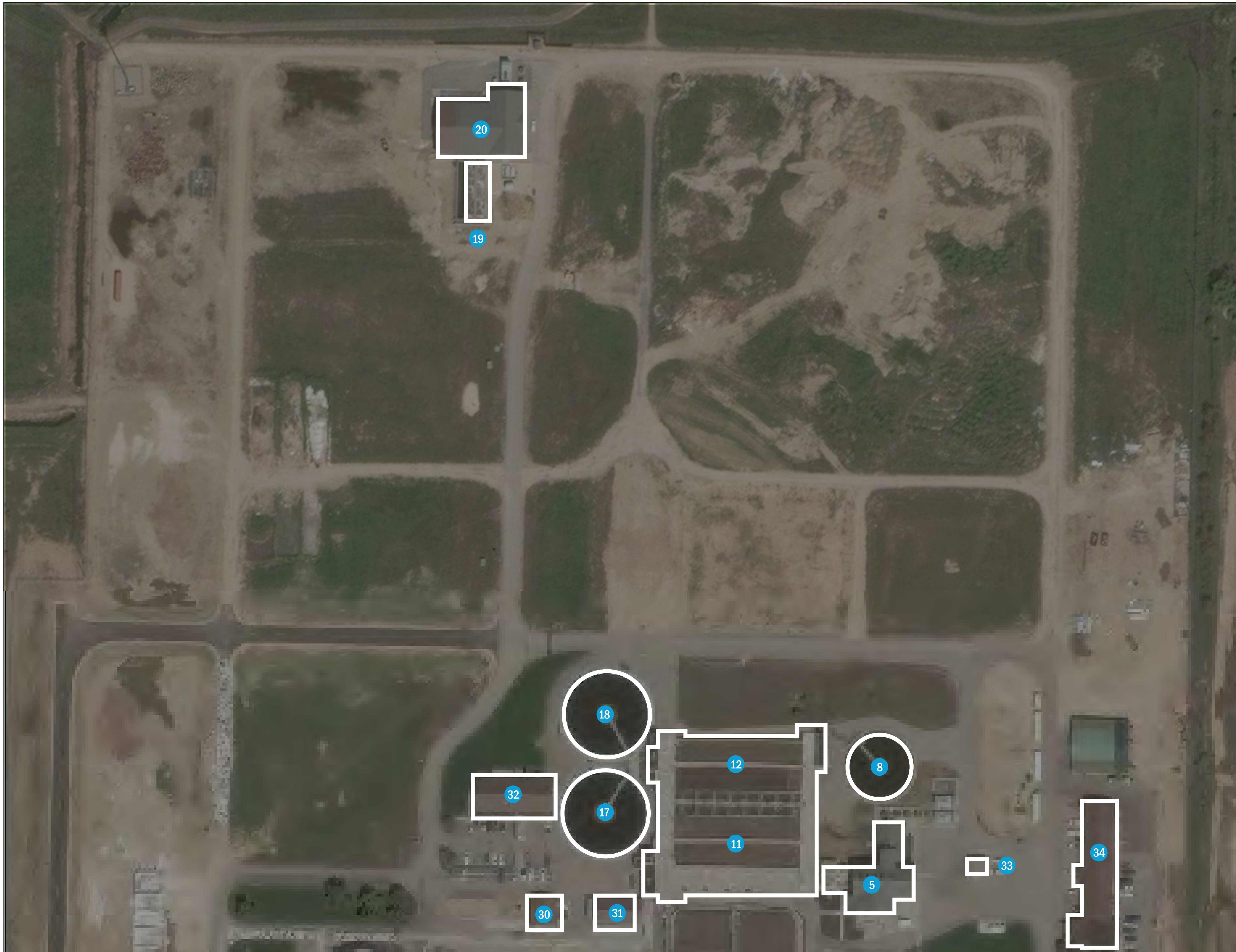
CITY OF BOISE WATER RENEWAL UTILITY PLAN

Brown AND Caldwell

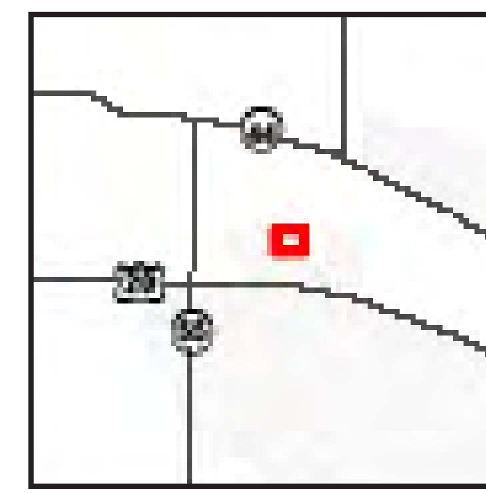
JACOBS JUB ATLAS FCS GROUP

Figure 2-14
West Boise Water Renewal Facility Northern Boundary
Water Renewal Utility Plan



Legend

5 Headworks Building
8 Primary Clarifier #3
11 Aeration Basin #5
12 Aeration Basin #6
17 Secondary Clarifier #5
18 Secondary Clarifier #6
19 Post Aeration Basin
20 UV Disinfection Building
30 T-Chlorine Building
31 Grounds Maintenance Building
34 Maintenance Building



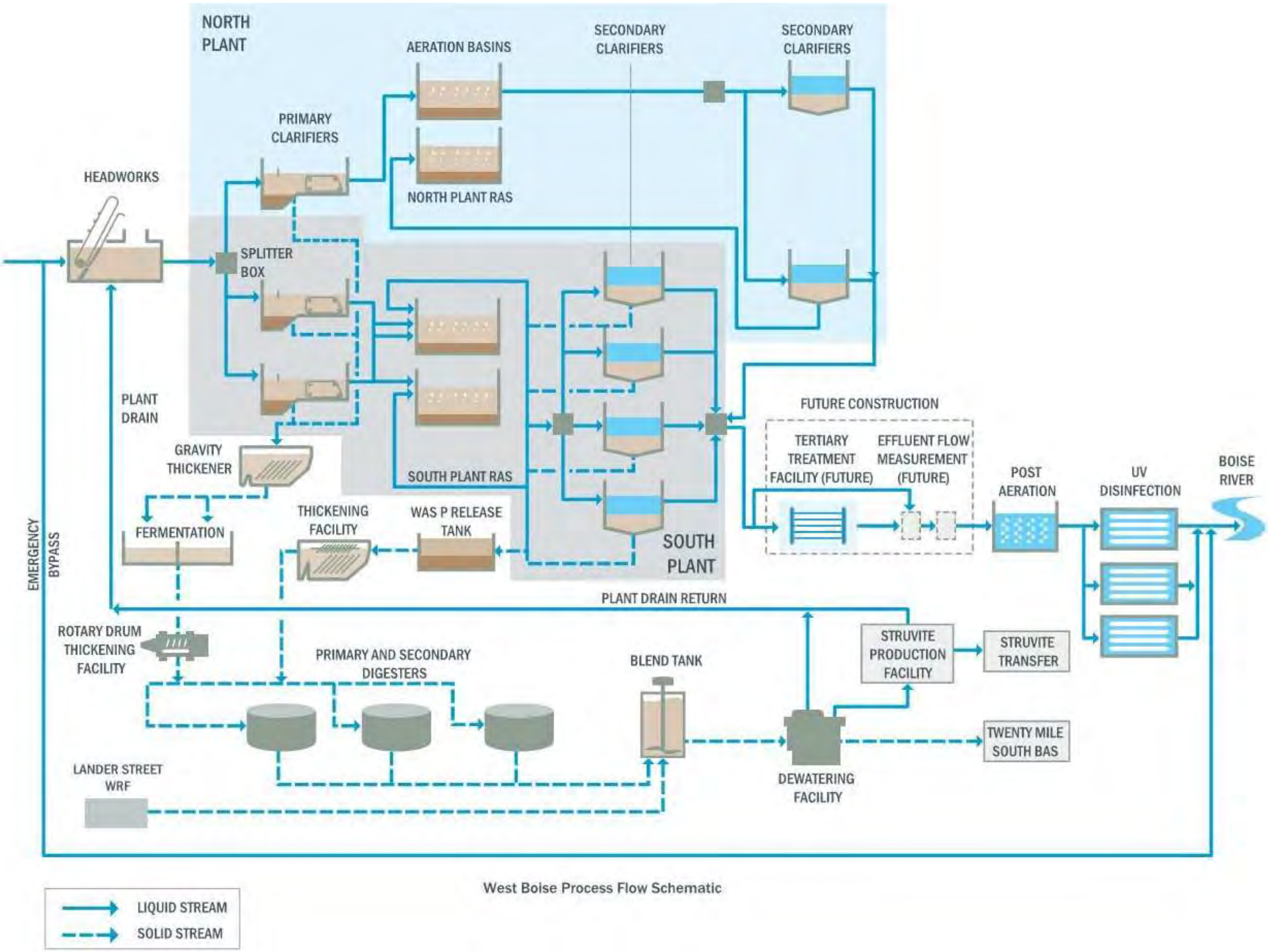


Figure 2-15. West Boise WRF process flow diagram

2.3.3.1 West Boise WRF Condition

A team of operations and engineering staff completed a desktop risk assessment for the West Boise WRF to determine the consequence and likelihood of failure for the unit processes and auxiliary systems. Processes that were determined to have the highest risk are noted in the following text to describe the criticality and/or condition issues that require prioritization for future plant rehabilitation efforts or CIPs. These processes will require attention within the current planning window. To this end, the city will continue to assess and prioritize replacing this infrastructure to maintain the performance of the West Boise WRF.

Medium-Voltage Electrical Distribution System (Primary Electrical Loop)

- Were this system to fail, it would result in the inability to fully treat used water, resulting in high potential for permit violations, public exposure to partially treated used water, and loss of public confidence.
- A single feed from IPC serves the facility, which creates one failure point for the entire system increasing the likelihood of complete system failure risk (no redundancy).
- Conditions of some components are unknown because staff have safety restrictions on opening equipment with hazardous voltages, leading to additional risk.

Communication (Supervisory Control and Data Acquisition)

- This area has a high consequence of failure risk due to loss of ability to run the plant and control the treatment processes, resulting in high potential for permit violations, public exposure to partially treated used water, and loss of public confidence.
- There is no redundancy.

Secondary Treatment (Aeration Basins and Diffusers)

- There is a high financial impact risk if galleries flood.
- This system has a high consequence to employee and public safety and health risk due to hazards associated with cleaning up flooded galleries and losing the ability to treat used water.
- This system has a permit violation risk if the aeration basins were to fail to treat used water.

UV Disinfection

- This system has a high environmental performance risk, system reliability risk, and public confidence risk since a failure could result in undisinfected water being discharged to the Lower Boise River causing permit violations and boil orders.
- The likelihood of failure risk has increased due to equipment age and because the system is proprietary, making it challenging to diagnose and repair without vendor assistance. Performance has also decreased due to recent testing that discovered higher dosages are needed.

2.3.3.2 West Boise WRF Capacity

This section discusses hydraulic and treatment capacity limits at the West Boise WRF.

2.3.3.2.1 Hydraulic Capacity

Table 2-27 reports the hydraulic capacity of key unit processes at the West Boise WRF. None of these limits is projected to be observed given the peak hour flow projection of 41.9 mgd at buildout.

Table 2-27. Hydraulic capacities			
Unit Process	Basis	Listed Unit Hydraulic Capacity (mgd)	Peak Hour Capacity (mgd)
Primary clarifier weirs	Firm capacity	2 x 12, 19	43
Headworks screens	Firm capacity	15	45
South Plant hydraulic limit (aeration basin weirs)	Total capacity	45.5 [a]	45.5
UV disinfection system	Total capacity	1 x 26.8, 2 x 15	56.8
Influent pumps	Firm capacity	2 x 21.6, 1 x 36	76

[a] *Projected limit is 36.4 mgd. Assuming 80 percent of flow to the south plant, this equates to a total influent flow of 45.5 mgd.*

2.3.3.2.2 Treatment Capacity

Similar to the Lander Street WRF, the West Boise WRF capacity chart was based on a cold weather, peak month flow, and peak month load scenario. Figure 2-16 depicts when components or unit processes of the West Boise WRF are expected to reach their limitations.

- The x-axis represents the peak month used water flow.
- The y-axis expresses raw influent BOD concentration at the WRF.
- The loading curve, represented as a solid black line, demonstrates the change in influent BOD concentration with increasing total system flow. This line is used to identify when the capacity limits are reached.
- The colored lines represent capacity curves for each controlling parameter. The point where each of the colored curves crosses the black line represents the capacity limitation for each corresponding component.

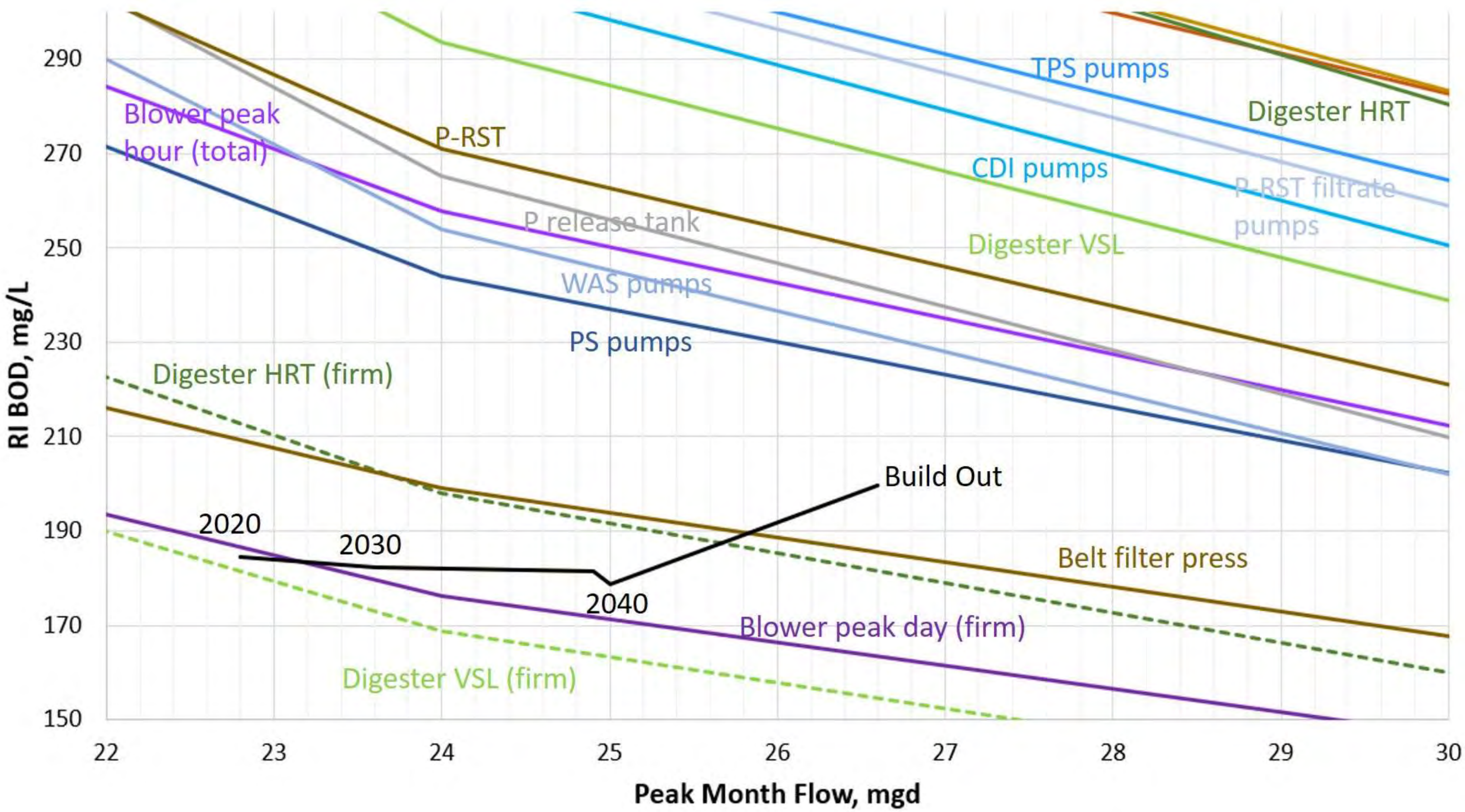


Figure 2-16. West Boise WRF capacity chart, 2020 update

Projected capacity limitations are summarized in Table 2-28. Notably, the secondary process is designated as currently limited. Curves for this system do not appear on Figure 2-16, as they are located at less than 22 mgd of peak month flow.

Table 2-28. Capacity limitations

Constraining Process	Maximum Month Flow (mgd)
Secondary process [a]	<20
Aeration blowers (one unit out of service)	23.2
Digesters (one unit out of service)	25.6
Belt filter presses (one unit out of service)	25.8

[a] *Secondary process limitations are based on meeting permit effluent limitations TP < 1 mg/L, NH_3-N < 0.3 mg/L, and NO_x-N < 15 mg/L.*

The aeration basin volume is insufficient to meet the target regulatory condition under current operating strategy. A secondary treatment expansion is required at the West Boise WRF to meet the 2040 target condition with the expected flows and loading to the facility. An additional aeration basin is one potential method to meet this goal. The final strategy for secondary treatment capacity expansion will be determined through a business case evaluation (BCE) process. Provisions for supplemental carbon and alkalinity will also be required to meet the regulatory targets. Were the BCE result to be increased aeration basin capacity, additional blower capacity would also be needed to meet 2040 demands.

After the aeration basin capacity constraints are addressed, digesters and belt filter press capacity will become the next limiting processes. The digestion system has a firm capacity of 25.6 mgd. It should be noted that the "Digester VSL (firm)" line shown in Figure 2-16 is based on a conservative volatile solids loading rate of 0.15 pounds per day per square foot. A more aggressive rate of 0.18 pounds per day per square foot may be more appropriate during peak conditions and would set the digester volatile solids loading capacity roughly equivalent to the hydraulic loading capacity, which is set at 25.6 mgd. Addressing these capacity constraints would likely require adding a fourth primary digester. The belt filter press capacity is set at 25.8 mgd with one unit out of service. This limitation may be resolved by adding more units or shifting to higher capacity equipment.

The North and South Plants have different limiting flow rates, indicating that an optimization of the flow split can increase the capacity of the combined plants. Optimizing the flow split may add up to 2 mgd of secondary process capacity to the system, depending on how the secondary process limitation is resolved. A new mixed liquor pump station should be a part of the secondary process expansion.

2.3.4 Dixie Drain PRF

The Dixie Drain PRF is a water treatment facility that removes non-point source TP pollution from the Dixie Drain, an agricultural drain The Dixie Drain PRF serves as a non-point source water quality offset, which replaces additional treatment and TP load reduction at the West Boise and Lander Street WRFs (point sources) that discharge to the Boise River. This pioneering pollutant offset project was the first of its kind in the United States and removes more TP from the watershed than would be removed by upgrading the city's existing WRFs. For every pound that is not removed at a WRF, 1.5 pounds are removed downstream at the Dixie Drain PRF.

The facility is located approximately 0.25 mile upstream and south of the Dixie Drain confluence with the Boise River. Flow from the Dixie Drain is diverted through the facility for treatment before returning to the drain, as shown on the site plan in Figure 2-17. TP load reduction is achieved with chemical precipitation and gravity settling in the facility.

As depicted in Figure 2-18, the treatment process includes an inlet screen facility for debris removal, followed by an intake pump station. A sedimentation basin allows for gravity settling of particulate matter. Flow then travels through a flash mix facility, where aluminum chlorohydrate (PAX, a liquid polyaluminum chloride coagulant) is added. The coagulant reacts with soluble phosphates and forms a precipitate floc that is then settled out in the settling pond. Flow leaves the facility over an outlet weir, rejoining the Dixie Drain. Floc is periodically dredged from the bottom of the settling pond and pumped to the floc management area for drying.

The TP removal requirements for the facility are tied to a phosphorus removal offset written into the city's West Boise WRF NPDES permit. The permitted offset includes a ratio. To receive credit for 1 pound of phosphorus at the WRFs, the city must remove 1.5 pounds of phosphorus through the Dixie Drain PRF. The offset is written into the city's current (administratively extended) NPDES permit, but the city does not receive credit for the phosphorus load that is removed at the Dixie Drain PRF until 2022. Before May 1, 2022, the TP load reduction required by the NPDES permit is 25 pounds per day as a seasonal average (May 1–September 30). The city is anticipating that the reissued permit will include a combined load phosphorus limit which will allow the city to use the full offset provided by the Dixie Drain PRF. The combined load limit is anticipated to be equivalent to a flow rate of 39 mgd (West Boise WRF buildout flow) and an effluent TP concentration of 0.1 milligrams per liter (mg/L) (May–September) or 0.35 mg/L (October–April).

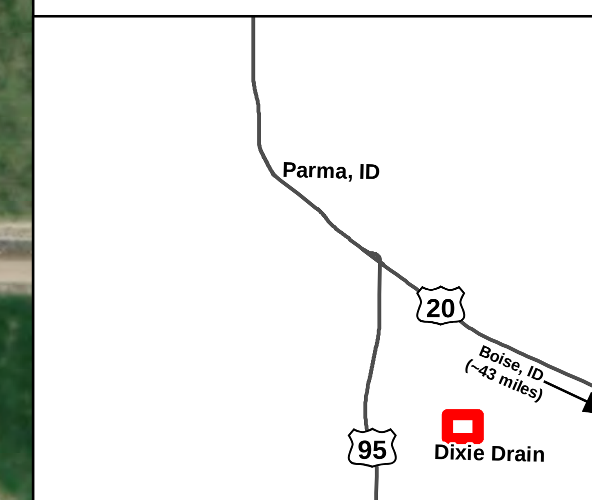
The Dixie Drain PRF has an Idaho Department of Water Resources (IDWR) water right order for diverting up to 200 cubic feet per second (cfs) from the Dixie Drain. Dixie Drain PRF was designed for a summer average TP removal efficiency of at least 70 percent. The winter average TP removal efficiency is 40 percent. While the water right determines the upper limit of inlet flows, actual flow available depends on seasonal fluctuations in the Dixie Drain. Per the United States Geological Survey (USGS), from 2014–2019, the average summer season (May–September) flow rate was 214 cfs, while the average winter season (October–April) flow rate was 101 cfs.

Besides flow rate, the other primary constituent impacting performance of the Dixie Drain PRF is inlet TP concentration. Per data collected by the City from 2016 to 2019, the average summer season (May–September) TP concentration was 0.26 mg/L, while the average winter season (October–April) TP concentration was 0.20 mg/L. The average summer season TP concentration from 2000 to 2013 was 0.35 mg/L, per data from the Idaho State Department of Agriculture, the USGS, and the city (Brown and Caldwell, 2014). With inlet TP concentrations trending lower, there is less load available to remove in the Dixie Drain PRF, reducing the available offset.

Figure 2-17
Dixie Drain
Water Renewal Utility Plan

Legend

1	Diversion Bladder
2	Inlet Screen Facility
3	Intake Pump Station
4	Intake Pump Station Electrical Building
5	Sedimentation Basin
6	Flash Mixing Facility
7	Settling Pond
8	Settling Pond Outlet Structure Weir
9	Existing Barn
10	Floc Management Area No. 1
11	Operations Building
12	Future Sediment Management Area
13	Future Flocculation Tank
14	Future Floc Management Area No. 2



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CITY OF BOISE WATER RENEWAL UTILITY PLAN

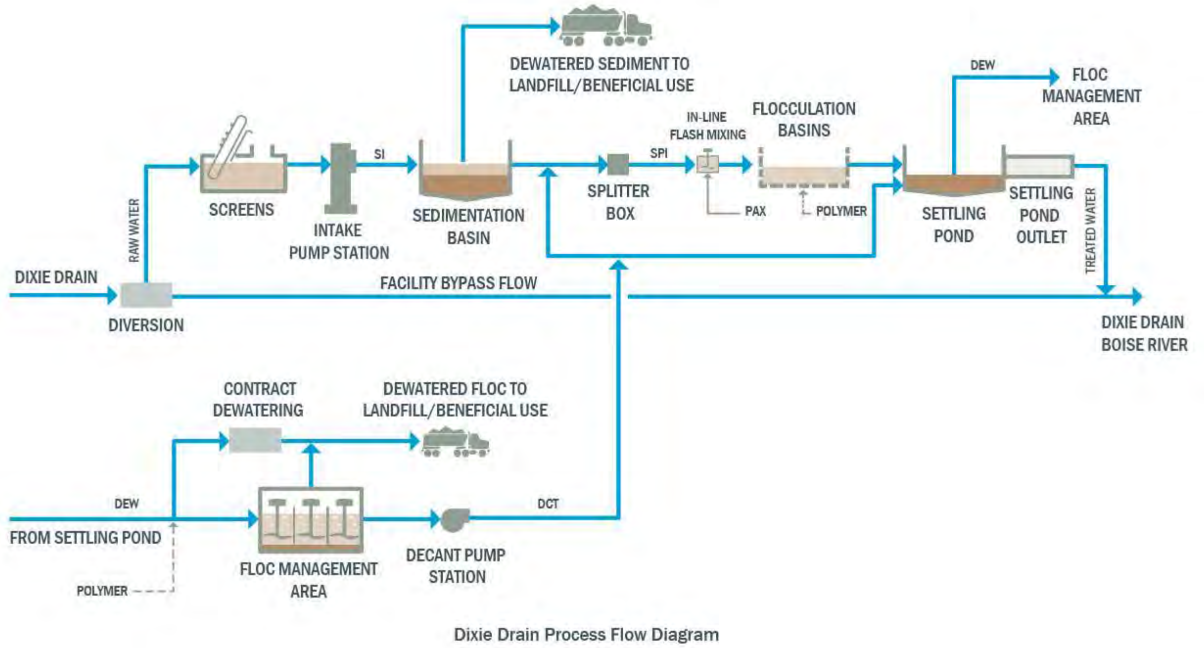

Figure 2-18. Dixie Drain PRF process flow diagram

2.3.4.1 Dixie Drain PRF Condition

The risk analysis performed at the Dixie Drain PRF was based on input from operations staff describing the condition of each asset, the consequence of failure, the likelihood of failure, and the redundancy of each process. The risk score is determined by multiplying the consequence and likelihood scores. The risk score multiplied by the business risk mitigation factor provides the business risk score. There were no processes with a risk score above 30, which is considered the cutoff for high risk. The three highest-risk processes are listed below:

- **Solids removal dredge:** The dredge system removes solids from the flocculation basin and is an important part of the phosphorus removal process. It is an expensive system in fair physical condition that requires periodic corrective maintenance.
- **Screening and rake system:** The screening and rake system removes debris as water enters the facility. Losing this system would limit the capacity of the system to remove phosphorus. This process is in fair physical condition and has required periodic corrective maintenance.
- **Drain diversion system:** The drain diversion system includes the bladder gates that divert flow into the facility. Losing this system would result in a high consequence of failure, since water would not be able to enter the facility. This system would be expensive to repair.

2.3.4.2 Dixie Drain PRF Capacity

The capacity of the Dixie Drain PRF is different from the capacities of the WRFs explained in previous sections. The Dixie Drain PRF was designed for a maximum flow of 200 cfs and for a design TP removal rate of 70 percent.

2.3.4.2.1 Hydraulic Capacity

The Dixie Drain PRF hydraulic profile was developed at three flow rates:

- **Maximum**: 200 cfs. This is the maximum allowable diversion from the Dixie Drain per the city's water right. Historical data indicate that this flow rate may be available only approximately 40–70 percent of the time the PRF is in operation (Brown and Caldwell, Preliminary Engineering Report – Dixie Drain Phosphorus Removal Facility, 2014).
- **Normal operation**: 150 cfs. This is a more conservative estimate of available flow. Historical data indicate that this flow rate will likely be available approximately 90 percent of the time the PRF is in operation.
- **Minimum**: 50 cfs. This corresponds to a low flow rate that, historically, has almost always been available in the Dixie Drain from May through September.

The WSE at the PRF outfall was estimated using readings from a nearby USGS staff gage in the Dixie Drain and accounts for conditions when high Boise River flows induce backwater into the Dixie Drain. The WSE at the PRF diversion was estimated using the city's monitoring data from the location beginning in 2010. An analysis showed that raising the WSE at the PRF inlet to 2,261 ft above mean sea level or higher could cause some flooding of the upstream properties to the south and east (Brown and Caldwell, 2014).

Pumping at the Dixie Drain PRF is necessary due to limited available hydraulic head. When high Boise River flows induce backwater into the Dixie Drain, the available head across the facility (without pumping) is estimated to be 1 foot. The intake pump station raises the hydraulic gradeline approximately 9.9 to 10.7 feet. The pump station has the capacity for the entire range of design flows, with two pumps in service at the minimum flow rate and four pumps in service at the maximum flow rate.

2.3.4.2.2 Treatment Capacity

Recent data appears to show a downward trend in flow and TP concentration in the Dixie Drain. Figure 2-19 shows that a reduction in available TP concentration and/or flow would reduce the inlet TP load and, in turn, reduce the mass of TP removed at the facility. Assuming the combined TP load limit described in Section 2.3.4 is implemented in the new IPDES permit, the summer target TP load removal at Dixie Drain PRF is calculated as follows:

39 mgd x [0.35 mg TP/L – 0.1 mg TP/L] x 8.34 lbs/gal x 1.5 = 122 lbs TP/day

This calculation assumes an outlet TP concentration of 0.35 mg/L from the WRFs and a used water flow rate of 39 mgd at the WRFs. The offset multiplier of 1.5 is also included.

To achieve this future target, TP removal requires an average inlet flow of around 150 cfs into the facility, assuming 70 percent of the inlet TP is removed. If the facility can continue to remove 78 percent of inlet TP like it has in 2018 and 2019, the average inlet flow required will drop to around 140 cfs. However, if TP concentrations in the drain continue on a downward trend, the inlet flow will need to be higher. These future scenarios, and the conditions that trigger alternative paths forward for the facility, are discussed in the Dixie Drain Facility Plan.

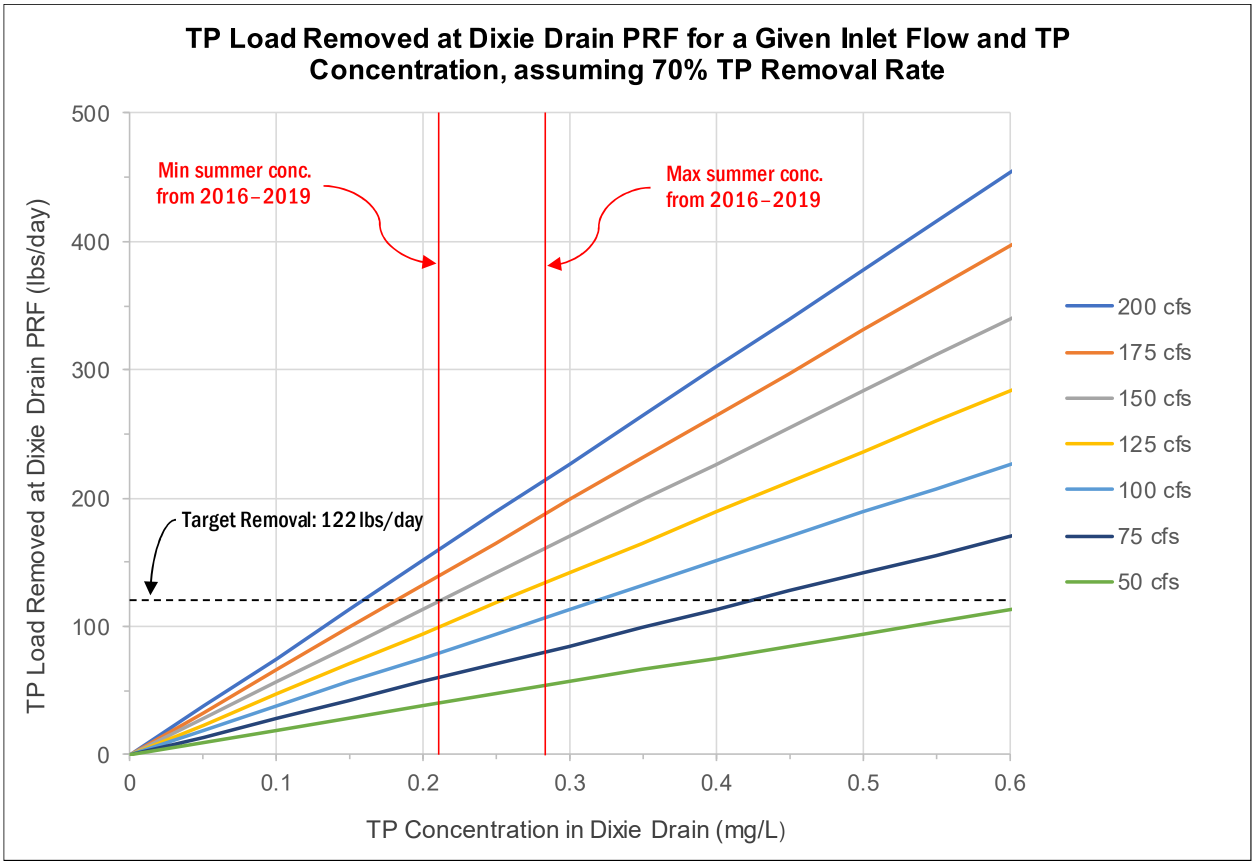

Figure 2-19. Dixie Drain PRF removal capacity based on inlet flow and TP concentration, assuming 70 percent TP removal rate

2.3.5 Twenty Mile South Biosolids Application Site

The city owns and operates a 4,225-acre farm approximately 20 miles south of Boise (Figure 2-20 and Figure 2-21). The TMSBAS receives biosolids generated at the two WRFs. Biosolids are made up of settled solids from the primary clarifiers, activated sludge that settled in the secondary clarifiers, and other minor solids treatment streams. Dewatered biosolids are trucked to the site in trailers that hold approximately 30 wet tons per load. The treated biosolids are stored in bunkers for up to 2 years, then applied to fields for growing forage crops that are eventually sold to farmers. In general, the city spreads all of the biosolids in inventory each spring and fall and typically has little carryover into the following year. This practice enables the city to store biosolids for several months at a time during the summer crop growing and winter seasons. The site is managed to comply with all local, state, and federal regulations governing the reuse of biosolids.

Biosolids are a valuable fertilizer. They help replenish the soil nutrients removed by the crops. Biosolids provide the nitrogen, phosphorus, and other nutrients necessary for plant life. Although the TMSBAS receives biosolids from the West Boise WRF, the enhanced biological phosphorus removal processes at both facilities, and the phosphorus recovery via struvite at the West Boise WRF, influence the phosphorus content of the biosolids that are transported to the TMSBAS.

Figure 2-20. TMSBAS

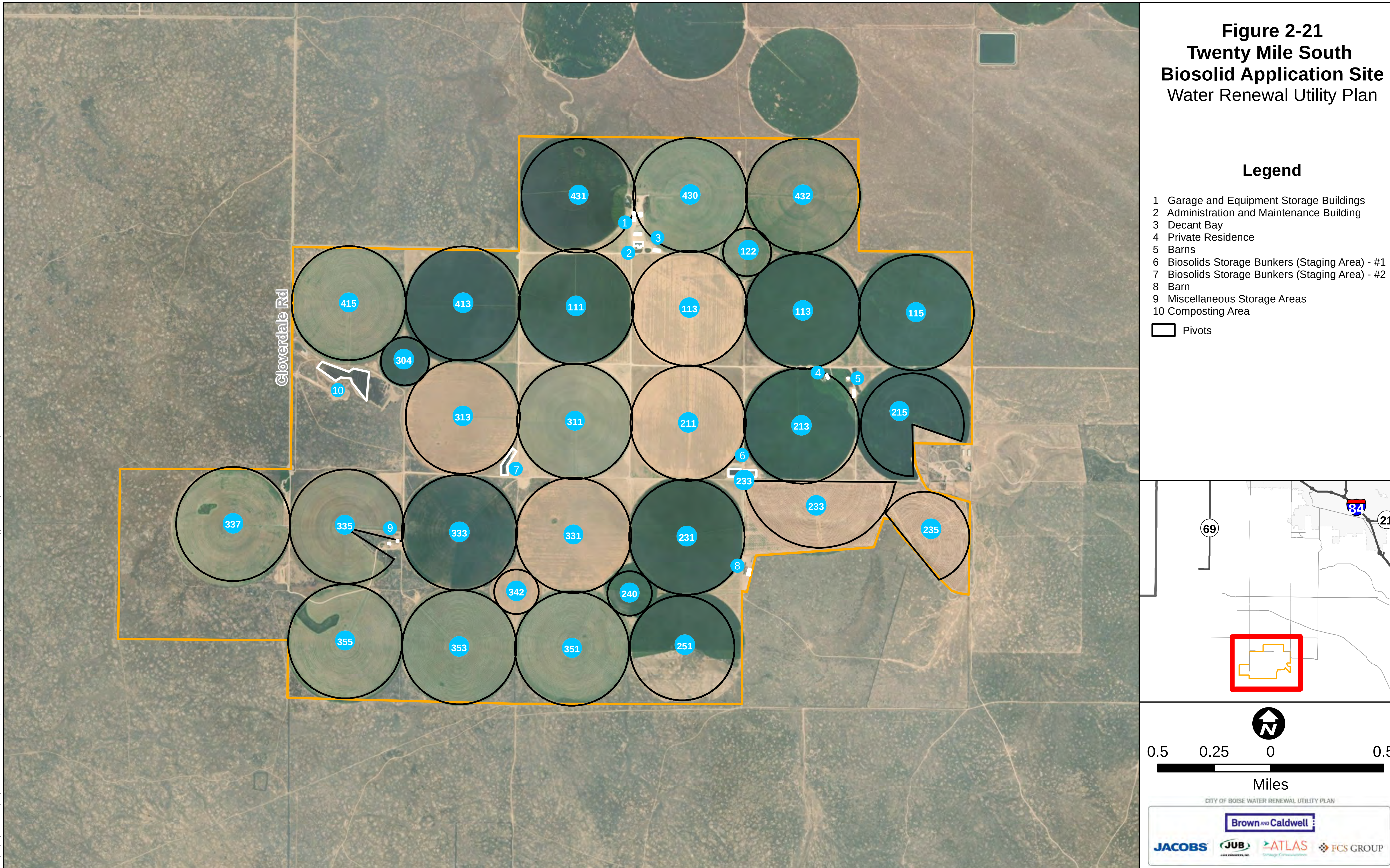

Figure 2-21
Twenty Mile South Biosolid Application Site
Water Renewal Utility Plan

2.3.5.1 TMSBAS Condition

The city performed a desktop condition assessment of the TMSBAS in 2020. The city's staff defined which elements of each unit process posed the greatest threat to achieving the city's level of service goals and then reviewed the consequence of unit process failures and the current understanding of the likelihood of such a failure.

The risk analysis performed at the TMSBAS included meeting with the plant's staff to understand the condition of assets and determine a consequence of failure, the likelihood of failure, and the redundancy of each process. The processes with a risk score above 30 are considered high risk and are described in further detail below:

Electricity

- If the electrical system were to fail, it would result in a high consequence of failure and would lead to the inability to operate the irrigation systems.
- The likelihood of failure is high based on past experience. IPC owns the electrical infrastructure that has typically failed. Failure includes transformers failing and power poles burning.

Well Water and Fire Suppression

- A failure of the well water system that provides water for the residences and fire suppression for the Administration Building would result in a high consequence of failure. The system of three wells is critical for protecting employee safety and would have a high financial consequence of failure.
- The physical condition of these wells is poor, resulting in a higher likelihood of failure.

Primary Irrigation System

- The primary irrigation system consists of four wells that serve nearly one-third of the pivot irrigation systems at the TMSBAS. The consequence of failure for this system would be high since crops would be lost, and these systems are typically expensive to repair or replace. Without the irrigation system, the TMSBAS would struggle to fulfill its mission since fields would not be available to land apply biosolids.
- Fair physical condition increases the likelihood of failure.

2.3.5.2 TMSBAS Capacity

The capacity of the TMSBAS depends on the nutrient loading applied to the site. Biosolids generation and application to the site are predicted to grow by roughly 1 percent per year, or 54 dry tons per year (HDR, 2020). Figure 2-22 shows the recorded solids trucked to the TMSBAS and the projected rate through 2040.

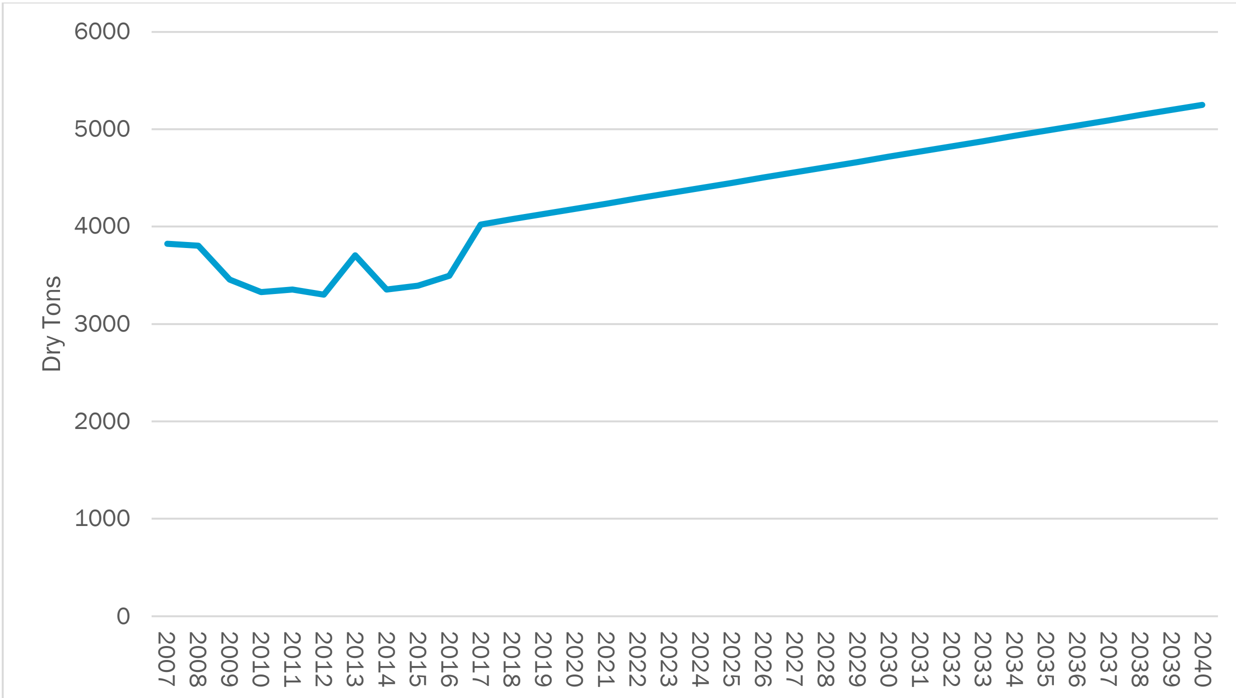

Figure 2-22. Solids to the TMSBAS (actual 2007 through 2017 and projected 2018 through 2040)

HDR assessed the capacity of the TMSBAS using four separate scenarios and 2040 projections:

- Scenario 1: Apply biosolids to all available TMSBAS acreage
- Scenario 2: Apply biosolids at agronomic rate for nitrogen
- Scenario 3: Apply biosolids at agronomic rate for phosphorus
- Scenario 4: Apply biosolids to half the acreage per year

Scenario 1

Assumes that biosolids are spread evenly onto 3,331 acres at the TMSBAS (this is the acreage used in 2017). This scenario helped determine whether there was sufficient acreage to meet anticipated loading requirements in 2040. In 2040, if the entire 2017 farm acreage were used, the nitrogen loading would be approximately 79 pounds per acre, which is below agronomic rates for most crops. Phosphorus loadings would be at or slightly below agronomic rates. The disadvantage of this scenario is that biosolids are applied to all available acres, thus, there is no "resting" of fields (no biosolids application for a season).

Scenario 2

The agronomic rate for nitrogen was assumed to average 275 pounds per acre, which was based on past farm performance. Based on applying biosolids at a nitrogen loading of 150 pounds per acre, a total of 1,669 acres would be required (about 50 percent of the available land). A nitrogen agronomic rate results in a phosphorus loading of 157 pounds per acre (or 79 pounds per acre of available phosphorus). Application of biosolids to meet crop nitrogen requirements will result in over application of phosphorus. The current regulatory framework does not restrict phosphorus loadings. However, the IDEQ will take primacy of the biosolids program in the near future, and IDEQ has indicated that it may implement a policy of evaluating soil phosphorus levels with depth.

Scenario 3

Application of biosolids is based on agronomic rate for phosphorus rather than nitrogen. TP generated in 2040 is estimated at 262,500 pounds per acre and, assuming an agronomic rate of 80 pounds per acre (40 pounds per acre of available phosphorus), results in the need for 3,281 acres. The current farm has 3,331 acres. To meet crop needs, nitrogen fertilizer will need to be added under this scenario (except for alfalfa, which is a legume and can adjust its own nitrogen levels).

Scenario 4

Scenario 4 is based on applying biosolids to half of the total number of fields in any given year. This scenario allows for management flexibility and enables each field to rest for 1 year before receiving more biosolids. Under this scenario, the nitrogen loadings are at agronomic rates for many crops (but at a higher loading than in Scenarios 1 and 3) and is nearly identical to Scenario 2.

Under the assumptions listed in the above scenarios, the city's TMSBAS has sufficient acreage to meet biosolids land application needs in 2040. Using nitrogen agronomic rates, the city requires about 50 percent of the acreage in any year for biosolids application, allowing the other acreage to be "rested" from biosolids application for that year. If regulatory requirements change, and the city is required to apply phosphorus at agronomic rates, then the entire acreage (3,331 acres) would be needed for annual application (Scenario 3).

2.4 Financial and Organizational Capacity

The city's ability to generate revenue to implement future projects and support ongoing operations is a key planning consideration. It is not uncommon for utility investment opportunities and needs to exceed the ability to generate revenue.

Similarly, WRS's organizational capacity is the capability of WRS to deliver water renewal services to a level that satisfies IDPES regulations and customer expectations. Organizational capacity considers the level of staffing necessary to meet these goals.

2.4.1 Financial Capacity

WRS operates as an enterprise fund within the city. User rate revenues and fees are collected to cover to the cost of operations and capital funding. In 2010 WRS collected nearly $33.7 million in revenue from user rates and fees (Figure 2-23). This revenue was used to pay $20.4 million in operating expenses and $13.4 million in capital projects. Since 2010, the revenue collected has grown year-over-year to $65.7 million in 2019. This revenue increase was needed to cover growing operational costs and capital expenditures related to growth, regulatory requirements, and infrastructure condition during this period. Examples of the increased costs include the addition of the Dixie Drain Phosphorus Removal Facility, capital investments at the West Boise Water Renewal Facility to improve phosphorus removal, reinvestment in the existing infrastructure at the Lander Street Water Renewal Facility, and increased staffing to support these facilities that are all required to meet regulatory compliance. The fund balance has also grown to $53.7 million in 2019 to cover greater reserve funding needs and to build funds for expected capital expenditures. WRS's approach to increasing financial capacity moving forward is discussed in more detail in Section 7.

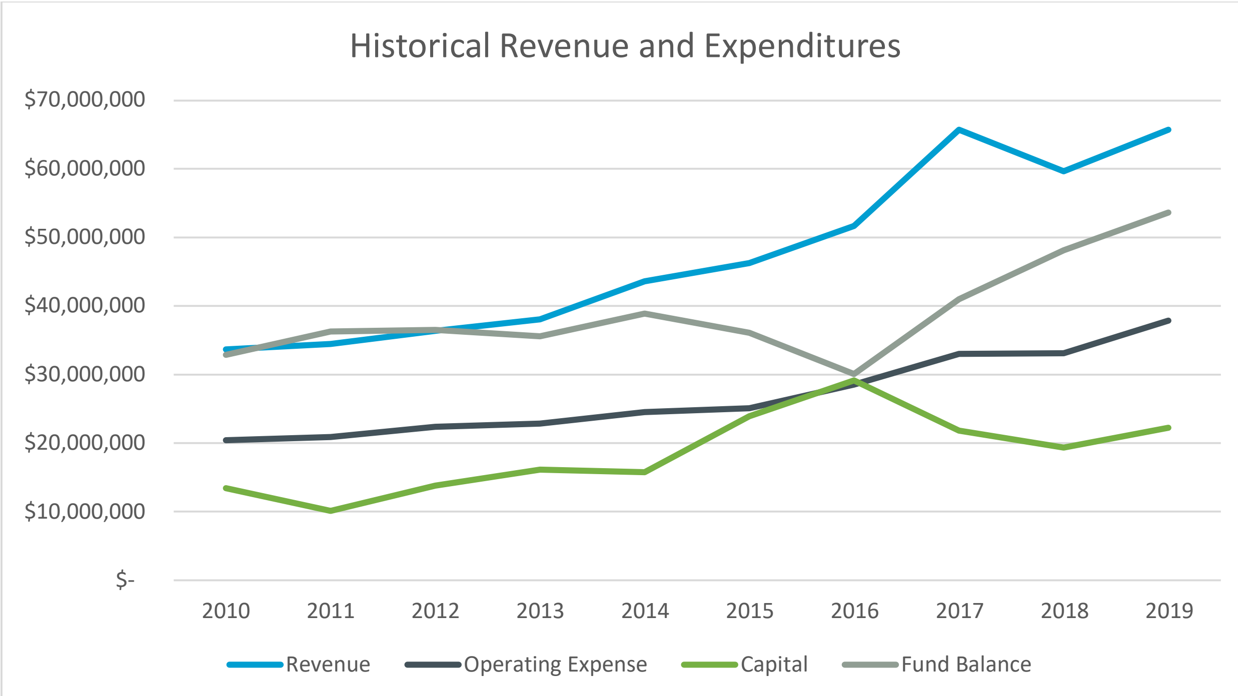

Figure 2-23. Historical revenue and expenditures

2.4.1.1 Funding

The city traditionally has rate- and fee-funded capital improvements and rate-funded operations and maintenance (O&M) expenses. Currently, the city generates approximately $65 million in revenue from a combination of user rates and fees. Since 1979, the city has regularly adjusted rates, which have averaged approximately 5 percent annually. Connection fees have also been adjusted throughout the same period.

Operating revenue is the cash flow available to the city as a result of deducting cash operating and financing expenses from the revenue earned from the sale of services to customers. The primary source of revenue is utility sales derived from the rates charged to customers for the city's WRS. Secondary sources of operating income include miscellaneous fees, charges, and other income not related to utility sales. Operating cash flow is often used either as a source of direct investment in capital projects in the current period or to increase cash reserves to make funds available as investment capital in a future period.

Section 67-8207 of the Idaho Statutes authorizes cities to impose connection fees on new customers as a condition of receiving utility service. The term "connection fee" can refer to a charge that recovers the cost of installing the physical service connection, but, in this context, it is a charge based on a proportionate share of the costs the city has already incurred to provide the capacity necessary to serve new customers.

2.4.1.2 Affordability

Affordability of utility services has become one of the most important discussions in the environmental industry over the last 5 years. Utilities are needing to address affordability more directly as the industry faces increasing regulatory considerations, renewing and replacing infrastructure, supporting economic development, and changing residential densities. When utility rates become unaffordable, revenues start to suffer from lower collection rates causing rates to increase and further exacerbate the issue.

Central to the topic of affordability are two competing concepts: the ability to pay and the willingness to pay. The EPA has maintained a standard whereby average sewer bills more than 2 percent of a community's median household income are above a community's ability to pay. The ability to pay can be thought of as the financial capacity of the customer. Willingness to pay is more difficult to measure but is important in the context of affordability because it connotes something about the value of the service being provided and its relative importance to members of the community. Even though utility bills may be well within a given household's ability to pay, there may be an unwillingness to pay if doing so forces the household to forgo goods and services that are perceived to have a higher value or importance than water renewal services.

WRS rates average $410 annually for a typical household, which falls well within EPA's standard guideline of 2 percent of median household income. However, WRS recognizes that even at this rate utility bills can have an outsized impact on lower income customers. This impact is demonstrated in Table 2-29, which shows the cost of a utility bill as a percentage of the household income for multiple income bins within the city.

Table 2-29. Weighted average residential indicator for Boise's WRS service area (2018)

Weighted Average Residential Indicator				
Income Bins	Bin Midpoint	Boise WRS Service Area		
		% Population in Bin	Bill as % of Midpoint	Weighted Impact
< $10,000	$5,000	6.8%	8.2%	0.6%
$10,001–$15,000	$12,500	5.0%	3.3%	0.2%
$15,001–$20,000	$17,500	5.4%	2.3%	0.1%
$20,001–$25,000	$22,500	5.2%	1.8%	0.1%
$25,001–$30,000	$27,500	5.0%	1.5%	0.1%
$30,001–$35,000	$32,500	5.5%	1.3%	0.1%
$35,001–$40,000	$37,500	4.5%	1.1%	0.0%
$40,001–$45,000	$42,500	5.3%	1.0%	0.1%
$45,001–$50,000	$47,500	3.9%	0.9%	0.0%
$50,001–$60,000	$55,000	8.9%	0.7%	0.1%
$60,001–$75,000	$67,500	9.9%	0.6%	0.1%
$75,001–$100,000	$87,500	12.5%	0.5%	0.1%
$100,001–$125,000	$112,500	8.0%	0.4%	0.0%
$125,001–$150,000	$137,500	5.1%	0.3%	0.0%
$150,000–$200,000	$175,000	4.3%	0.2%	0.0%
> $200,000	$200,000	4.7%	0.2%	0.0%
Weighted average residential burden				1.5%

2.4.2 Organizational Capacity

WRS is composed of over 300 employees who serve in a myriad of functions throughout the organization from operations to permit compliance verification to long-term planning. These employees work daily to provide the outcomes the community expects of WRS.

WRS is the primary utility within the city's Public Works Department. As such, the majority of the Public Works Department staff support WRS. Figure 2-24 depicts the overall organizational structure of the Public Works Department. As of July 2020, there are five divisions within the Public Works Department. The Division Manager for each division reports directly to the Public Works Director. More detail for each of these divisions that directly contributes to WRS is provided in the following sections. The Municipal Facilities Division is tasked with managing facilities outside of WRS and, therefore, it not discussed further.

Water Renewal

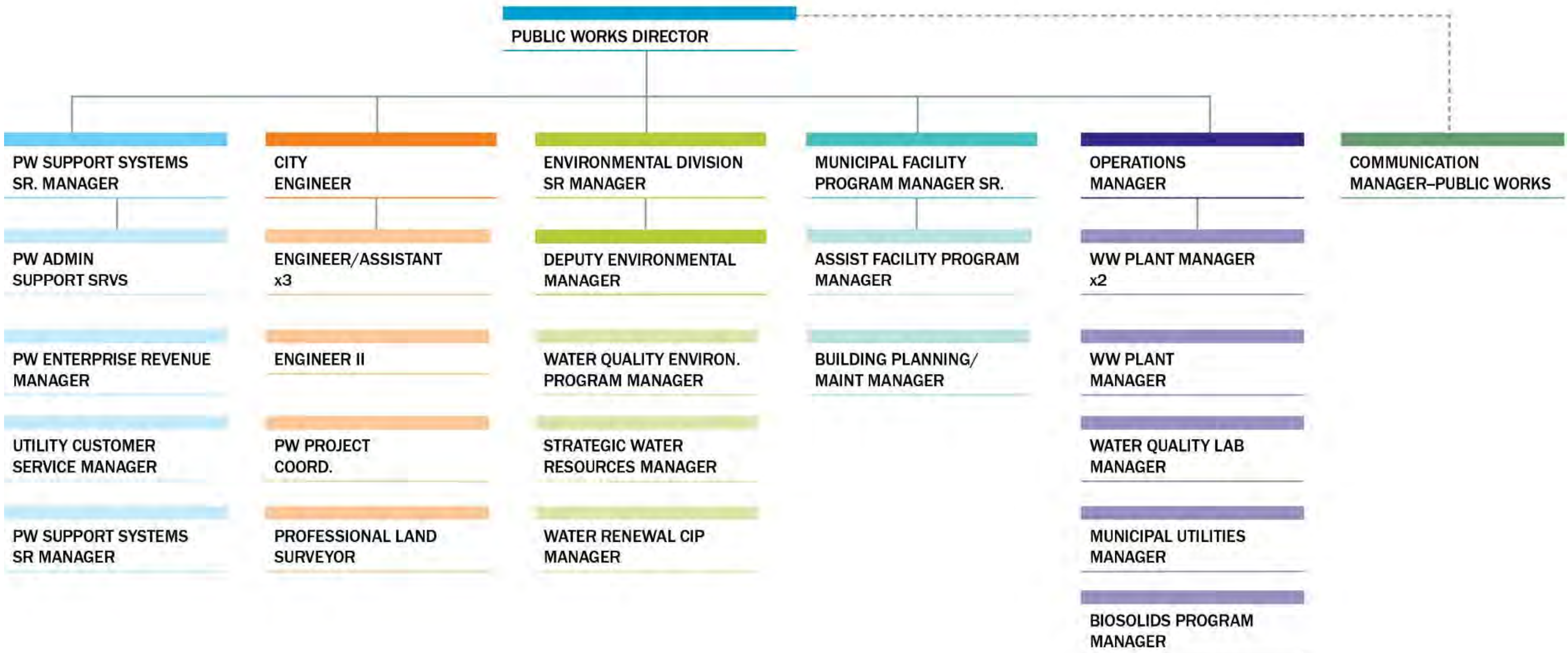

Figure 2-24. Organizational chart (summary)

2.4.2.1 Environmental

The Environmental Division is responsible for implementing environmental, economic, and community projects and programs throughout the city related to air quality, water quality, water resources, sustainability, solid waste, and planning for WRS. Figure 2-25 depicts the current organizational structure for the Environmental Division, Strategic Planning, and Capital Planning.

Environmental

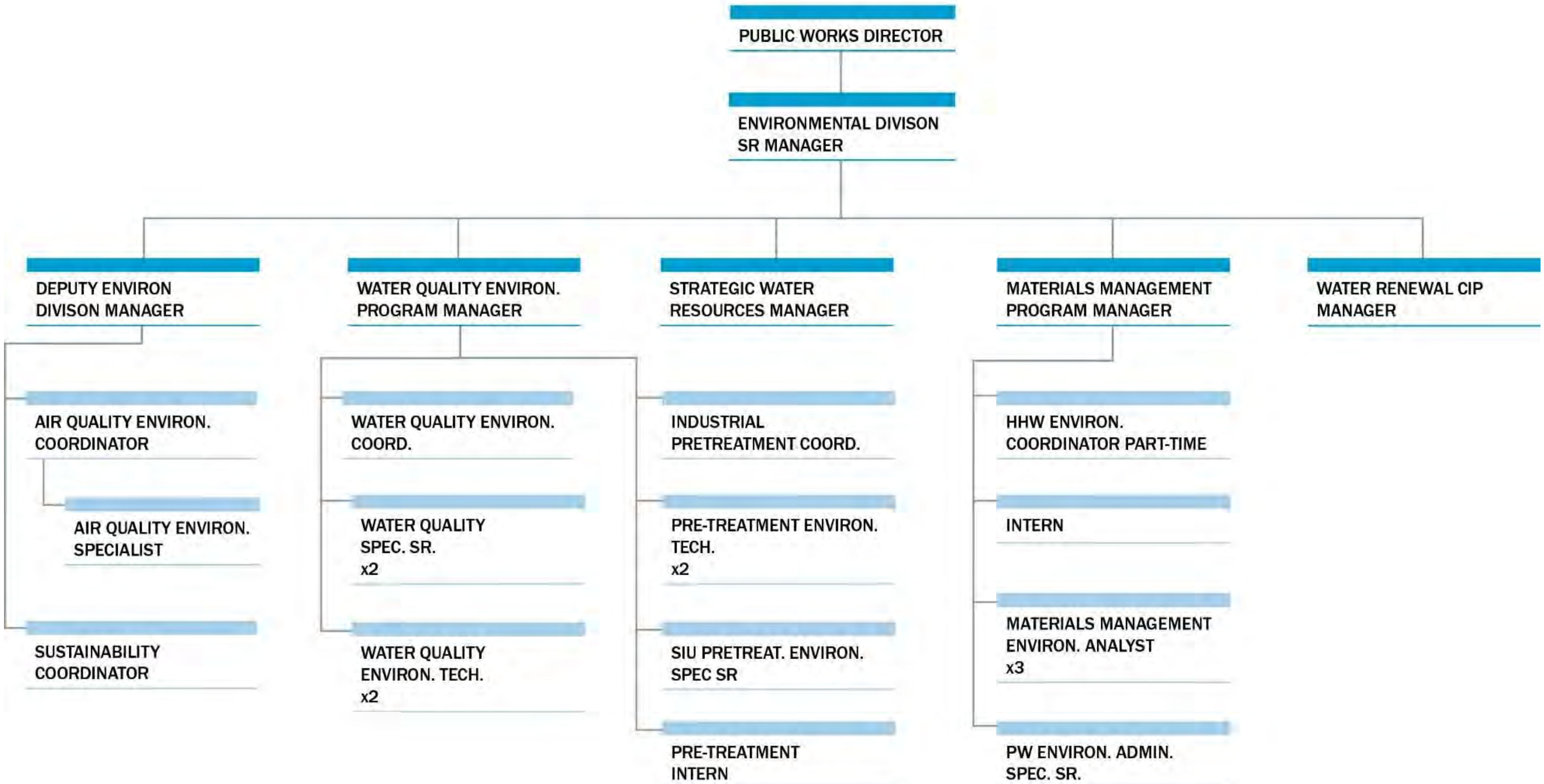

Figure 2-25. Environmental organizational chart

2.4.2.2 Engineering

The Engineering Division is responsible for implementing projects related to WRS, including WRF improvements and collections system upgrades. Engineering also implements stormwater and drainage control projects and geothermal improvements. The Engineering Division manages the pressure irrigation system for the city and is in charge of reviewing and approving development permits. Figure 2-26 depicts the current organizational structure for the Engineering Division.

Engineering

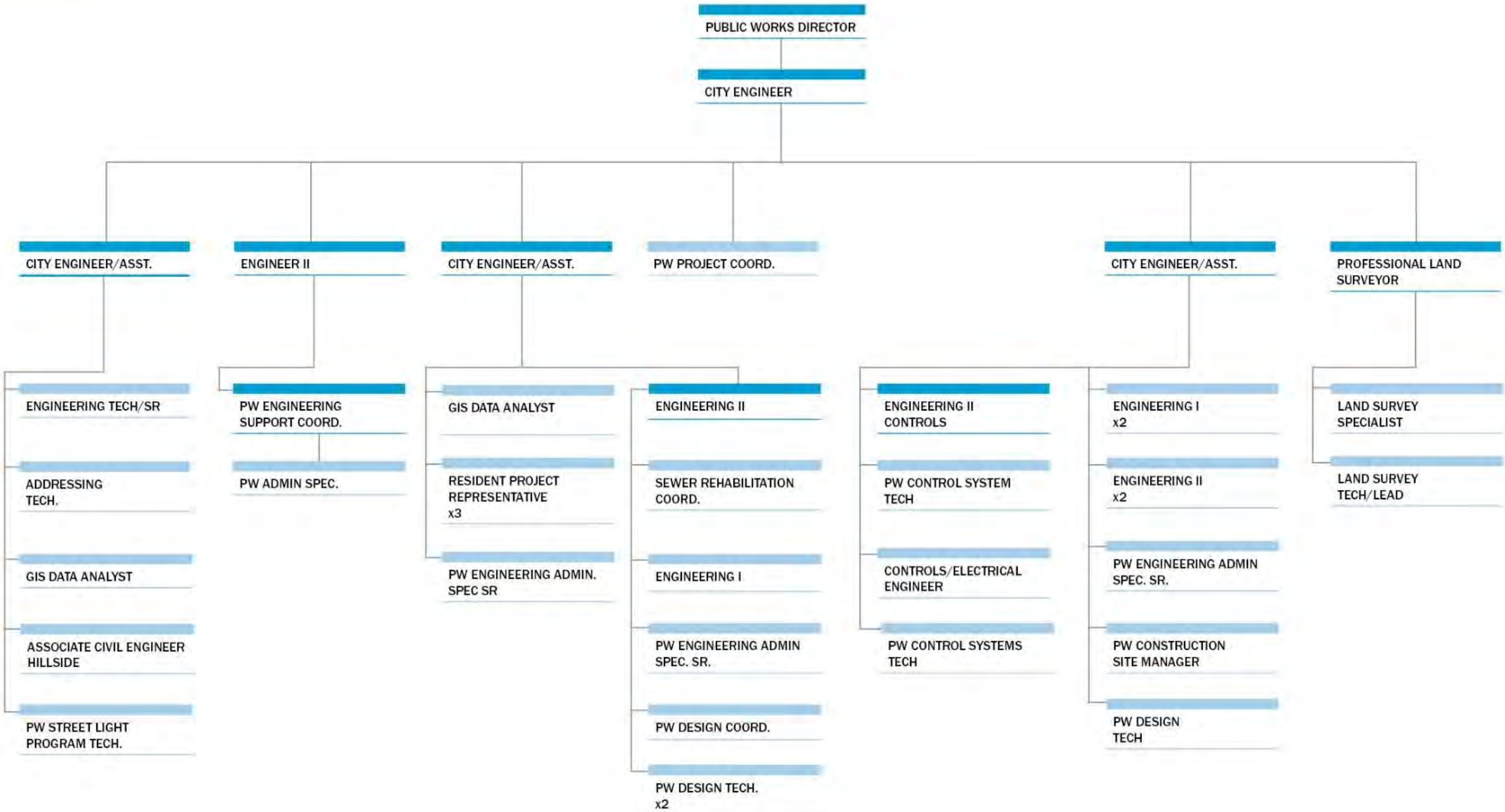

Figure 2-26. Engineering organizational chart

2.4.2.3 Administration

The Administration Division includes customer service, revenue, and communications. Customer service manages utility billing services and bills WRS customers for water renewal services. The revenue department manages funds for current and future WRS capital projects. It manages the incoming revenue from rates and connection fees and works with WRS to determine how much funding is needed in which year to complete the necessary improvement and/or expansion projects related to water renewal and conveyance. The communications department manages public outreach and education for WRS. Public outreach includes the stakeholder engagement performed for the Utility Plan and also includes operation of the WaterShed. Figure 2-27 depicts the current organizational structure for the Administration Division.

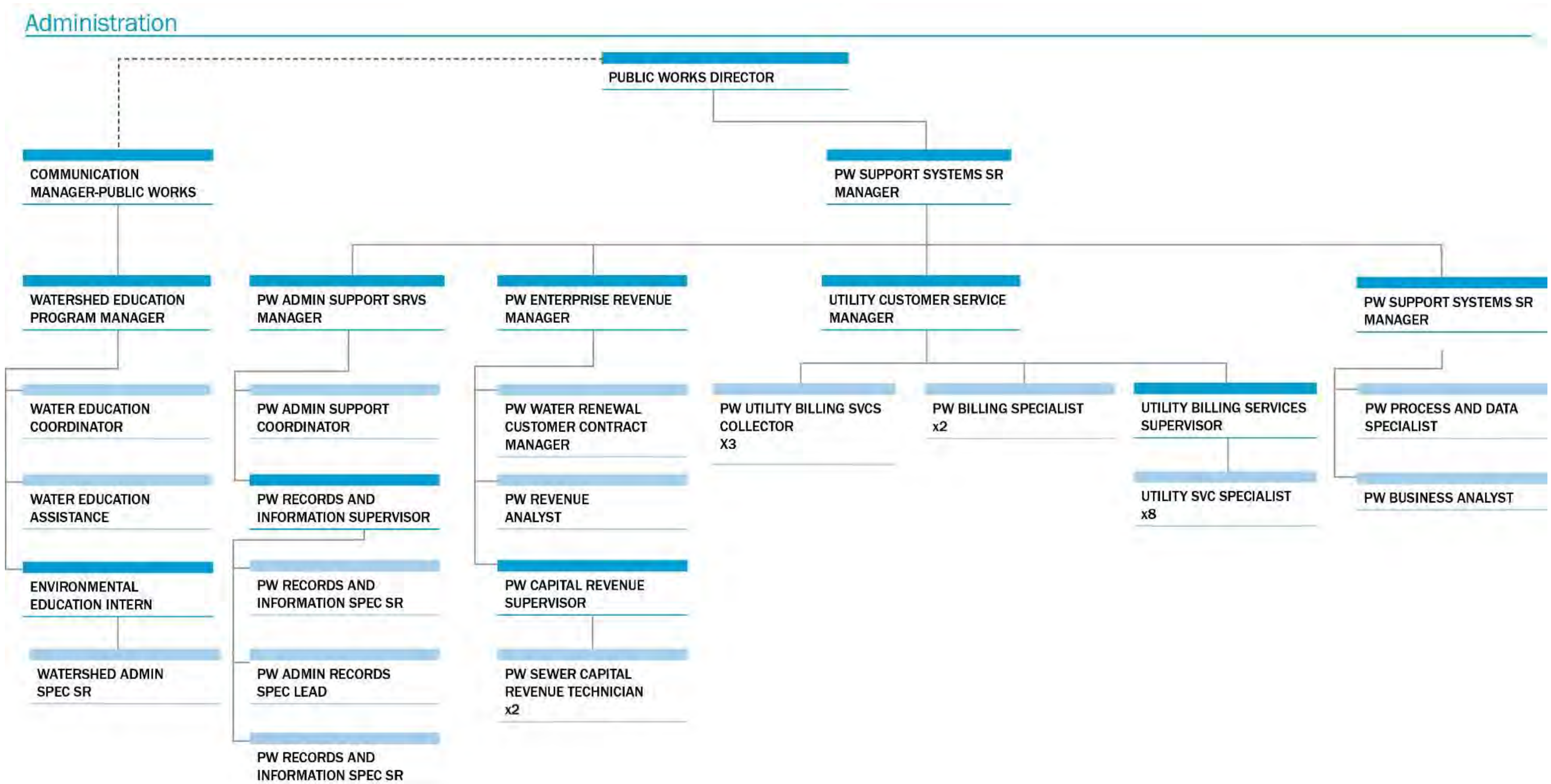

Figure 2-27. Administration organizational chart

2.4.2.4 Operations

The Operations Division includes WRF staff who operate and maintain the WRFs, work in the water quality laboratory, and manage biosolids application and crops at the TMSBAS. Each facility is broken down further in the following sections. Figure 2-28 depicts the current organizational structure for the Operations Division.

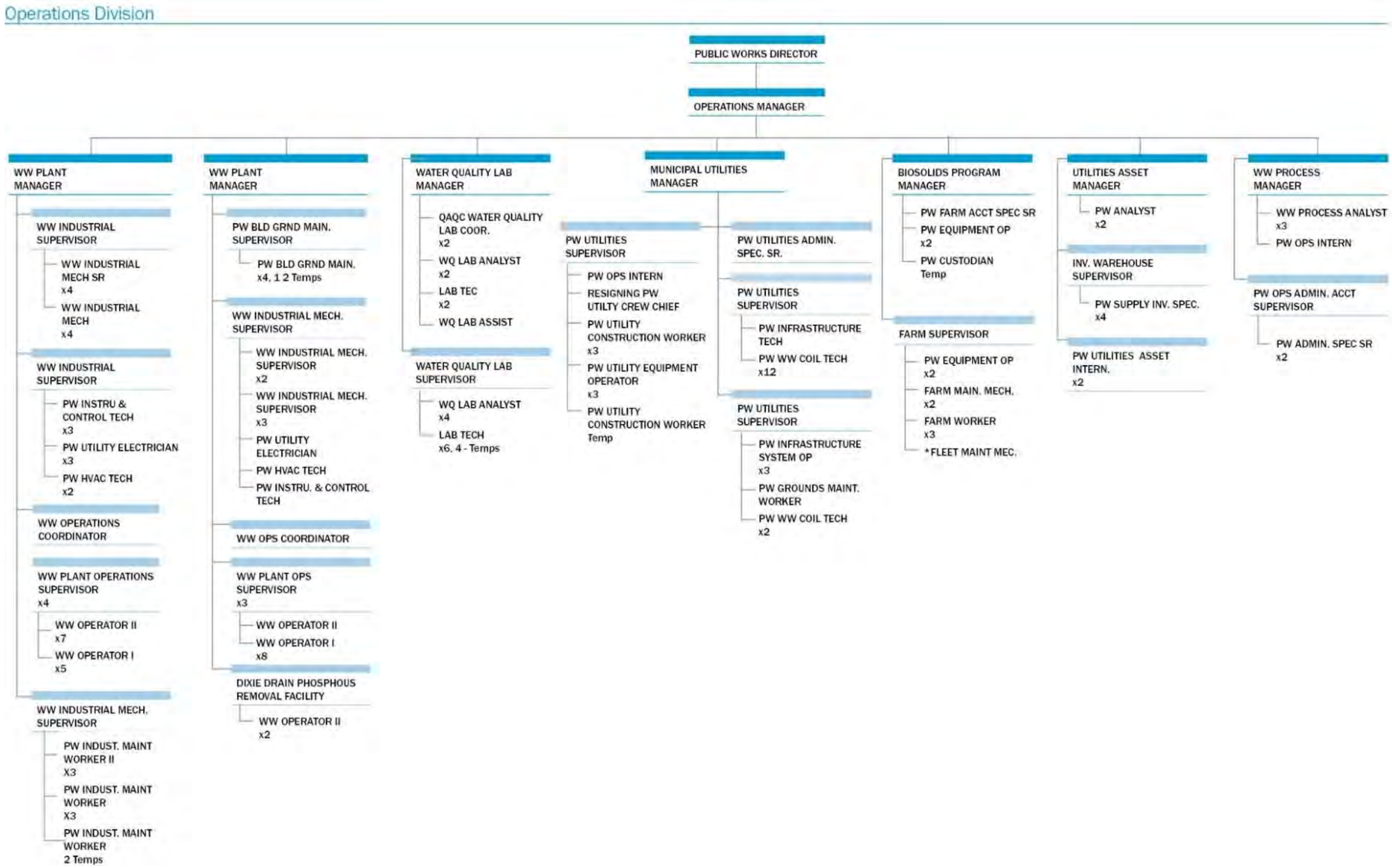

Figure 2-28. Operations organizational chart

2.5 Community Expectations

The decisions contemplated throughout the course of the Utility Plan are generational decisions that will require significant investment by the community. Therefore, it is critically important to both understand and align with community interests and expectations with the future investment and actions for WRS. This section describes the community expectations for WRS and how stakeholder feedback was gathered and incorporated throughout the development of the Utility Plan.

2.5.1 Level of Service

Level of service goals set the bar for the levels of service that will be provided to the community. The level of service goals support the core values of the city and connect the utilities' actions to broader city initiatives. The goals provide a framework for continual and consistent review of organizational and operational performance and keeps WRS transparent and accountable.

WRS iteratively developed a set of level of service goals through the development of the Utility Plan. The goals were based on the broad community feedback themes gathered through multiple rounds of community input and internal expectations from city staff. With each round of community feedback, the goals were reviewed and adjusted. Finally, the goals were presented to the Advisory Group, described in more detail in Section 2.5.2, for final validation prior to finalization. The following list is the level of service goals for WRS:

- Help sustain the Lower Boise River's quality to support multiple community uses
- Act and communicate transparently
- Support a robust, vibrant economy consistent with the city's visions
- Protect the health and safety of our community and staff
- Recover, recycle, and renew water, energy, and other products from the materials we receive
- Operate cost-effectively and maintain a resilient utility
- Develop partnerships to effectively solve community issues
- Attract and retain engaged, thriving employees
- Provide high-quality customer service

2.5.2 Community Engagement

The city used a phased community approach throughout the development of the Utility Plan. Ideas were iteratively developed and tested with the community. Starting with broad themes and concepts, the community was asked to provide the input to WRS. As evaluations progressed, more targeted questions were asked about specific opportunities and details. For example, early stakeholder input showed broad public support for reusing water. Several technical approaches for reusing water, such as industrial reuse and supplementing irrigation, were developed and presented to stakeholders. These presentations included the technical details on implementation, potential rate impacts, and the long-term benefits and consequences.

The city collected input from over 2,700 community members during the development of the Utility Plan. A myriad of community engagement approaches were used to diversify the feedback gathered and ensure findings were representative of the community. Phone surveys, online surveys, in-person focus groups, and community events were all used as a means of gathering community feedback.

The culminating community engagement effort for the Utility Plan was the formation of an Advisory Group. This group, comprising 24 members, held six monthly meetings to review the water opportunities discussed in Section 4. They provided input for the city's level of service goals, various perspectives on potential uses of water in the community, and feedback on the preferred approach moving forward for the city. Ultimately, this group assisted the city in setting the strategy for WRS for decades to come.

To gather feedback, WRS used the engagement for the Utility Plan as an opportunity to educate the community about WRS and included participation in multiple community events, such as the Easter EGGstravaganza Event at the Boise Zoo, Boise Farmer's Market, and Treefort Music Festival. With each of these events, WRS raised the awareness of the critical role it plays in the community. Materials uses during these events are shown in Figure 2-29.

Figure 2-29. Example stakeholder outreach materials

2.5.3 Community Expectations

Several key themes emerged from the multiple rounds of community feedback conducted through the planning effort. These themes changed the direction and outcomes of the Utility Plan.

- The community has a strong overall approval and opinion of WRS based on the historical reliability and performance of the utility.
- Maintaining and improving the health of the Boise River and the environment is critically important to the community.

- While the community has high regard for WRS, there is an expectation and hope to better utilize water resources moving forward. There is an interest in pursuing different uses of renewed water to offset other, non-potable uses in the community.
- There is an expectation that WRS continues to provide the reliable service it is known for in the future in the face of changing conditions. The community was supportive of options that increased the community's resiliency to changing conditions and provided for robust water renewal systems.
- The community is willing to invest in WRS if those investments are aligned with the outcomes they expect. This willingness is balanced by an acknowledgement that affordability of services will be important moving forward.

2.6 Gap Analysis

The previous sections have defined the boundary conditions that will be used to guide the alternatives developed and analyzed as part of the Utility Plan. Increasing external demands, both increasingly stringent regulatory requirements and growth, will require additional investments in capacity within the water renewal system. This situation is compounded with the need for continual investment in the existing infrastructure, some of which is at or beyond its useful life. As the city looks to make these investments, additional capital funding and organizational capacity will likely be needed. Finally, and most importantly, the community expectations for WRS continue to increase and more will be expected from WRS moving forward. These factors set the conditions against which all future actions will be weighed.

Section 3

Water Products

Section 1 introduced the concept of switching the mindset from simply meeting compliance requirements and disposing of byproducts to focusing on managing, recovering, and recycling resources. The most prominent resource for WRS is renewed water. This section discusses how the city plans to manage this resource now and into the future.

3.1 Current Water Products

WRS currently collects and renews water from homes, businesses, and industries in Boise and the surrounding areas. In the context of the future water products discussed in Section 3.2, the city's current approach to renewed water is focused on river discharge with some recent actions to further enhance the river. The city renews approximately 30 mgd that is safely discharged to the Boise River. As discussed in Section 2, renewed water is required to meet strict regulatory requirements to maintain the health and water quality of the Boise River. The city currently meets and exceeds these requirements and, in doing so, has looked for opportunities to enhance the Boise River. Such enhancements have recently included implementing the Dixie Drain PRF, which is focused on improving the water quality of the Boise and Snake Rivers.

While the current approach has served the city well for decades, it does not provide an opportunity to reuse the renewed water in our community. The renewed water discharged to the Boise River quickly flows downstream to be used by other communities before eventually reaching the Pacific Ocean. The following section describes how the city considered better utilizing this resource for the benefit of the community.

3.2 Future Water Products

Water renewal produces a product that can be used over and over again—water. As the city transitions the focus of WRS to managing, recovering, and reusing its resources, renewed water represents the most abundant resource.

The following sections discuss water products the city can produce through various levels of treatment at the WRFs. The future water products investigated at the beginning of the project ranged from continued river discharge to using recycled water for irrigation to direct potable reuse. Section 3.2.1 describes the process the city took to work through the water product alternatives and the multiple touchpoints the city had with the public to align alternatives with community feedback. Sections 3.2.2 through 3.2.6 then describe the water products WRS will pursue in the future.

Many of the potential water products presented in the following sections focus on recycled water. Recycled water is the term used when highly-treated renewed water is put to beneficial use within the community. There are many levels of recycled water, ranging from quality suitable for irrigation of non-food crops to quality suitable for use in parks, playgrounds, and irrigation of food crops. The city focused on Class A recycled water, the highest quality of recycled water in Idaho. Renewed water treated to Class A standards can be recycled for applications that take the place of non-potable water. Class A Recycled Water standards require the city to continually monitor and test water to ensure it meets strict quality standards set by the IDEQ.

The outcome of the assessment presents a new water future for the city where WRS will produce recycled water for industrial use and aquifer recharge. These new water uses will be focused on new capacity within the system with the ability to provide additional recycled water in the future. WRS will also continue to discharge renewed water back to the Boise River and look to further enhance the river.

3.2.1 Alternative Assessment

The alternative assessment started with looking at the products WRS currently produces and asking the public what it would like to see WRS do with these products. The resounding response was that WRS should be doing more with the renewed water it produced. An alternative analysis was conducted, in conjunction with ongoing stakeholder engagement, to produce a strategic direction for WRS. Over the course of multiple years, the city evaluated potential water products, then tested these ideas with the public.

Ultimately, a recommended approach emerged that was the least total asset cost that met community expectations to expand the city's use of water products, preserved the health of the Boise River, and invested in water resiliency.

3.2.1.1 Stakeholder Feedback

The city surveyed the public three times over the course of the planning phase to gauge support for various uses of renewed water. In-depth interviews and focus groups were also conducted to refine WRS's approach to resource management. Overall, the stakeholder outreach process confirmed the residents of Boise want to see WRS do more to reuse the renewed water it produces, but only when it makes economic sense.

The following specific outcomes were confirmed through the multi-phase community engagement efforts:

- The community cares greatly for the health of the Boise River and is willing to pay more to protect the river and the environment.
- The community expects WRS to maintain the high level of reliability it has been known for and is interested in looking at decentralizing infrastructure as a means of increasing resiliency.
- The community is focused on identifying resilient solutions and sees the benefit of protecting water resources for the future.
- The community is interested in solutions that keep resources local and make them available throughout the community.
- The community supports investing in solutions that will lead to better outcomes, but this willingness is balanced by a need to keep services affordable.

These outcomes were used to craft investment options, which were presented to an Advisory Group made up of representatives from Boise neighborhoods, businesses, and nonprofits over the course of six meetings. The Advisory Group supported creating diverse portfolios that combined investment options to meet outcomes. These portfolios were then explored in more technical detail before arriving at the Recommended Approach.

3.2.1.2 Investment Options

The following sections summarize the seven investment options presented to the Advisory Group. The investment options were not fully formed at the time they were presented in order to receive feedback from the group and incorporate it into the final investment options. Each investment option aligns with the outcomes described by stakeholder engagement.

3.2.1.2.1 River Discharge

The Boise River runs through the heart of the city and provides many opportunities for recreation and enjoyment for Boise residents. One way the city supports the health of the river is by meeting regulatory discharge requirements set by the IDEQ. Renewed water discharge to the river supports flow during low flow times, such as during winter months when the river experiences low flow conditions. Stakeholder feedback indicated it was important to the public to maintain the flow in the river, especially during low flow periods.

River discharge largely represents the status quo for how the city currently manages the water products from water renewal. Used water is collected and treated to state and federal requirements at the two WRFs and is then discharged to the Boise River (Figure 3-1).

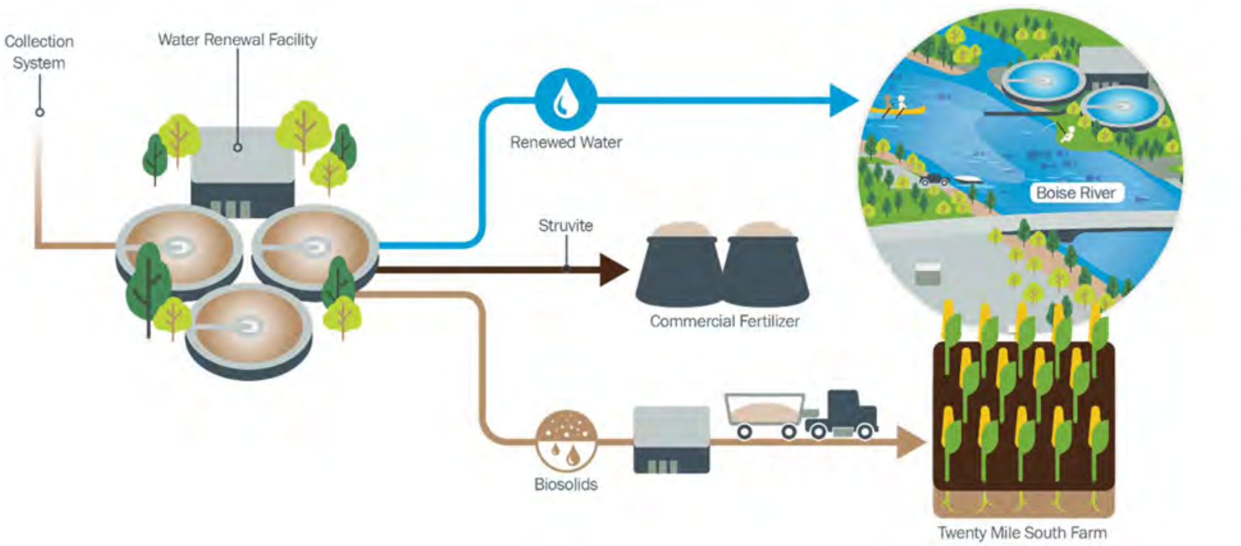

Figure 3-1. Investment option: river discharge

3.2.1.2.2 Enhance the River

Community feedback overwhelmingly indicated that protecting the Boise River was a top priority for the community. The community expects that WRS does not just maintain but looks for opportunities to enhance the Boise River.

Enhance the river focuses on enhancing the overall community value of the Boise River beyond the current regulatory requirements. The Advisory Group helped define boundaries for the Boise River from Lucky Peak downstream to Eagle Road (i.e., the portion of the river within the city limits) and encouraged the city to focus on watershed-scale improvements such as shading projects and side channel restoration, in addition to enhancements at the existing WRFs to further increase renewed water treatment beyond regulated levels (Figure 3-2). These investments would be targeted to improve the overall community value and use of the Boise River.

Figure 3-2. Investment option: enhance the river

3.2.1.2.3 Industrial Reuse

Industrial reuse involves providing local industries recycled water to run processes in which potable water is not required. Recycled water uses include commercial applications such as carwashes and industrial uses such as datacenters, food processors, and other industrial facilities that use water for heating and cooling.

This investment option helps the city meet the stakeholder outcome to build future resiliency by protecting water resources for the future. Recycling water for industrial reuse puts renewed water to beneficial use and increases the utility of water in Boise. Treating industrial flows at a separate facility also frees up capacity at the existing WRFs. Figure 3-3 shows recycled water produced at a WRF sent to industries to use in place of potable water.

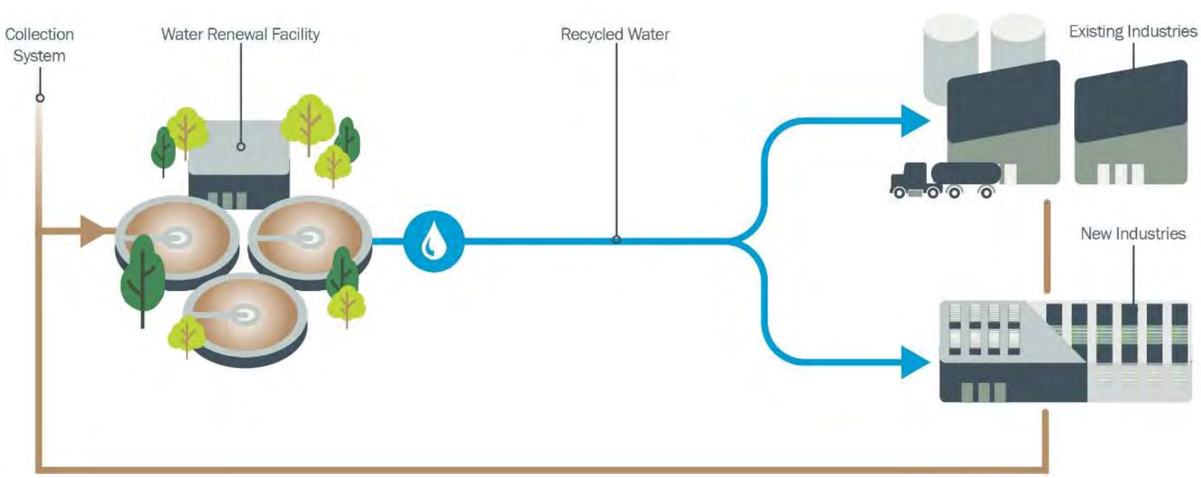

Figure 3-3. Investment option: industrial reuse

3.2.1.2.4 Aquifer Recharge

Aquifer recharge focuses on replenishing the groundwater in the Treasure Valley using recycled water. While there are several approaches to accomplish recharge, Figure 3-4 shows the currently assumed approach using infiltration basins. Recycled water from a WRF would be conveyed to a series of infiltration basins that would allow the recycled water to slowly percolate into the aquifer. Once reaching the aquifer, this water would then be available for future use by the community providing resiliency for future water shortages

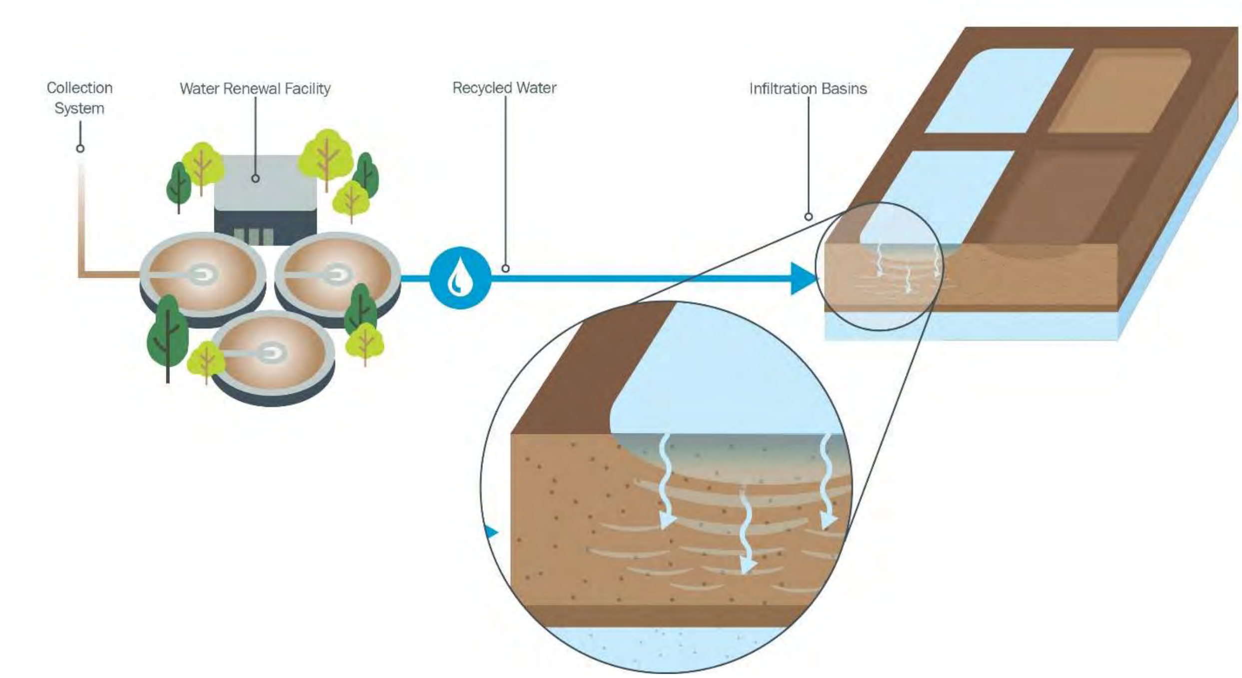

Figure 3-4. Investment option: aquifer recharge

3.2.1.2.5 Local Food Production

Producing locally grown food uses the three main water renewal products, water, energy, and biosolids, which are all produced at the WRFs. Two methods of growing food were investigated: traditional farmland and greenhouses. The city operates the TMSBAS where it applies biosolids produced at the West Boise WRF and grows crops, primarily feed crops for livestock. Sending recycled water to the TMSBAS is a logical next step to producing food using only WRF products. Greenhouses require all three products, water, nutrients, and energy, to grow food in a small footprint year-round.

Boise is the largest city within a 300-mile radius and imports the majority of its food. Currently, only 8 percent of farmland in the Treasure Valley is used to cultivate food crops for human consumption (National Agricultural Statistics Service Cropland Data Layer, 2017). Growing local food with products created at the WRFs would increase the city's food resilience by providing a reliable, local source for food production. Figure 3-5 illustrates the potential end uses for water, solids, and energy products produced at WRFs to grow local food.

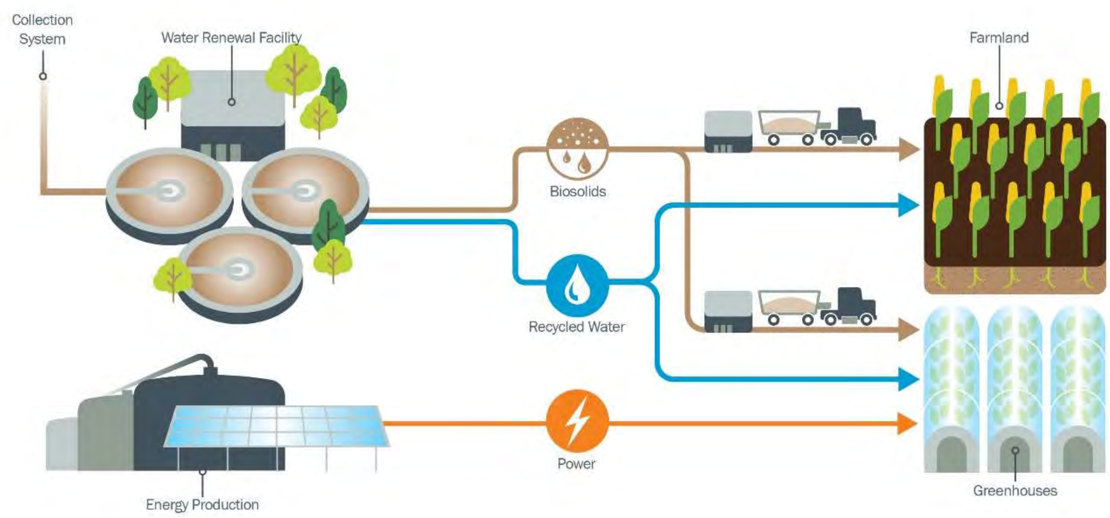

Figure 3-5. Investment option: local food production

3.2.1.2.6 Closed-Loop System

Using recycled water for non-potable uses, such as irrigation, is widely seen as the most logical way to reuse water and cut down on potable water use. The closed-loop system takes it one step further and uses recycled water for other non-potable uses within the home such as flushing toilets. The goal of this approach is to use the water as many times as possible before it is ultimately discharged from the system.

The closed-loop system maximizes the use of water within homes and businesses by providing recycled water for non-potable uses inside and outside (Figure 3-6). This system would reduce the amount of potable water used for irrigation, toilet flushing, and other uses where potable water is not needed to minimize the demand on the water supply, thereby increasing the city's resiliency to future water shortages in the Treasure Valley.

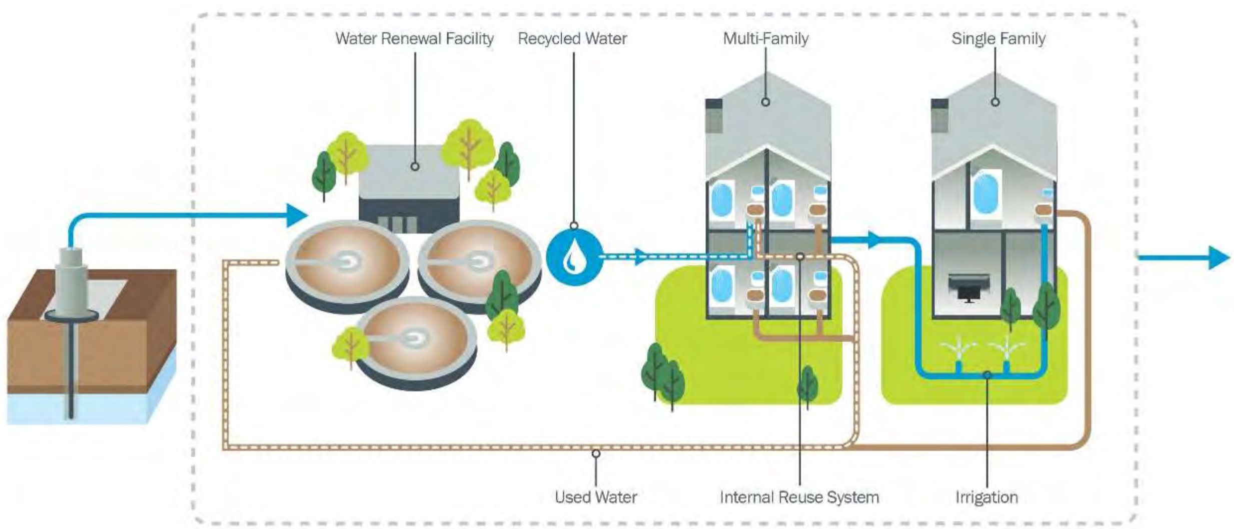

Figure 3-6. Investment option: closed-loop system

3.2.1.2.7 Decentralized Management

The decentralized management of used water has the potential to make water renewal products more accessible to the communities near the WRFs. New, smaller WRFs would be built near high-growth areas to manage treatment locally instead of sending the used water back to the two existing WRFs. This investment option takes a different approach to managing growth within the system and minimizes the influence of future regulations on discharge requirements to the river. Decentralized management also disperses the risk associated with centralized treatment—if one facility were to go down, there would be other facilities to manage the treatment, which is in alignment with the outcome to minimize stakeholder risk.

Decentralized management implements a "community-scale" water renewal process in locations across the community. These small WRFs would produce recycled water that could be used nearby (Figure 3-7). This investment option also puts the use of recycled water back into the hands of the user, likely in the form of irrigation water.

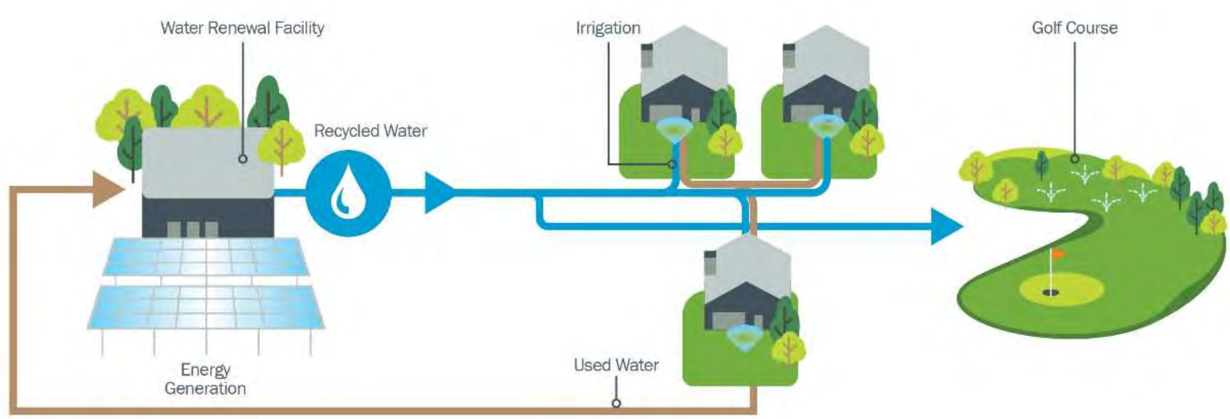

Figure 3-7. Investment option: decentralized management

3.2.1.3 Portfolios

WRS used the options above to shape a series of portfolios. A portfolio included a combination of investment options and was used to describe how and where the water would be renewed and ultimately used. The portfolios were explicitly developed to test the tradeoffs of the community's stated interests. For example, the interest in local food production needs to be balanced with the cost to scale up to use a meaningful amount of water to be financially viable as a renewed water strategy. The interest in high volumes of recycled water also needs to consider the cost of reducing or eliminating the use of existing infrastructure. The portfolios were developed on a spectrum that ranged from the least change to the most change.

On the least-change end of the spectrum was the "Status Quo" portfolio, which assumed pursuing continued river discharge for all renewed water while meeting capacity and regulatory requirements. On the other end of the spectrum was a portfolio that represented the most change from the status quo, incorporating all the investment options described above and producing the most recycled water. In between these, the differing factors between portfolios included the amount of water treated in each new or existing water renewal facility, the amount of renewed water distributed for various uses such as aquifer recharge or irrigation, and a centralized versus decentralized approach to capacity management. Finally, a "Do Nothing More" alternative was also considered to compare the risks of doing nothing to increase capacity or meet new regulations. This option was not a viable alternative but was part of the analysis purely for comparison.

Of note, two portfolios were added to the analysis after the completion of the Advisory Group (denoted as Portfolio B.2 and C.2). These portfolios were developed to evaluate the cost-effectiveness of the neighborhood-scale solutions while closely matching the intended outcomes of Portfolios B and C. Excluding the "Status Quo" and "Do Nothing" options, which do not meet community expectations, the portfolios evaluated can be summarized in the list below.

- Portfolio A: Most closely represents combined Advisory Group feedback and incorporates all investment options
- Portfolio B: Delivers recycled water for new capacity only
- Portfolio B.2: Delivers recycled water on new capacity only, without neighborhood-scale solutions
- Portfolio C: Focuses on scaling local food production
- Portfolio C.2: Focuses on scaling local food production without neighborhood-scale solutions
- Portfolio D: Most closely represents combined advisory group feedback without neighborhood-scale solutions

Additional information on each of the portfolios is available in *TM T-38 Water Renewal Utility Plan Portfolios Business Case Evaluation*, which is included as a Reference Document.

3.2.1.4 Business Case Evaluation Summary

The city chose to use a BCE approach to analyze the potential, viable long-term investment option portfolios, which is consistent with previous water renewal planning activities. The BCE process is a thorough method that considers the overall cost of asset ownership and allows public and private sectors to make informed asset management decisions. The BCE is a sophisticated methodology that uses objective criteria and life cycle present value analysis to evaluate the alternatives in a decision. The BCE considers capital, O&M, repair and replacement (R&R), and risk and benefit costs associated with asset ownership to provide a holistic view of the financial components and considerations that come with each portfolio being evaluated.

For the purposes of planning and understanding the long-term impact of this decision on WRS, a 40-year evaluation period was used in the BCE. This period, which extends beyond the 20-year planning horizon, was selected for three primary reasons. First, the 40-year period allows replacement costs for new infrastructure to be captured in the analysis. Secondly, the 40-year period captures at least 20 years of operating costs for all new infrastructure. Finally, the longer evaluation period allows future risks and benefits to be fully captured in the evaluation. The longer evaluation period allows for a more complete understanding of the total cost of asset ownership for the various portfolios.

A summary of the net present value (NPV) results from the BCE is provided in Table 3-1 and Figure 3-8. NPV is the present value of future costs. The lowest cost alternative is the one with the least negative NPV. The BCE results indicate Portfolio B.2 as the lowest cost of asset ownership, followed closely by Portfolio B. Notably, Portfolio B.2, which prioritizes shifting newly added capacity towards recycled water, has the lowest expected cost. This result is driven by several factors:

- Portfolios B and B.2 have the lowest capital cost, nearly 25 percent lower than the next closest portfolios (see Figure 3-9).
- Portfolios that prioritize sending more water to recycled water and aquifer recharge, such as Portfolio C.2, better manage regulatory risks (see Figure 3-10). However, the cost for implementing this option must be balanced with increasing pressure on affordability for these options.
- Portfolios that provide more uses of the water, such as Portfolio A, bring with them higher benefits (see Figure 3-11). However, similar to the discussions on risks, these benefits must be balanced with the overall costs and the related pressure on affordability.

Table 3-1. BCE total NPV summary ($M) [a, b]							
Portfolio	Capital Costs	O&M Costs	R&R Costs	Cash NPV	Risk Costs	Benefit Costs	PTAC
Portfolio A	$521	$3510	$438	($1,247)	$500	$198	($1,498)
Portfolio B	$305	$208	$337	($809)	$493	$171	($1,050)
Portfolio B.2	$295	$160	$310	($731)	$485	$151	($983)
Portfolio C	$420	$226	$356	($955)	$457	$149	($1,105)
Portfolio C.2	$368	$186	$336	($848)	$429	$135	($1,062)
Portfolio D	$431	$272	$350	($1,004)	$487	$182	($1,258)

[a] *Cells highlighted in green indicate the lowest cost portfolio for the conditions shown.*

[b] *Total costs are shown in 2019 dollars, represent the period 2020 through 2060, and are rounded to the nearest $1M. Portfolio level cost estimates are assumed to have an accuracy of +20% to -20%.*

NPV = net present value.

PTAC = potential total cost of assets.

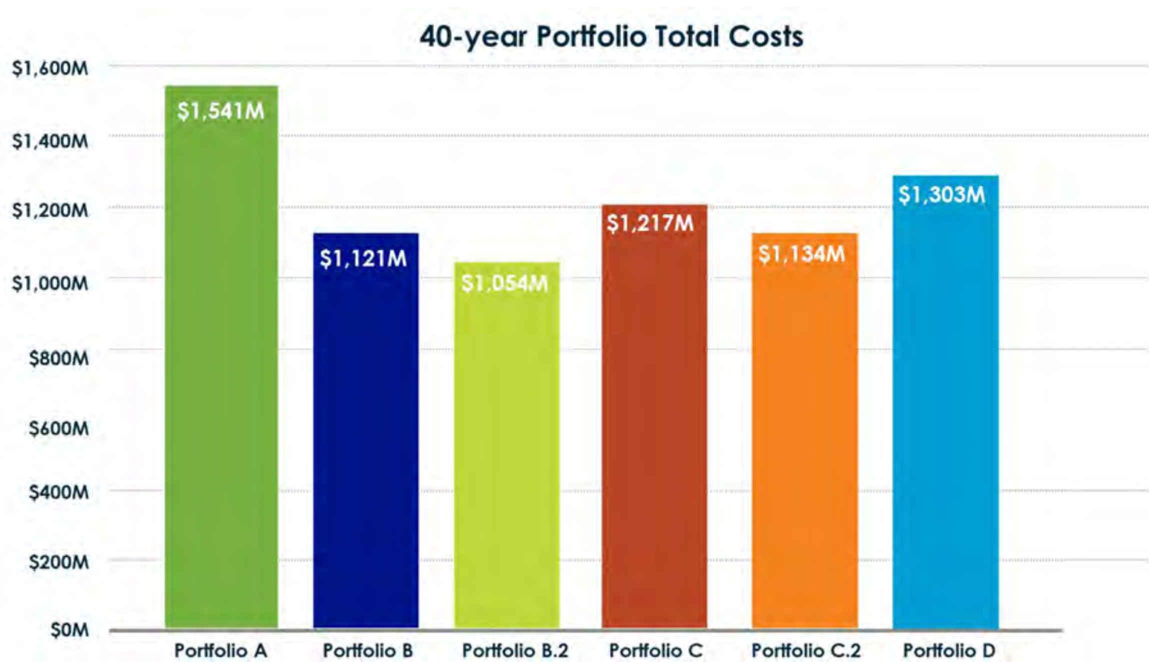

Figure 3-8. Business case evaluation results

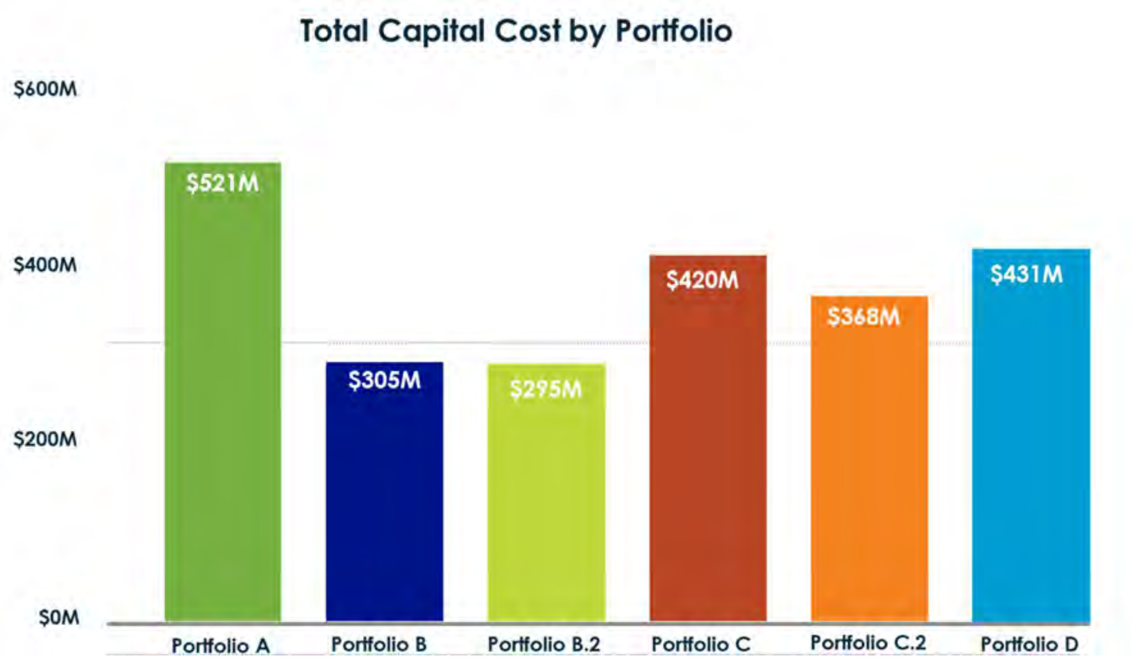

Figure 3-9. Total capital costs

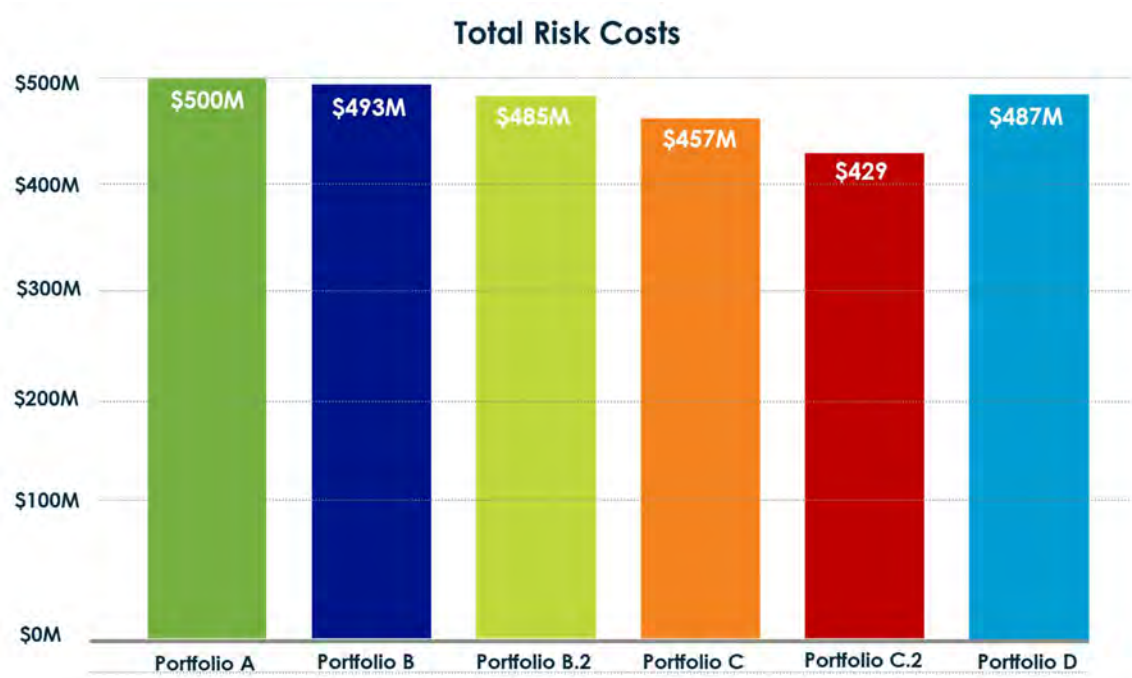

Figure 3-10. Total risks costs

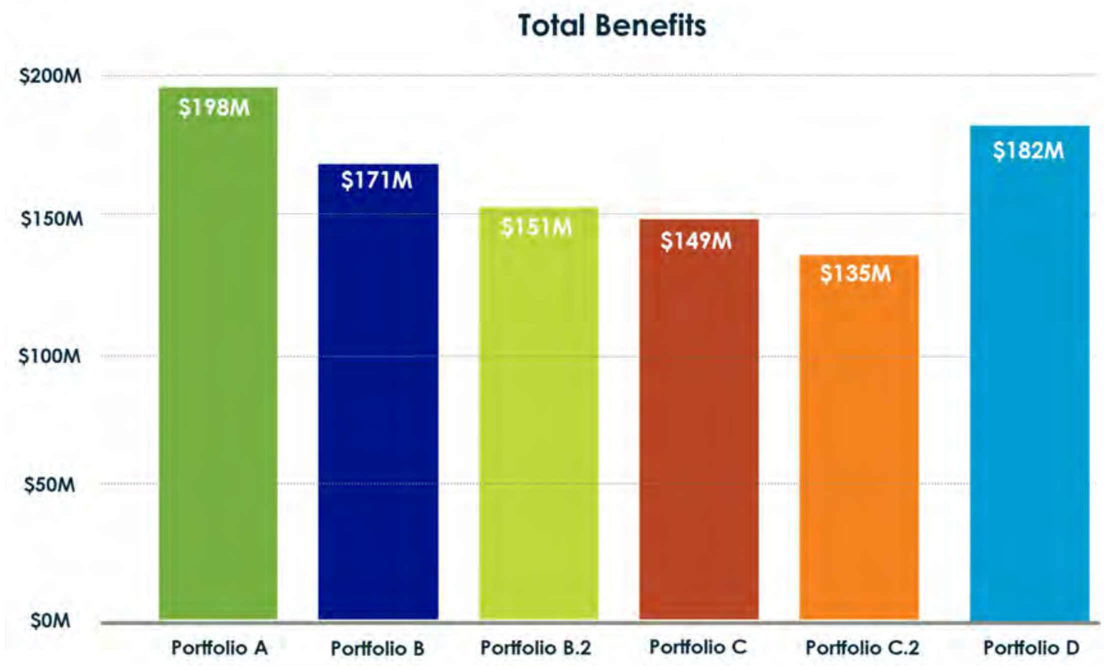

Figure 3-11. Total benefit costs

In addition to the baseline condition presented in Table 3-1, a sensitivity analysis was also completed for the BCE. This exercise tests the assumptions to ensure the decision is as accurate and resilient as possible to future conditions. The magnitude and timing of these conditions is unknown, but the sensitivity analysis allows the evaluators to measure a range of outcomes based on what may occur. The sensitivity analysis tested the portfolios under the following conditions:

- Increasing and decreasing the expected capital costs
- Removing and doubling the value of the risks and benefits
- Increasing the value of groundwater relative to surface water
- Increasing and decreasing the likelihood of additional surface water regulations

Portfolio B.2 had the lowest total cost in all sensitivities, except if there were to be a decrease in discharge permit requirements, which is unlikely to occur. However, the sensitivity on the value of groundwater provided interesting results. As the value of groundwater increases, the preferred portfolio shifted towards those that provide more recycled water (Portfolio C.2 and then Portfolio D). This shift is important to note because, as described later in the Utility Plan, Portfolio B.2 offers future flexibility. As the value of water increases, this portfolio allows for a shift to increase recycled water in the future.

3.2.1.5 Scenario Planning

Scenario planning helps identify potential future states that may affect Boise, and consequently WRS. WRS identified top scenarios that might occur and have widespread effects on future life in Boise, including changes to the climate, changes to the community, economic downturn, and continued growth. Each scenario affected several different risk and benefit costs, and ultimately the BCE outcome. The risk and benefit costs were adjusted from the initial alternatives' analysis described in Section 3.2.1. By including scenario planning in the analysis, the city is ensuring the preferred portfolio stands up to future challenges.

3.2.1.5.1 Climate Change and Resiliency Scenario

The climate change and resiliency scenario assumes water becomes scarcer throughout Boise due to an extended drought. The demand for local food increases due to the increased difficulty of importing food from outside the Treasure Valley. The following risk and benefit costs were adjusted:

- Higher value of food and water
  - Value of food increases (+25 percent)
  - Value of water (surface and ground) increases (+100 percent, +360 percent)
- Recycled water rates increase with water rates (+25 percent)
- Water rates increase and cause affordability concerns (goal 1.25 percent [-0.25 percent])

Table 3-2. BCE scenario planning: climate change and resiliency ($M) [a,b]

Portfolio	Capital Costs	O&M Costs	R&R Costs	Cash NPV	Risk Costs	Benefit Costs	PTAC
Portfolio A	$521	$351	$438	($1,247)	$570	$419	($1,404)
Portfolio B	$305	$208	$337	($809)	$547	$330	($1,025)
Portfolio B.2	$295	$160	$310	($731)	$537	$310	($956)
Portfolio C	$420	$226	$356	($876)	$518	$351	($1,046)
Portfolio C.2	$368	$186	$336	($848)	$487	$331	($1,007)
Portfolio D	$431	$272	$350	($1,004)	$553	$400	($1,163)

[a] *Cells highlighted in green indicate the lowest cost Portfolio for the conditions shown.*

[b] *Total costs are shown in 2019 dollars, represent the period 2020 through 2060, and are rounded to the nearest $1M. Portfolio level cost estimates are assumed to have an accuracy of +20% to -20%.*

This scenario assumes groundwater becomes more valuable than surface water due to its availability all year. A cost increase of upwards of 360 percent was seen in California during the 2011 to 2017 drought. The climate change and resiliency scenario pushes the decision to the Status Quo portfolio, which has a lower capital cost. The increase in the value of surface water, along with the value of groundwater, pushed the outcome to the portfolio with the lowest capital cost instead of to the portfolio with more aquifer recharge.

3.2.1.5.2 Changing Community Scenario

A changing demographic and political views in the Boise community brings the focus to different priorities. Groundwater is less important and there is a reduced willingness to pay for level of service projects. The following risk and benefit costs were adjusted:

- Value of water changes
  - Surface water value increases (+150 percent)
  - Groundwater value decreases (-50 percent)
- Affordability risk decreases (goal of 2 percent [+0.5 percent])
- Public perception risk increases (+50 percent)

Table 3-3. BCE scenario planning: changing community ($M) [a,b]							
Portfolio	Capital Costs	O&M Costs	R&R Costs	Cash NPV	Risk Costs	Benefit Costs	PTAC
Portfolio A	$521	$351	$438	($1,247)	$413	$270	($1,391)
Portfolio B	$305	$208	$337	($809)	$426	$308	($927)
Portfolio B.2	$295	$160	$310	($731)	$420	$287	($863)
Portfolio C	$420	$226	$356	($876)	$380	$268	($990)
Portfolio C.2	$368	$186	$336	($848)	$359	$256	($953)
Portfolio D	$431	$272	$350	($1,004)	$405	$271	($1,139)

[a] *Cells highlighted in green indicate the lowest cost Portfolio for the conditions shown.*

[b] *Total costs are shown in 2019 dollars, represent the period 2020 through 2060, and are rounded to the nearest $1M. Portfolio level cost estimates are assumed to have an accuracy of +20% to -20%.*

Under the changing community scenario, Portfolio B.2 is the least cost option. This outcome is due to the increased value of surface water by 150 percent as this portfolio has the highest amount of river discharge (49 mgd) and the lowest capital cost.

3.2.1.5.3 Economic Downturn Scenario

An economic downturn produces more competition in the construction market, increases affordability concerns, increases the risk of public dissatisfaction with level of service projects, and decreases the amount of recreation along the river. The following risk and benefit costs were adjusted:

- Cost of capital decreases (-10 percent)
- Affordability risk increases (goal of 1 percent [-0.5 percent])
- Public perception risk increases (+50 percent)
- Recreation along the river benefit decreases (-50 percent)

Table 3-4. BCE scenario planning: economic downturn ($M) [a, b]							
Portfolio	Capital Costs	O&M Costs	R&R Costs	Cash NPV	Risk Costs	Benefit Costs	PTAC
Portfolio A	$469	$351	$438	($1,196)	$670	$230	($1,628)
Portfolio B	$275	$208	$337	($780)	$614	$207	($1,176)
Portfolio B.2	$265	$160	$310	($702)	$603	$186	($1,107)
Portfolio C	$378	$226	$356	($835)	$559	$200	($1,187)
Portfolio C.2	$331	$186	$336	($812)	$557	$187	($1,173)
Portfolio D	$388	$272	$350	($962)	$619	$213	($1,360)

[a] *Cells highlighted in green indicate the lowest cost Portfolio for the conditions shown.*

[b] *Total costs are shown in 2019 dollars, represent the period 2020 through 2060, and are rounded to the nearest $1M. Portfolio level cost estimates are assumed to have an accuracy of +20% to -20%.*

3.2.1.5.4 Continued Growth Scenario

Boise continues to see economic growth. There is increased competition within the construction market, a decrease in affordability concerns, the public is more supportive of level of service projects, and there is increased pressure on groundwater to support growth. The following risk and benefit costs were adjusted:

- Cost of capital increases (+10 percent)

- Affordability risk decreases (goal of 3 percent [+1.5 percent])
- Public perception risk decreases (-25 percent)
- Value of water:
  - Groundwater increases (+50 percent)
  - Surface water stays the same

Table 3-5. BCE scenario planning: economic growth ($M) [a,b]							
Portfolio	Capital Costs	O&M Costs	R&R Costs	Cash NPV	Risk Costs	Benefit Costs	PTAC
Portfolio A	$574	$351	$438	($1,298)	$342	$263	($1,379)
Portfolio B	$336	$208	$337	($839)	$364	$251	($951)
Portfolio B.2	$324	$160	$310	($760)	$360	$232	($886)
Portfolio C	$462	$226	$356	($917)	$312	$236	($994)
Portfolio C.2	$404	$186	$336	($884)	$298	$223	($960)
Portfolio D	$474	$272	$350	($1,046)	$325	$246	($1,127)

[a] Cells highlighted in green indicate the lowest cost Portfolio for the conditions shown.

[b] Total costs are shown in 2019 dollars, represent the period 2020 through 2060, and are rounded to the nearest $1M. Portfolio level cost estimates are assumed to have an accuracy of +20% to -20%.

The increased value of groundwater relative to surface water pushes the outcome slightly towards the portfolios with more aquifer recharge. However, the increased capital cost pushes the outcome towards the least capital portfolios. Portfolio B.2 has the lowest NPV of the other portfolios.

3.2.1.6 Recommended Approach

The BCE analysis and sensitivity analyses consistently demonstrate that Portfolio B.2 has the lowest potential total asset cost. These results demonstrate that Portfolio B.2 balanced near-term costs with long-term risks and is aligned with the community's expectations. Considering all of these factors, Portfolio B.2 is the Recommended Approach to managing renewed water for WRS moving forward.

The Recommended Approach (Portfolio B.2) fulfills stakeholder outcomes to care for the health of the Boise River, build resiliency, minimize stakeholder risk, produce recycled water, and balance outcomes with the cost of services. This approach represents a pivot away from river discharge and status quo towards recycling water. Under Portfolio B.2, the city will build a recycled water program and decentralize the approach to water renewal while prioritizing investment in the existing collection and renewal system.

The Recommended Approach from the Utility Plan focuses new capacity on recycled water applications, specifically industrial recycled water and aquifer recharge (Figure 3-12). Additionally, community expectations suggest that investments should continue to be made that enhance the quality and use of the Boise River and go beyond meeting regulatory requirements. Figure 3-12 shows the target levels of implementation for each product as a percentage of the overall capacity of the water renewal system. Figure 3-13 visually depicts the Recommended Approach with the emphasis on enhancing the Boise River, developing an industrial recycled water program, and pursuing aquifer recharge.

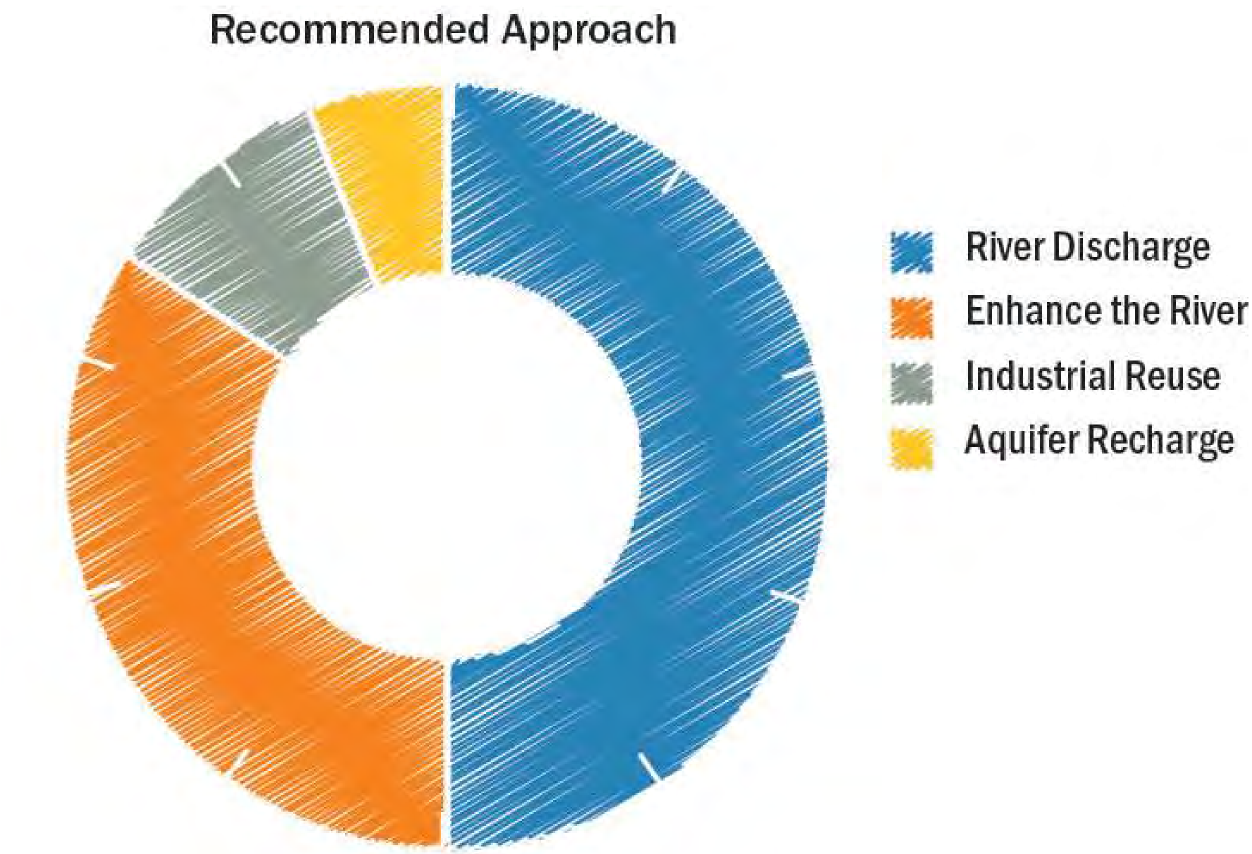

Figure 3-12. Recommended Approach target levels of implementation

Figure 3-13 visually depicts the Recommended Approach with the emphasis on enhancing the Boise River, developing an industrial recycled water program, and pursuing aquifer recharge. The Recommended Approach will manage and leverage growth in new ways. It is expected that proposed WRFs would be built closer to where growth is projected to occur and closer to areas for aquifer recharge and industrial reuse. This decentralized approach to water renewal management satisfies public concerns around centralized risk, makes better use of water resources, and lowers the cost to transport recycled water to areas where it can be beneficially used. The specific approach to these facilities will be further developed as the city moves into the implementation phase of the Utility Plan (see Section 7). Using the existing infrastructure at the Lander Street and West Boise WRFs also allows the city to maximize previous investments.

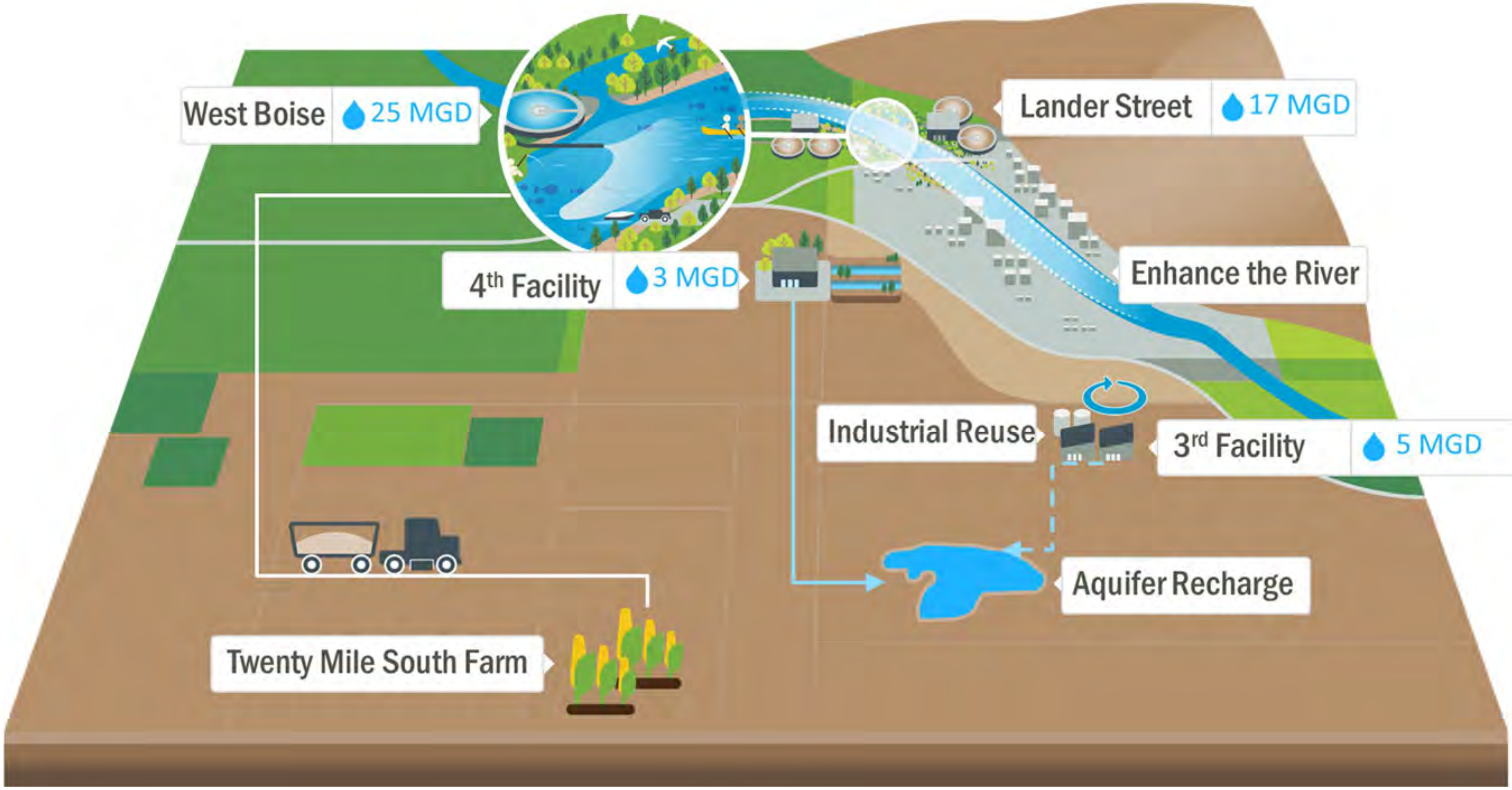

Figure 3-13. Map of system under Recommended Approach

Although the Recommended Approach does not address stakeholders' interest in local food production due to cost effectiveness at the required scale, it is a dynamic portfolio where the city can change trajectory on future projects—for example, send water to the farm or more water to aquifer recharge.

The Recommended Approach also positions the city to respond to future water challenges by diversifying what the city does with its renewed water. The results of the BCE demonstrated that this approach is the best option to manage near- and long-term risks. It also allows the city to be flexible to best manage water resources in the future as conditions continue to change. This plan can be viewed as a steppingstone that positions Boise to address future challenges without overinvesting in the near-term.

In summary, the Recommended Approach achieves the following outcomes:

- Minimizes capital and operational costs determined through the BCE analysis
- Effectively manages risk and benefit costs
- Leverages investment in existing assets while also providing recycled water
- Embraces the concept of decentralized management
- Provides flexibility to pivot if conditions change

3.2.2 River Discharge

The city currently discharges all the water renewed at the WRFs to the Boise River. This strategy requires the WRFs to be compliant with federal and state requirements reflected in an NPDES discharge permit. The state of Idaho currently administers the permits, with the next permit for the city being an IPDES discharge permit. The required treated effluent quality is dependent upon the receiving water body's health and as determined in an NPDES discharge permit. The Boise River has nutrient, carbon, and temperature limits.

The city has been discharging to the Boise River since it began to treat its used water. The city has invested heavily in treating used water to the quality allowed to be discharged to the Boise River. Each permit cycle, approximately 5 years as prescribed in the Clean Water Act, brings the potential for revised discharge limits. The allowable discharge limits have evolved over time to now include limits for criteria such as nutrients and temperature. The strategy to date has been to make the investments required to meet the water quality requirements. This strategy is becoming increasingly capital resource intensive.

Continuing to discharge renewed water to the Boise River has several advantages. The city can realize the return on many years of investment while investing in additional facilities to serve future needs and goals. The city's Operations Division has extensive knowledge in what it takes to operate and maintain these assets. Although the overall percentage of flow from the WRFs is small compared to the overall flow in the Boise River, in the winter when river flows are lowest, it represents between 10 to 20 percent of the river's overall flow. There is public support for keeping some renewed water flow in the river to benefit downstream users.

Definition and Level of Service Connections

River discharge is a common approach to managing used water. The most common technical approaches to treating used water are via the activated sludge process or a chemical treatment process. Activated sludge is a biological process that employs naturally occurring bacteria to renew the used water. Chemical treatment processes renew water through chemical addition requiring reliance on chemical manufacturing and distribution supply chains. The city is prioritizing biological processes over chemical processes at the existing WRFs. The city has employed various activated sludge processes as methods to meet discharge requirements. The activated sludge process requires investments in facilities for physical separation processes, aeration systems, disinfection systems, thickening and digestion systems, equipment for solids handling, and associated pump stations and utilities to convey effluent through the treatment process. Many of the same investments would be required for a chemical treatment process with an added requirement for much larger chemical handling facilities. The result of employing the activated sludge process is large WRFs with full-time O&M staff to produce water that meets the allowable water quality limits set forth in the NPDES permit.

The effluent flows discharged to the Boise River correspond directly to WRF inflows. Flows increase based on residential, commercial, and industrial water usage. Growth in any of these sectors will also result in increased water supply to the WRFs. Historical (1983–2016) seasonal treated effluent discharge to the Boise River for both the Lander Street and West Boise WRFs are depicted in Figure 3-14 and Figure 3-15, respectively. The figures include the percentage of river flow during the four seasons.

Water conservation efforts have the potential to reduce WRF influent flows. The city has limited ability regarding water supply and has limited ability to impact the quantity of water that it will treat and discharge to the Boise River except for encouraging water conservation and evaluating treated effluent recycled water alternatives.

Idaho House Bill 608 from the 2012 legislature contains the provision that municipal WRFs are not obligated to discharge their renewed water into surface water receiving bodies. However, the city's WRFs' discharge of renewed water to the Boise River is driven by the need to manage effluent flows in the most cost-effective manner for the city's rate payers while meeting continuously evolving regulatory requirements and water quality standards. These challenges often occur seasonally, at times of the year when the balance of treated effluent flows and loads with river flows and quality limitations make meeting mixing zone requirements in the river more challenging. This situation results in potential elevated treatment costs if no other seasonal discharge alternatives are evaluated. Discharging treated effluent to the river impacts some of the level of service goals.

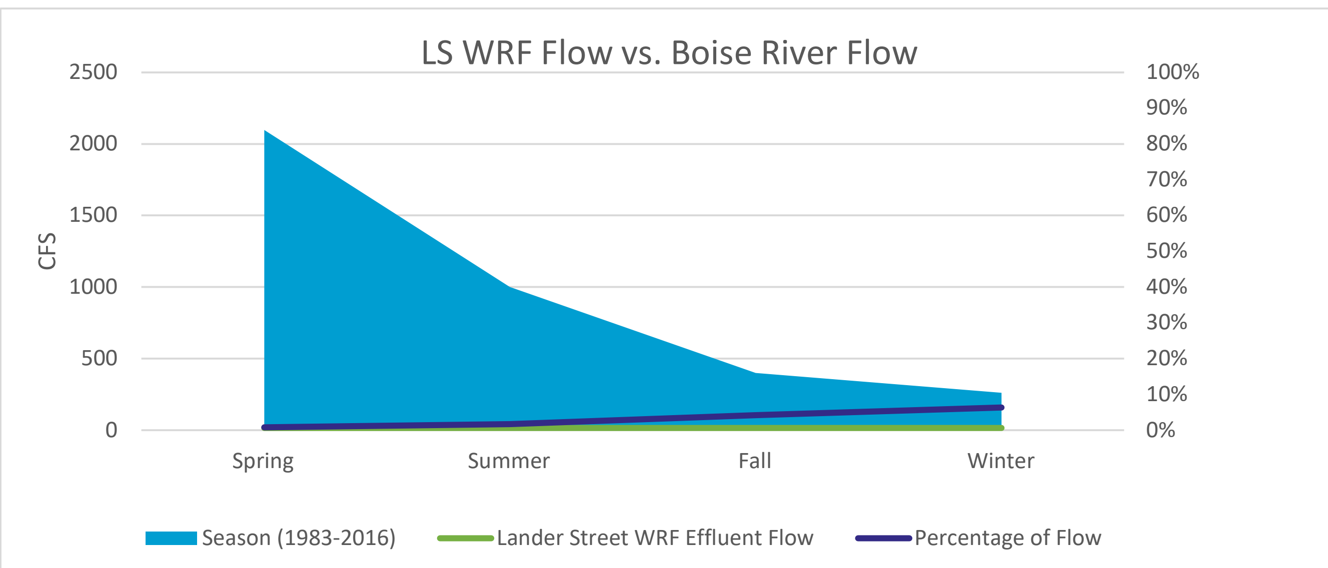

Figure 3-14. Lander Street WRF discharge contribution to the Boise River

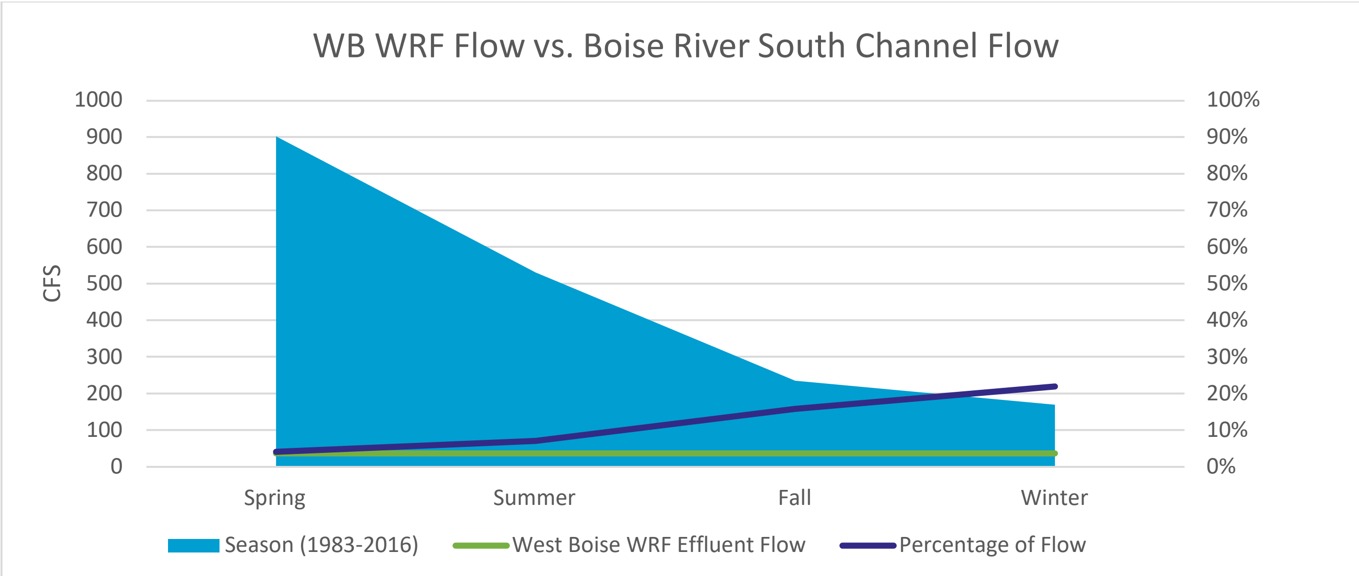

Figure 3-15. West Boise WRF discharge contribution to the Boise River

As allowable discharge limits continue to evolve, WRFs are often required to implement new strategies and technologies to meet the new criteria. Depending on the magnitude of the permit modification, this can be as simple as revising an operational strategy or as complex as major capital investments in new technologies. As described previously, there are a number of requirements that must be met for river discharge, which are described in the city's NPDES permit.

Discharging water to the Boise River impacts the level of service goals as described in Table 3-6.

Table 3-6. River discharge connection to level of service goals

Level of Service Goal	Relationship to River Discharge
Help sustain the Lower Boise River's quality to support multiple community uses	Continuing to discharge renewed water to the Boise River will sustain river flows and improve water quality.
Recover, recycle, and renew water, energy, and other products from the materials received	While discharging water, the Boise River supports river health and provides water to downstream users; it does not make this product available to the local community.
Operate cost-effectively and maintain a resilient utility	The city has invested heavily in treatment systems enabling it to discharge treated water to the Boise River. Continuing to discharge to the river makes use of existing assets and realizes expected return on the investments. It also helps to operate cost-effectively.
Support a robust, vibrant economy consistent with the city's vision	Discharging water to the Boise River has a positive impact on the amount of flow and the water quality characteristics of the river preserving multiple community uses, including recreational opportunities and other economic development.
Develop partnerships to effectively solve community issues	The Boise River has many stakeholders who have united to protect and enhance the river's water quality, quantity, habitat, and recreational potential. Continuing to discharge renewed water to the Boise River places the city in a position to collaboratively improve this community asset.
Protect the health and safety of the community and staff	Discharging to the Boise River helps fulfill the goal to protect the health and safety of our community by operating reliable WRFs that have a long history of good operating performance to protect public health.

3.2.2.1 Projects

The city has invested heavily in infrastructure that allows it to produce treated effluent that meets current water quality criteria and standards for discharge to the Boise River. As the discharge criteria change and become more stringent, and as the city's continued growth leads to increased flows and loads, the city's WRFs will require modifications and/or expansion to meet river discharge requirements. Continuing river discharge will require continued investment in the Lander Street and West Boise WRFs.

The Lander Street WRF is currently undergoing a capital investment for asset replacement and capacity expansion with the current construction projects for headworks and disinfection reaching completion in the next several years. This capital investment will continue in the future with projects to increase secondary clarifier capacity, address capacity constraints in the secondary treatment system, replace the existing primary clarifiers and blowers, and add tertiary treatment to meet TP limits. Beyond these identified projects, systematic reinvestment in this facility will be required to continue replacing assets at the end of their useful life.

Similarly, West Boise WRF will require continued reinvestment to support river discharge and is expected to include a project to expand capacity of the secondary treatment system. A project will also be required to construct tertiary treatment to meeting TP limits. Beyond these projects, replacing the existing infrastructure at the West Boise WRF will be required, especially during the latter stages of the planning period. It is also expected that additional regulatory requirements will drive further investment at the West Boise WRF prior to 2040.

The pricing for these anticipated projects is discussed further in Section 3.2.2.3. Section 7 describes the process by which these projects will be further evaluated as part of the ongoing capital improvement planning process.

3.2.2.2 People

The city has vast experience operating, maintaining, and managing water renewal systems to produce water for river discharge. The people who make this happen have the skill sets required to perform the required functions. Operators have licensure and experience on the biological and mechanical treatment systems that allows them to support the ongoing water renewal processes. Mechanics have knowledge and experience performing preventative and corrective maintenance on WRF assets to maintain them in operable condition. Purchasing and warehouse staff are required to coordinate the procurement and orderly storage of replacement parts. Laboratory analysts are required to verify that water produced for river discharge meets the requirements for both water renewal process control and permit compliance. Additional required staff have skill sets to maintain the instrumentation and physical facilities (buildings, tanks, grounds, etc.). Operations management and administration skill sets are necessary to ensure that overall efforts from multiple shifts and staff groups are coordinated and support the overall water renewal mission.

In addition to the day-to-day activities at the WRFs, project management and engineering support is needed to plan for expansions and asset replacement projects. Engineering support serves as an interface with regulators, and permit development support help WRS understand permit compliance and plan for potential future permits. Project management is needed to direct and verify that water renewal projects properly support the water to be discharged into the Boise River.

Table 3-7. Staffing considerations for river discharge

Job Role at WRFs	Anticipated Start Year	Job Description
Facility manager	Currently staffed	Coordinate and oversee all teams and verify permit compliance
Operator	Currently staffed	Monitor and adjust processes to renew water
Mechanic	Currently staffed	Maintain and repair equipment
Laboratory technician	Currently staffed	Analyze water samples for process control and permit compliance
Instrument technician	Currently staffed	Calibrate and maintain instruments used for process control and compliance
Facilities and grounds technicians	Currently staffed	Maintain the buildings and grounds
Purchasing and warehouse technicians	Currently staffed	Procure and warehouse equipment replacement parts
Engineering and project management	Currently staffed	Coordinate with regulators on permit development, plan and design process expansions and improvements, coordinate project construction and implementation

Although some of these skill sets could be provided by contract workers, having these staff in house provides greater coordination and verifies that the required skill sets will be available to complete the critical mission of water renewal.

3.2.2.3 Pricing

Continuing the current approach of river discharge will require continued investment in the Lander Street and West Boise WRF. This investment focuses on replacing existing infrastructure, meeting regulatory requirements, and increasing the capacity of the existing WRFs. Table 3-8 presents the expected costs for projects over the planning period. As described in Section 7, the approach and cost for each of these projects will be further defined through the capital project delivery process.

Table 3-8. Projects and pricing considerations for river discharge

Anticipated Projects	Location	Project Completion Year	Projected Capital Cost [a]
Secondary treatment capacity expansion	West Boise WRF	2023	$12.4M
Tertiary treatment	West Boise WRF	2026	$28.2M
Additional regulatory requirements	West Boise WRF	2036	$59.1M
Planned repair and replacement	West Boise WRF	Ongoing	$115M
Annual repair and maintenance	West Boise WRF	Ongoing	$7.5M
Headworks and ultraviolet disinfection system replacement	Lander Street WRF	2022	$22.3M [b]
Blower replacement	Lander Street WRF		$3.6M [b]
Primary clarifier replacement	Lander Street WRF	2027	$29.4M
Secondary clarifier replacement + STEP	Lander Street WRF	2027	$39.2M
Tertiary treatment	Lander Street WRF	2027	$27.4M [b]
Planned repair and replacement	Lander Street WRF	Ongoing	$155M
Annual repair and maintenance	Lander Street WRF	Ongoing	$5.1M

[a] *AACE Class 5 cost estimate (+100%, -50%)*

[b] *Does not include costs prior to fiscal year 2021.*

3.2.3 Enhance the River

The Boise River is a prized asset to Boise residents. The city's WRS has a unique opportunity to both meet and exceed water quality requirements and enhance the community value of the Boise River. Enhancing this community resource while addressing water renewal regulatory requirements makes this an attractive approach.

The enhance the river investment option focuses on enhancing the water quality and the Boise River ecosystem health beyond current regulatory requirements. Water could be treated to a higher quality at the WRFs. River temperature could be decreased in favor of aquatic species by restoring native riparian vegetation, side channels, and wetlands. Nutrient, sediment, and bacteria loading could be reduced by enhancing riparian buffers, restoring wetlands, modernizing agricultural practices through a water quality trading framework, and diverting recycled water to local canals. This multi-faceted approach to enhancing the river focuses on watershed-scale improvements in addition to enhancements at the existing WRFs. These investments promise to improve the overall community value and use of the Boise River.

3.2.3.1 Definition and Level of Service Connections

The water quality improvements would be located both at the city's WRFs and on the river itself. Water treatment at the WRFs would be enhanced so that the water discharged to the river is of a higher quality than is currently required by regulations and addresses concerns about impacts from emerging constituents. Emerging constituents include many compounds that are not currently regulated but may have long-term impacts on receiving water bodies and will likely be regulated to some degree in the future. These constituents can include pharmaceuticals and personal care products that act as endocrine disruptors that alter the normal functions of hormones in aquatic life and can lead to reproductive effects even at low levels of exposure. Regulators are continuing to study the effects of emerging constituents on receiving water bodies to determine if and how limits for emerging constituents could be enacted to mitigate these negative impacts. There are multiple technologies that could address emerging constituents. For the purposes of planning, ozone treatment was selected as a representative technology to show the needed investment to enhance the river. Depending on the specific goals for river enhancement, alternative technologies will be considered as projects are implemented.

In addition to emerging contaminant concerns with water quality, regulators are concerned with the Boise River's water temperature being higher than ideal for aquatic life. Reducing water temperature and focusing on providing habitats for species to thrive throughout their life cycle have multiple benefits. Besides shading the mainstem of the Boise River, the tributaries could also be shaded to reduce the thermal load. Shading can improve river health to some degree, but creating side channels can have more benefit for the river habitat. Creating side channels improves the river's ecosystem health, enhances the river's habitat for aquatic species, and restores native riparian vegetation. Side channels contribute to shading and temperature reduction through groundwater and surface water interactions.

Sediment, nutrient, and bacteria levels increase in the river as a result of return drains from agricultural land. Figure 3-16 shows where different pollutants enter the Boise River beginning at the Diversion Dam and ending at its confluence with the Snake River. Pollutants can decrease water quality (water becomes cloudy), grow algae and other aquatic plants more aggressively than the river would otherwise, and increase bacteria, which increases the potential for infection. These are much larger issues than just focusing on WRF projects for water quality improvement, but they can have a large impact on Boise River's health and aesthetics. The city can be a leader in these efforts to improve river water quality and be an example of responsible environmental resource management and stewardship.

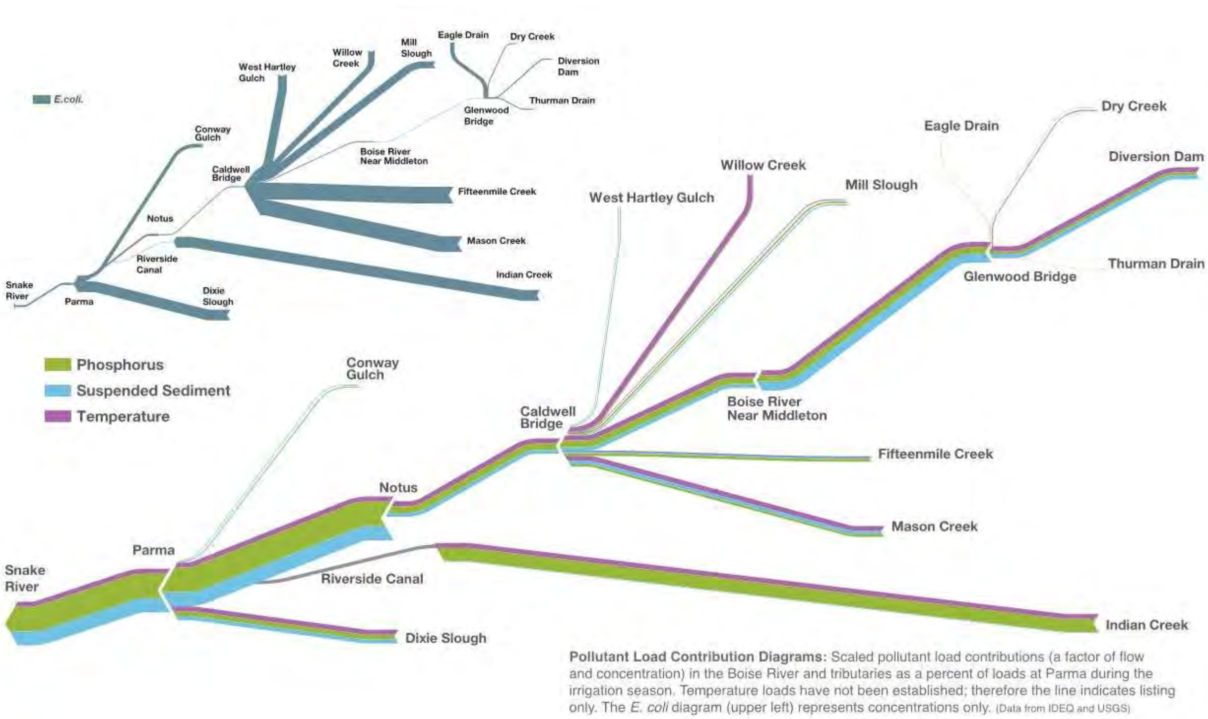

Figure 3-16. Boise River pollutant load contribution

Source: Boise River Enhancement Network River Enhancement Plan (2015)

Pursuing recycled water at the Lander Street or West Boise WRFs in the future may be an effective strategy for reducing the nutrient and temperature loadings to the Boise River. This approach would have a positive overall impact on the water quality in the Boise River while providing a beneficial nutrient for irrigated agriculture. Given the location of these facilities, pursuing this approach would likely focus recycled water use for irrigation and local food production, which is further described in Section 3.2.6.1. This could potentially be accomplished by recycling water in a local canal or irrigation system.

Enhancing the Boise River impacts the level of service goals as described in Table 3-9.

Table 3-9. Enhance the river connection to level of service goals	
Level of Service Goal	**Relationship to River Enhancement**
Help sustain the Lower Boise River's quality to support multiple community uses	Enhancing the Lower Boise River through improved water quality and ecosystem enhancements, like side channels and shading, contributes to the community using this asset in multiple ways. This option directly helps sustain and improve the Boise River's quality to support multiple community uses. It also improves Boise River's aesthetics, which are highly desired by Boise residents.
Operate cost-effectively and maintain a resilient utility	The city has invested heavily in treatment systems enabling it to discharge treated water to the Boise River. Continuing to discharge to the river and improving the water quality discharged makes use of existing assets and expands them to meet additional river health goals.
Support a robust, vibrant economy consistent with the city's vision	Enhancing the water quality in the Boise River has a positive impact on the river to preserve recreational opportunities tied to economic development. It increases the financial impact for recreational opportunities on the river.
Develop partnerships to effectively solve community issues	Enhancing the river demonstrates the commitment of WRS to be a partner in river stewardship and a leader in achieving multiple goals concurrently.
Protect the health and safety of our community and staff	Enhancing the river helps to improve river health, which protects the health and safety of our community.

3.2.3.2 Projects

To be successful in enhancing the Boise River's water quality and river ecosystem health, projects would be required both at the WRFs and on the river and its tributaries. For example, it is currently assumed that advance treatment would be installed at the Lander Street WRF to enhance the abilities of this facility to improve the river's water quality as it flows through the city. The West Boise WRF is located near the western city limit, and adding an advanced treatment system there is not expected to positively impact the river water quality for the Boise residents since few Boise residents live or recreate downriver of the West Boise WRF.

Additionally, programmatic investment in river enhancements will be needed during the planning period to further this investment option. Enhancements could take many forms, including riparian shading and side channel development projects. The portion of the Lower Boise River watershed in Boise's city limits is presented in Figure 3-17, and potential sites where shading and side channel projects could be completed are highlighted. These potential project sites are all located on public land and are not currently fully shaded. Many of the historical side channels and sloughs have been developed and would be challenging to rehabilitate at this point. Figure 3-18 expands the view from Boise's city limits to the greater Treasure Valley to show that there are many sites where the Boise River could be enhanced throughout the valley.

Riparian shading projects would help reduce water temperature and improve the river's aesthetics. There are approximately 11 miles of river within Boise's city limits. There are about 20 sites that could be enhanced to create more than 3 miles of riparian planting that are not currently provided with trees to shade the river.

New or restored river side channels could be created to enhance the river water quality and ecosystem habitat. There are about 20 sites that could be enhanced to create more than 4 miles of side channel. These sites would provide habitat for aquatic and riparian species to improve the river's health. Some of the potential locations would likely not be developed since they are already supporting multiple community uses, like city parks, along the river.

Figure 3-17
River Enhancement
Water Renewal Utility Plan

Legend

- Tributaries on Public Land
- Slough on Public Land
- Slough
- Historic River\Sloughs*

*as digitized from 1867 Cadastral Surveys

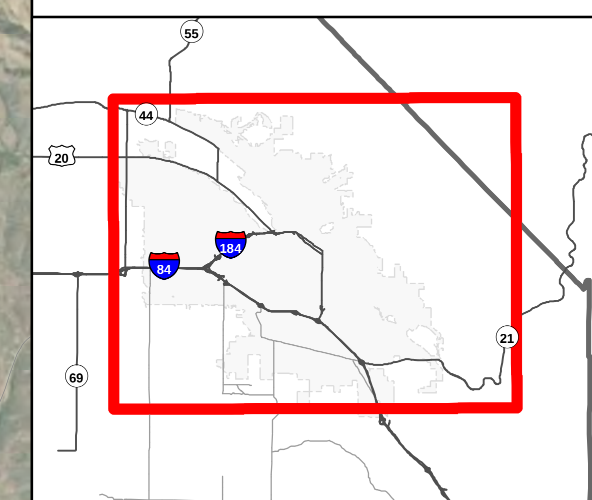

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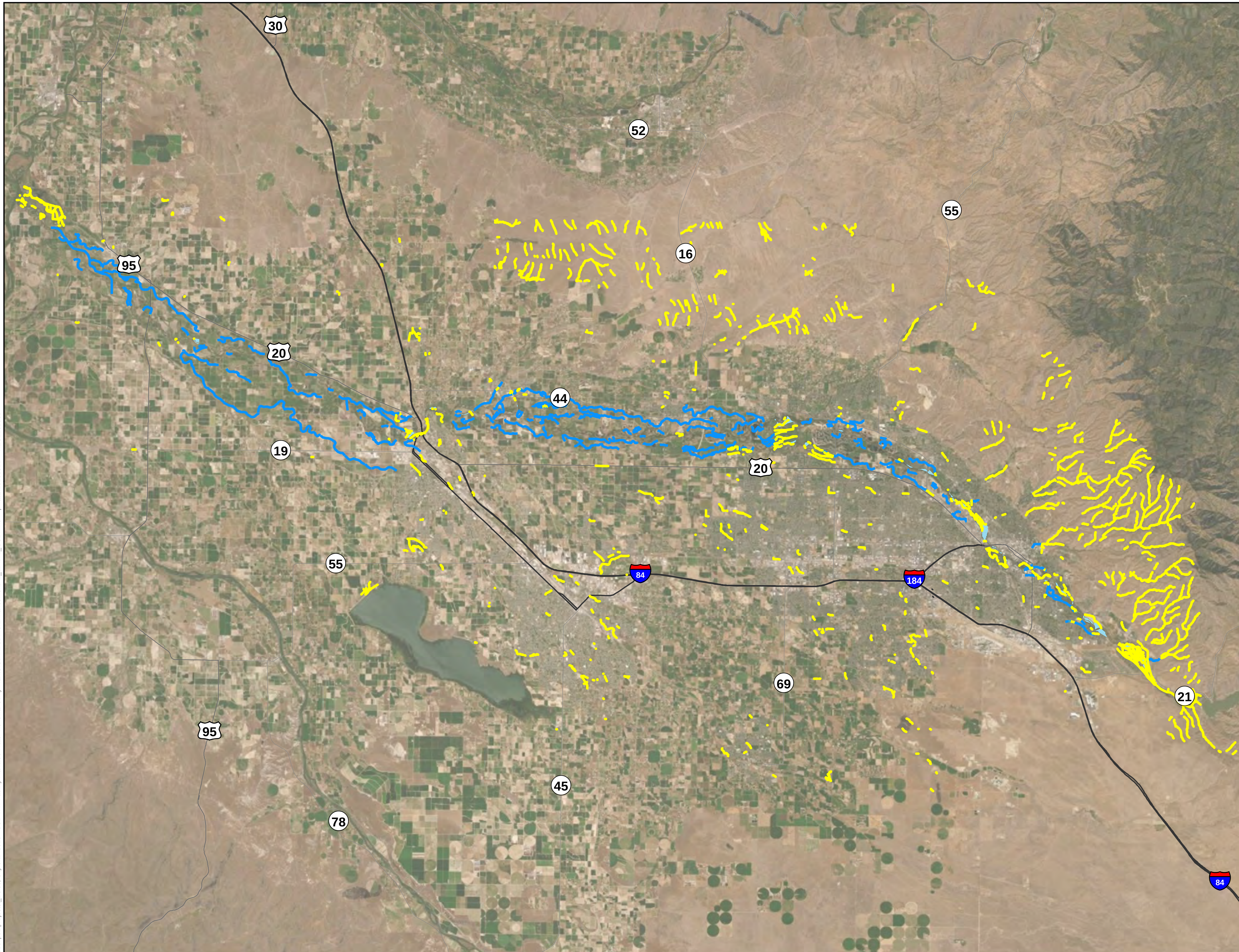
Figure 3-18
River Enhancement
Water Renewal Utility Plan



Legend

- Tributaries on Public Land
- Slough on Public Land
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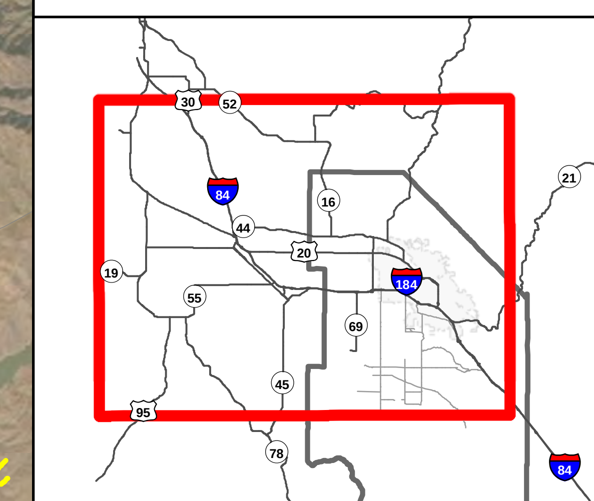
- Historic River\Sloughs*

*as digitized from 1867 Cadastral Surveys



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CITY OF BOISE WATER RENEWAL UTILITY PLAN

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3.2.3.3 People

The Boise River has a multitude of stakeholders who have been focused on many aspects of river health and vitality for many years. Some stakeholders like the Army Corps of Engineers focus on the quantity of water, and irrigation companies rely on that water for their livelihood. Many others focus on the aquatic and river ecosystem species of plants and animals that contribute to river health and vitality. Other groups are interested in the recreational opportunities afforded by this community asset. The city's involvement in river matters spans each of these groups and more. To provide leadership and input on Boise River topics, the city employs staff in a variety of departments and focus areas. A greater emphasis on enhancing the river is expected to require additional human resources. Some of the roles are currently filled, but additional staff will be required as projects become more involved and more numerous.

Table 3-10. Staffing considerations for enhance the river

Job Role at WRFs	Anticipated Start Year	Job Description
River enhancement coordinator	2024	Coordinate with other river stakeholders and coordinate and oversee river enhancement projects
River health specialists	Currently minimally staffed, increase in 2023	Water quality monitoring, technical support for decision makers
Engineering and project management	Currently staffed, increase in 2023	Engineering and project management
WRF operators, mechanics, and technicians	Currently staffed, increase in 2023	Operating the existing WRFs and additional treatment technology

3.2.3.4 Pricing

The WRFs have received a heavy investment to meet regulatory requirements for water quality. Adding an advanced treatment process for emerging constituents at the Lander Street WRF would continue this pattern, although it would go above regulatory requirements and enhance the water quality. WRS has traditionally not been a major player in river enhancement projects outside the WRFs. The following Boise River and tributary shading projects and channel restoration projects are included to enhance the river ecosystem.

Table 3-11. Projects and pricing considerations for enhance the river

Anticipated Projects	Location	Project Completion Year	Projected Capital Cost [b]
Advanced treatment	Lander Street WRF	2028	$28.0M [a]
Enhanced the river programmatic investment	Mainstem Boise River and tributaries within Boise's city limits	Ongoing	$19.3M

[a] *Ozone was chosen as a representative process for developing costs for advanced treatment*

[b] *AACE Class 5 cost estimate (+100%, -50%)*

3.2.4 Industrial Reuse

Industrial reuse would provide recycled water to local industries for use at their facilities. This recycled water would offset the use of potable (drinking) water and support the city's economic development vision.

Industrial reuse benefits the city by both providing a means of discharging recycled water effluent and offsetting potable water consumption by replacing potable water with another resource.

3.2.4.1 Definition and Level of Service Connections

Industrial reuse involves providing local industries recycled water to run processes in which potable water is not required. Recycled water uses include commercial applications such as carwashes and industrial uses such as datacenters, food processors, and other industrial facilities that use water for heating and cooling.

The city's capacity to produce and distribute industrial recycled water is driven by four factors:

- Volume of influent used water to the city's WRFs. Considerations include both average influent flow and seasonal/diurnal variations in flow.
- Capacity to treat influent to recycled water quality.
- Capacity to store and distribute water to industrial users.
- Volume of industrial recycled water useable by industrial customers.

The development of industrial reuse as a portfolio option must also consider variations in demand for water by industrial customers. Like the volume of influent to the city's WRFs, the volume usable by industrial customers is subject to seasonal and diurnal variations. Use of water by industrial customers will also likely be subject to variations due to production changes and periodic shutdowns for maintenance. Typical water use requirements by a facility are another means of understanding potential demand for recycled water. Typical water demands and used water discharge volumes for a range of industries are summarized in Table 3-12. At a planning level, it is estimated that up to 5 mgd of industrial reuse demand may exist within the city's system.

Table 3-12. Used Industrial water flows and water demand for typical industries

	Industrial Wastewater Flow	Water Demand	Quality Required	Industrial Facility Area	Notes
Food and Beverage					
Brewery	0.3–1 mgd	Varies	Purified water [a]	10–20 acres	Large microbrewery
Dairy	0.5–1 mgd	0.5–1 mgd	Potable	5–15 acres	Yogurt, milk, and ice cream
Potato	1–2 mgd	1.25–2.5 mgd	Potable	50–70 acres	French fry facility
Fruit and vegetable	0.5–1 mgd	0.75–1.25 mgd	Potable	3–8 acres	Canned fruit and vegetables
Bakery	0.25–0.5 mgd	0.25–0.5 mgd	Potable	6–10 acres	Pies, dough, bread
Technology					
Semiconductor	2–4 mgd	2–4 mgd	Purified water	100–280 acres	–
Data center	0.36 mgd	0.36–1.12 mgd	Reuse, TDS, and fecal concerns	30–50 acres	–
Pharmaceutical and Chemical					
Pharmaceutical/chemical manufacturing facility	0.1–0.5 mgd	0.1–0.5 mgd	–	–	Active ingredients for antibiotics
Energy					
Power plant: natural gas combined cycle	4–11.5 mgd	12–35 mgd	–	60–100 acres	200–600 MW [b] plant
Other					
Distribution centers or cold storage facility	5,000–10,000 gpd	5,000–10,000 gpd	Potable	60–80 acres	–

[a] *Brewery will use membrane treatment to purify water supply because the water is used in their final product.*

[b] *megawatt*

Industrial reuse assumes treatment of effluent to Class A quality per IDAPA 58.01.17 (Recycled Water Rules). The rules require municipal used water to be oxidized, clarified, filtered, and disinfected, at a minimum. Approved vendors and reliability requirements are also described in the rules. Additionally, water is subject to the numerical criteria summarized in Table 3-13. Class A quality is the target level of treatment, but there might be future circumstances and users where less stringent qualities, such as Class B, are preferred and more cost-effective. The city will continue to monitor the customer needs as the development of the industrial reuse program progresses.

Table 3-13. Summary of Class A water quality standards (IDAPA 58.01.17, Recycled Water Rules)

Parameter		Criteria
Disinfection requirement	Contact time	Minimum 90 minutes based on peak day dry weather flow
	Concentration/contact time	Minimum 450 mg-min/L [a]
Disinfection requirement (alternative)		A disinfection process that, when combined with filtration, has been demonstrated to achieve 5-log inactivation of virus
Coliform requirement		Less than 2.2 organisms per 100 mL, 7-day average
		No sample in excess of 23 organisms per 100 mL
Turbidity	Sand or cloth filtration systems	Less than 2 NTU [b] arithmetic mean
		Not to exceed 5 NTU at any time
	Membrane filtration systems	Less than 0.2 NTU arithmetic mean
		Not to exceed 0.5 NTU at any time
Total Nitrogen		Less than 10 mg/L (arithmetic mean) for groundwater recharge systems Less than 30 mg/L (arithmetic mean) for residential irrigation and other non-recharge uses
pH		Between 6.0 and 9.0
BOD_5		Less than 5 mg/L (arithmetic mean) for groundwater recharge systems
		Less than 10 mg/L (arithmetic mean) for residential irrigation

[a] *mg-min/L = milligrams per minute per liter*

[b] *NTU = nephelometric turbidity unit*

Specific industrial use customers may require water quality beyond Class A. This plan assumes that, if treatment beyond Class A quality is required, it will be provided by the industrial user. Specific uses allowed for Class A recycled water are described in IDAPA 58.17.01. These generally include irrigation, construction uses, cleaning outdoor areas, firefighting/suppression, commercial laundries, groundwater recharge, and subsurface distribution. The allowed uses do not include direct potable reuse or production of food or beverage products, cooling systems, or indoor non-contact uses such as cleaning. The rules allow for other uses with IDEQ approval. It is possible that non-contact uses, such as use in cooling towers or other cooling systems, could be approved by the IDEQ with no additional treatment beyond Class A quality. It is assumed that approval of direct potable reuse in food or beverage production would require more advanced treatment such as ultrafiltration, reverse osmosis, and pilot testing. Approved uses are summarized in Figure 3-19.

Industrial reuse impacts the city's level of service goals are described in Table 3-14.

Table 3-14. Industrial reuse connection to level of service goals	
Level of Service Goal	**Relationship to Industrial Reuse**
Recovery, recycle, and renew water, energy, and other products from the materials we receive	Industrial reuse aligns with sustainability goals by recovering water and using it as a resource. Implementing industrial reuse positions a city as a leader in innovative, sustainable solutions.
Act and communicate transparently	Implementing industrial reuse will require decisions to be made regarding where water is available and which users receive industrial reuse water. User agreements that place conditions on both the city and the user will also need to be developed. Transparency in how these decisions are made will build trust.
Operate cost-effectively and maintain a resilient utility	Treating water to Class A recycled water quality will require an additional investment in treatment and distribution infrastructure. The cost of this treatment may be partially offset by the sale of recycled water, but revenue from recycled water sales is not likely to fully offset the cost of treatment. Costs for treatment not paid by the sale of water will need to be recovered through rates/fees for treatment. Financial impacts to implement industrial reuse should be balanced with other level of service goals.
Support a robust, vibrant economy consistent with the city's vision	Industrial reuse keeps a resource within the community and facilitates industrial growth by providing water to support local industrial growth. The availability of recycled water has the potential to draw like-minded industries to Boise to use this resource. As noted above, this needs to be balanced with the rates required to achieve a higher level of treatment and to distribute recycled water to industrial reuse projects.
Develop partnerships to effectively solve community issues	Industrial reuse projects bring water quality out of the treatment plant and into projects within the community, providing multiple avenues to engage, connect with, partner with, and educate the public on water quality issues. Developing reuse in partnership with industries and the IDEQ creates a model that can be used by other cities and industries in Idaho to expand industrial reuse.

Figure 3-19. Class A approved uses per IDAPA 58.17.01

3.2.4.2 Projects

Implementing industrial reuse will require constructing an industrial reuse treatment and distribution system. This system would include a WRF producing recycled water, an industrial reuse distribution system, and recycled water storage. Each of these projects are further described below. While not a capital project, there is upfront programmatic work required to develop an industrial reuse program. This work includes developing policies and procedures and coordinating with the IDEQ, developing agreements with recycled water users, and developing a rate structure for recycled water.

Industrial Reuse WRF

For the purposes of planning it is assumed that recycled water for industrial use would be produced at a new Third WRF located in the southeast area of the city. The Third WRF would produce water for both industrial reuse and aquifer recharge. As shown in Figure 3-20, this would place the WRF within proximity of the major industrially zoned areas in the city and the Gateway East Urban Renewal

District. As currently envisioned, the Third WRF would focus on producing recycled water for both industrial reuse and aquifer recharge for industrial flows originating from the southwest Boise area. Recycled water for industrial reuse could also be made available in the future from the existing Lander Street and West Boise WRFs. The proximity of each of these sites to industrial users will, to an extent, impact the viability of potential industrial reuse projects.

Industrial Reuse Distribution

A distribution system of pumps and piping would be constructed to convey recycled water from the Third WRF to industrial users. At the conceptual level, the city would construct the trunk of the line and booster stations, with individual connections constructed by users as industrial development occurs. The booster stations would likely be shared between the industrial reuse and aquifer recharge water products, with smaller jockey pumps used to pressurize the industrial reuse distribution system. Further detail of the proposed industrial reuse distribution system can be found in the *Recycled Water Master Plan*.

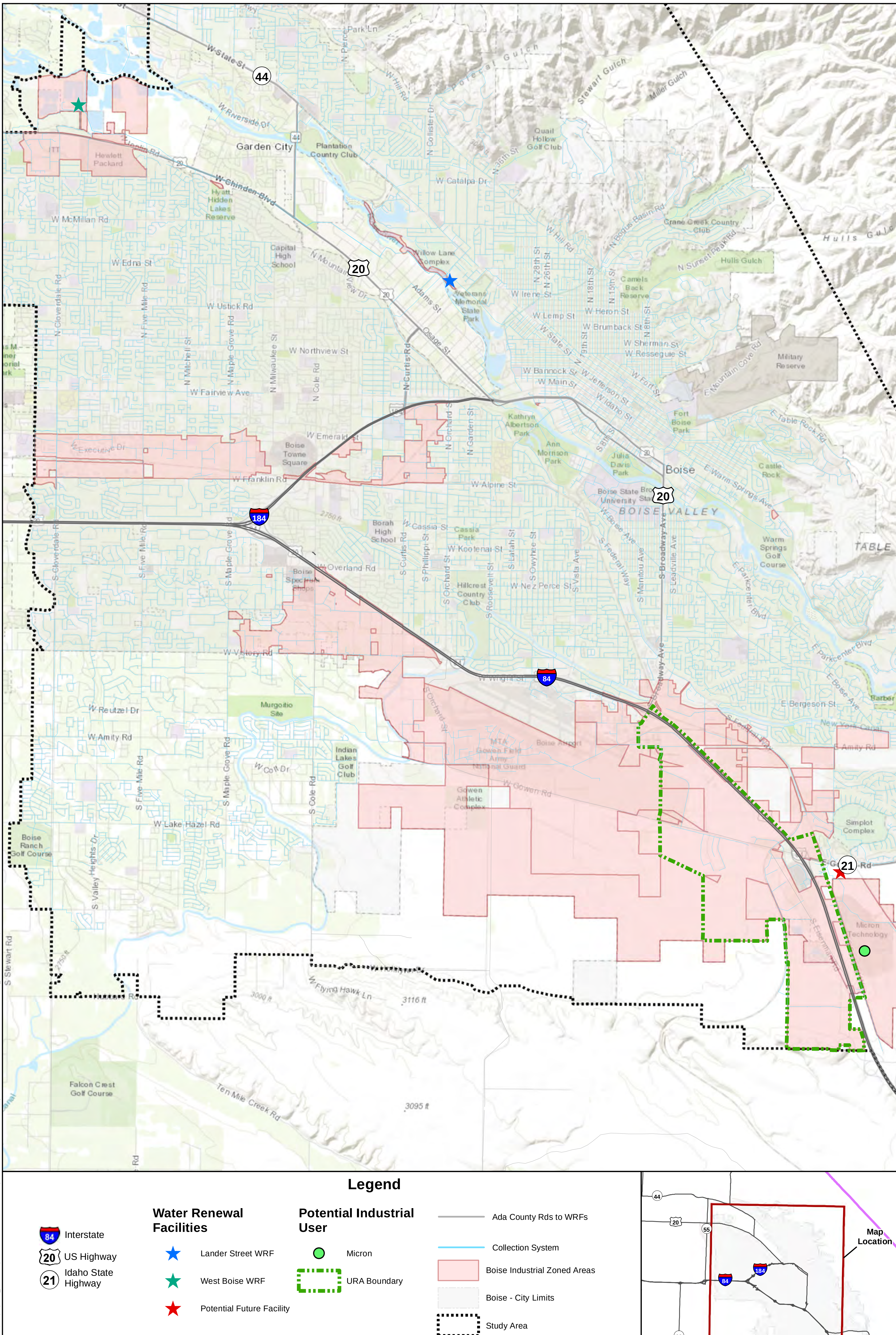
It is expected that industries reusing recycled water will be located within industrially zoned areas. The city has four industrial zones:

- **M-1 (Light Industrial District):** Zone intended for light industrial uses that may be appropriate near commercial or residential development. This zone does not allow residential uses.
- **M-2 (Heavy Industrial District):** Zone intended for heavy industrial uses that, for reasons of health, safety, or general welfare, are not permitted in the M-1 District. M-2 lands should also be separated from commercial or residential development, and M-2 uses should not create hazardous conditions. This zone does not allow residential uses.
- **T-1 (Technological, Industrial Park):** Zone intended for well-designed technological-industrial parks that can accommodate light industrial, technological, professional office, and similar uses. These parks may be adjacent to residential districts if they are located on an arterial roadway and are not materially detrimental to the health, safety, and welfare of nearby residents. This zone does not allow residential uses and has a minimum lot area of 20 acres.
- **T-2 (Technological, Manufacturing Park):** Zone intended for manufacturing and technological facilities that may have a greater impact on the surrounding area than industries allowed in the T-1 District. T-2 lands should also be served by major transportation facilities and be buffered from adjacent residential areas. This zone does not allow residential uses and has a minimum site area of 200 acres.

Most industrially zoned areas fall within the Airport Commerce District to the south of the city and centralized near the Boise Airport. A map showing all industrially zoned areas is shown in Figure 3-20. The figure shows the Gateway East Urban Renewal District bordered by a green dashed line. This Urban Renewal District is located near the proposed location of the Third WRF.

Storage

Storage projects can increase the viability of recycled water as a product by providing for instantaneous peak flows in excess of the minimum dry weather flow produced by the Third WRF. It is generally assumed that there will be no large-scale city-funded storage projects; however, individual users may choose to construct their own on-site storage systems. Implementation of a recycled water program would likely be in conjunction with aquifer recharge; water not recycled during periods of low demand would be sent to aquifer recharge. These projects are general in nature; specific projects are developed and described in the *Third WRF Facility Plan* and *Recycled Water Master Plan*. Refer to Section 3.2.4.4 for a summary of projects.



CITY OF BOISE WATER RENEWAL UTILITY PLAN

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Figure 3-20
Industrial Land Use Map
City of Boise - Water Renewal Utilities Plan

\\bcbofp01\projects_Boise_City of\148619 - COB WW Facility Plan\299 Water Renewal Utility Plan\GIS\MXDs\IndustrialLandUse11x17P_WRUPv2.mxd - pwatts 20200821 ILUM200701

3.2.4.3 People

Additional staff required to implement industrial reuse include the following:

- Industrial reuse coordinator
- Industrial reuse engineers and operators
- Treatment and distribution O&M staff
- Supporting staff, including human resources, information technology support, and administrative support

A key staff role to implement industrial reuse will be an industrial reuse coordinator. The industrial reuse coordinator will oversee and manage the program, develop and guide program policy, and interface with city management, IDEQ, industries, and the public.

Additionally, staff will need to perform day-to-day program functions such as preparing reports, coordinating production changes (either on the user side that affects demand for reuse water or on the supply side when city facilities are offline), and verifying compliance with user agreements. Depending on the scale of the program, these functions could be performed by the industrial reuse coordinator, or they could be performed by one or more industrial reuse engineers or operators who support the industrial reuse coordinator.

Additional O&M staff will be required for industrial reuse. This category includes O&M staff required for the Class A treatment system and distribution systems. Note that while there is likely overlap between the skills required for these positions and existing O&M positions or positions required for other water products, adding treatment and distribution infrastructure will increase the number of staff required.

Additional supporting staff, including human resources, information technology, procurement and warehouse staff, and administrative support, will likely be required to support the additional engineering and O&M staff.

Industrial reuse staffing considerations, including those necessary to produce recycled water, are summarized in Table 3-15.

Table 3-15. Staffing considerations for industrial reuse		
Job Role at WRFs	**Start Year**	**Job Description**
Industrial reuse coordinator	Prior to design and construction of the Third WRF	Oversee and manage the industrial reuse program, develop policy, and interface/partner with the IDEQ, industrial users, and other stakeholders
Industrial reuse engineers/operators	Prior to completion of the Third WRF	Assist the reuse coordinator in day-to-day program management, reporting, and compliance
Third WRF facility manager	Prior to completion of the Third WRF	Coordinate and oversee all teams and verify permit compliance
Third WRF operator	Prior to completion of the Third WRF	Monitor and adjust processes to renew water
Third WRF mechanic	Prior to completion of the Third WRF	Maintain and repair equipment
Laboratory technician	Prior to completion of the Third WRF	Analyze water samples for process control and permit compliance
Third WRF instrument technician	Prior to completion of the Third WRF	Calibrate and maintain instruments used for process control and compliance
Third WRF facilities and grounds maintenance personnel	Prior to completion of the Third WRF	Maintain the buildings and grounds
Purchasing and warehouse technicians	Prior to completion of the Third WRF	Procure and warehouse equipment replacement parts
Engineering and project management	Prior to design and construction of the Third WRF	Coordinate with regulators on permit development, plan and design process expansions and improvements, and coordinate project construction and implementation
Distribution system O&M staff person	Construction of distribution system	Responsible for O&M activities related to pressure lines, valves, booster pumps, and storage tanks

Although some of these skill sets could be provided by contract workers, having these staff in house provides greater coordination and verifies that the required skill sets will be available to complete the critical mission of water renewal.

3.2.4.4 Pricing

There are two primary considerations for pricing industrial reuse water: the market price of water paid by industrial users and the cost of treatment and distribution to produce industrial reuse water.

Uses of Class A water within industrial facilities shown in Figure 3-20above. Additional uses may be permitted by the IDEQ on a case-by-case basis, but they may require additional levels of treatment and pilot testing. It is assumed for the purposes of the Utility Plan that additional treatment beyond Class A quality would be provided by the user. Because of the limitations on use, rates for industrial reuse water are typically less than those for potable water. While rates vary between utilities, a rate for industrial reuse water between 50 and 80 percent of the potable water rate is typical. Additional fees may apply for connection costs and demand charges.

Costs for industrial reuse include the cost of treatment beyond the level required for river enhancement and the cost to distribute water. Specific pricing for the city's system will need to be established as the industrial reuse plan is developed and specific use projects, treatment projects, and distribution projects are identified. Projects impacting pricing are summarized in Table 3-16.

The buildout of the industrial reuse distribution network will be timed with other infrastructure projects and when other customers come online. The city is committed to building the distribution network for the first million gallons per day of recycled water and will plan for expansion when there is adequate demand for the product.

Table 3-16. Projects and pricing considerations for industrial reuse			
Anticipated Projects	**Location**	**Project Completion Year**	**Projected Capital Cost [a]**
Industrial reuse WRF (5 mgd)	Third WRF	2030	$54.9M
Industrial reuse distribution, first 1 mgd capacity [b]	Industrial zones near Third WRF	2030	$12.1M

[a] *AACE Class 5 cost estimate (+100%, -50%)*

[b] *Additional distribution capacity will depend on demand and when customers come online.*

3.2.5 Aquifer Recharge

The city's Class A recycled water can be used to recharge the Treasure Valley aquifer where soil and groundwater conditions are favorable. As climate change and local growth continue to heighten water demand and stress supplies, groundwater resources will hold critical value in the future. The use of recycled water for aquifer recharge addresses these growing concerns about the depletion of Idaho aquifers. In a semi-arid environment like Boise, aquifers provide a buffer to uncertain surface water flows. As climate change and local growth continue to heighten water demand and stress supplies, groundwater resources will hold critical value in the future.

3.2.5.1 Definition and Level of Service Connections

Most groundwater that is pumped from the Treasure Valley aquifer is used for agricultural irrigation and domestic water supply. Over the years, as groundwater is continuously pumped, the volume that is withdrawn from the system is not always replaced at the same rate. This imbalance can lead to aquifer depletion. Groundwater levels in some areas south of Boise have declined by up to 16 feet, as measured by change in poteniometric surface between the years 1996 and 2008. [4]

Infiltration basins would provide one potential method for recharge delivery, where Class A recycled water is applied to basins with permeable soils. The recycled water is further treated naturally as it infiltrates through the vadose zone, and reductions in nitrogen, phosphorus, and heavy metals concentrations can be achieved. This recharge method stores water in the shallow aquifer, as opposed to aquifer storage. Alternatively, injection wells or vadose zone wells could also be used to add recycled water to the aquifer. Figure 3-21 illustrates the concept for aquifer recharge.

When treated recycled water is land applied with the intent to recharge an underlying aquifer, a Class A reuse permit is required under Idaho's Recycled Water Rules (IDAPA 58.01.17). It is expected that the IDEQ would grant this permit to the city. Compliance with the Ground Water Quality Rule (IDAPA 58.01.11) is also necessary for aquifer recharge.

[4] Contor et al, *Managed Aquifer Recharge in the Treasure Valley: A Component of a Comprehensive Aquifer Management Plan and a Response to Climate Change,* 2011

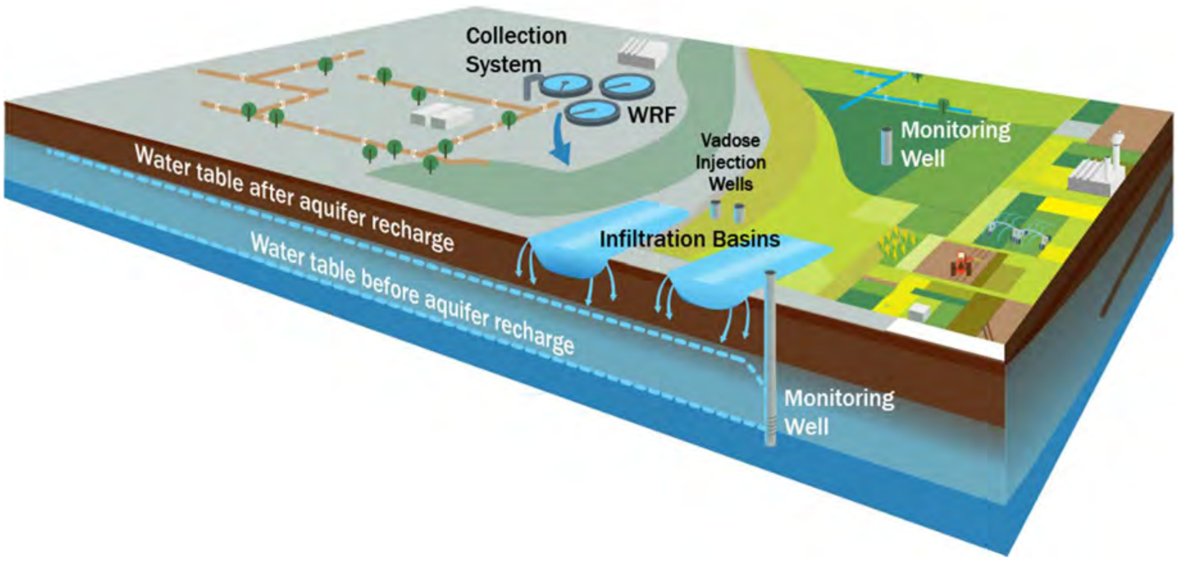

Figure 3-21. Aquifer recharge and monitoring activities

The city's resource capacity to produce a water source for an aquifer recharge product is driven by the flow received at the city's WRFs. The Recommended Approach is anticipated to provide up to 8 mgd of recycled water for aquifer recharge. This capacity could increase with growth and additional utility connections; conversely, water conservation may decrease product capacity in the future. Potential challenges for aquifer recharge projects include water quality, water management (monitoring and accounting), and water rights.

The aquifer recharge investment option impacts the level of service goals as described in Table 3-17.

Table 3-17. Aquifer recharge connection to level of service goals

Level of Service Goal	Relationship to Aquifer Recharge
Help sustain the Lower Boise River's quality to support multiple community uses	Provide environmental protection of the Lower Boise River through treatment and infiltration of used water that reduces pollutants discharged to the Boise River.
Operate cost-effectively and maintain a resilient utility	Aquifer recharge would provide resiliency to future water shortages in the Treasure Valley and position Boise as a water reuse leader.
Support a robust, vibrant economy consistent with the city's vision	Elevating the water table provides opportunity for increased groundwater use for irrigation and industry. Economic development may be enhanced by having additional aquifer storage. Another economic advantage of preserving the water levels in the Treasure Valley aquifer is that, as demand for water grows, the local water source eliminates the need to import water from elsewhere.
Develop partnerships to effectively solve community issues	Promote and advance environmental and resource management issues by bringing attention to resource management with the public, regulators, and neighboring cities. Aquifer recharge projects will build relationships between the city and local agricultural irrigators and groundwater users. These relationships will bring the benefits of aquifer recharge out into the broader community and will provide local agricultural irrigators with a safe and reliable source of water without impacting aquifer levels.
Protect the health and safety of our community and staff	Aquifer recharge helps to improve river health by eliminating discharge to the river, which protects the health and safety of the river and our community.

3.2.5.2 Projects

Similar to industrial reuse, pursuing aquifer recharge will require a WRF producing recycled water, a recycled water distribution system, and an aquifer recharge site. These components are further described below.

Recycled Water WRF

Aquifer recharge requires a WRF that produces recycled water. This could be accomplished at the existing Lander Street and West Boise WRFs with additional investment in treatment. However, due to the likely location of aquifer recharge sites to the south of the city, it is currently assumed that recycled water would be produced at two new WRFs located south of Interstate 84, one of which was discussed in Section 3.2.4. These WRFs would capture flow from the southern portion of the city to produce recycled water to be recharged to the aquifer.

Aquifer Recharge Transmission Main

Transmission mains will be required to move recycled water from the recycled water booster stations to the aquifer recharge sites. The exact route of these transmission mains will depend on the final siting of the WRFs and aquifer recharge sites.

Aquifer Recharge Site

Infiltration basins are one option for aquifer recharge, where recycled water is applied to basins with permeable soils and allowed to percolate into the shallow aquifer. Further treatment may also be accomplished as the recycled water percolates through the vadose zone materials. This groundwater can be later recovered for a variety of uses. Although travel time and residence time datasets are not directly available for this area, they will be important to consider during preliminary investigations of an aquifer recharge facility. The benefits of infiltration basins over vadose zone injection wells include an overall lower cost and no water storage requirement. Disadvantages include infiltration being limited to shallow unconfined aquifers and the large amount of land area required.

Vadose zone injection wells are another potential aquifer recharge method that is used when infiltration basins are not viable due to near surface lithology or lack of sufficient land area for basins. Advantages of these wells include lower cost compared to deeper injection wells and the benefit of some treatment typically found by infiltration basins. Disadvantages include initial cost of constructing the wells and maintaining them.

Several areas have been identified as potential infiltration areas in a Preliminary Infiltration Site Analysis (BC, 2015; 2017) that evaluated the geology, vadose zone, land slope, and land use of local areas. These potential sites are shown in Figure 3-22. The amount of area required to infiltrate the WRF effluent discharge is dependent upon several factors. Infiltration rates vary widely for the range of geologic materials present in the area, and heterogeneities result in broad variations in hydraulic conductivity. Table 3-18 depicts the acreage required of specific soil types to infiltrate the range of expected effluent (3–8 mgd).

Table 3-18. Land requirement estimates based on WRF discharge and infiltration rates

Soil Type	Infiltration Rate (ft/day)	Acres Required for Infiltration Basins Based on WRF Recycled Water Production [a]			
		Third WRF 2040 Flow	Fourth WRF 2040 Flow	Third WRF Buildout	Fourth WRF Buildout
		(4.6 mgd)	(3.1 mgd)	(10 mgd)	(11.5 mgd)
Gravelly silt loam	9.92	1.42	0.96	3.09	3.55
Clay loam	7.96	1.77	1.20	3.86	4.42
Silt loam	4.18	3.38	2.28	7.34	8.42
Sandy loam	3.86	3.66	2.46	7.95	9.12
Sandy clay loam	2.84	4.97	3.35	10.81	12.40
Silty clay loam	1.44	9.80	6.61	21.31	24.45
Stony silt loam	1.10	12.83	8.65	27.90	32.00
Fine sandy loam	1.10	12.83	8.65	27.90	32.00
Very fine sandy loam	1.02	13.84	9.33	30.09	34.51
Loam	1.0	14.1	9.5	30.7	35.2
Sandy clay	0.10	141.18	95.14	306.91	352.03
Heavy clay	0.04	352.95	237.85	767.27	880.06

[a] *Acreage does not include required land for infrastructure or drying basins.*

To site the most suitable infiltration area, preliminary site investigations will include subsurface testing, groundwater quality testing, soil permeability analysis, and suitability evaluations. Once the preliminary site investigations narrow down potential infiltration areas, detailed evaluations will include the installation and development of monitoring wells to determine groundwater flow direction and groundwater quality at the selected site(s). Then, the development of a hydrogeologic model of the site will be required to support a Reuse Permit application.

Once a site is chosen as a viable location for infiltration, a property survey, boundary survey, and topographic survey need to be conducted, as well as a Phase I Environmental Site Assessment for property transaction. Land use permits will be necessary dependent on the location selected for aquifer recharge as well as right-of-way access along the distribution line to the aquifer recharge site.

Water production wells—both private/domestic and public—are an important consideration when siting aquifer recharge facilities. Additional permitting requirements may be necessary because of the potential risk to nearby drinking water sources, particularly with treated effluent recharge facilities. If a water production well falls within a certain travel time distance from a recharge facility, then a monitoring plan needs to be developed and implemented for the subject water production well to operate the recharge facility (IDEQ, 2017). This permitting item puts a constraint on the operation and adds costs to recharge. This secondary evaluation would involve filtering the wells database to show the location of nearby water-supply wells and evaluating the proximity to the different high-scoring zones.

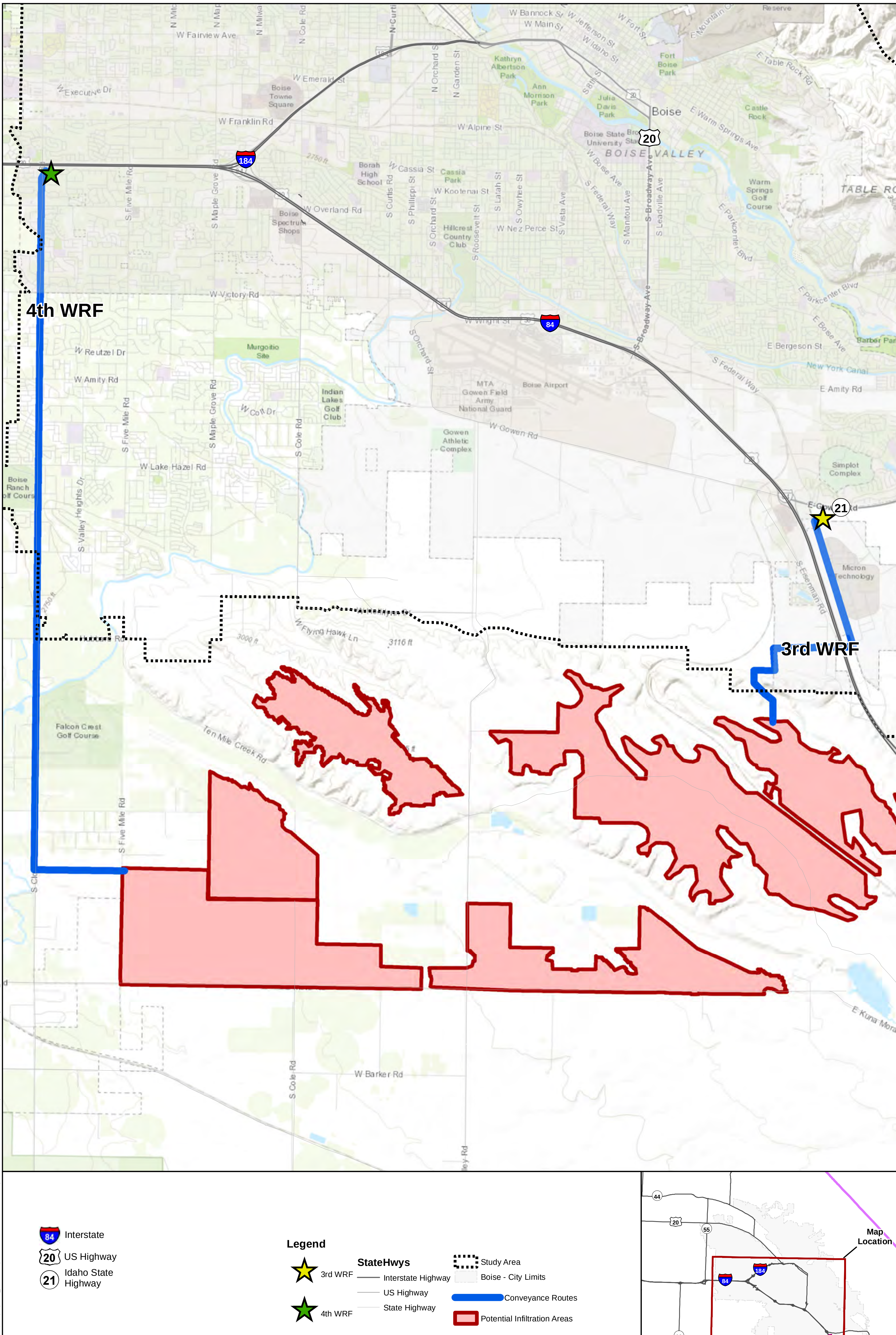

Figure 3-22
Aquifer Recharge Map
City of Boise - Water Renewal Utilities Plan

3.2.5.3 People

Additional staff required to implement industrial reuse include the following:

- Aquifer recharge coordinator
- Field operators
- Recharge basin maintenance and grounds personnel

A critical staff role for a successful aquifer recharge program will be an aquifer recharge coordinator. The aquifer recharge coordinator will oversee and manage the program; develop and guide a monitoring program; and interface with city management, the IDEQ, irrigators, and the public. Staff will also need to perform day-to-day program functions such as preparing reports, maintaining infiltration basins, and ensuring permit compliance. A field technician will be required to perform some of these daily duties.

Additional O&M staff will be required for aquifer recharge. This includes O&M staff required for the Class A treatment system, distribution systems, and infiltration basin land area grounds maintenance. Additional supporting staff will also be required.

Table 3-19. Staffing considerations for aquifer recharge

Job Role at WRFs	Start Year	Job Description
Aquifer recharge coordinator	Prior to design and construction of aquifer recharge system	Coordinate and manage aquifer recharge program; interface/partner with the IDEQ and other stakeholders; verify permit compliance
Distribution system O&M staff person	Construction of distribution system	Responsible for O&M activities related to pressure lines, valves, booster pumps, and storage tanks
Field operators	Prior to completion of aquifer recharge areas	Collect monitoring data; assist with basin development and maintenance
Recharge basin maintenance and grounds personnel	Prior to completion of aquifer recharge areas	Maintain the buildings and grounds
Fourth WRF facility manager	Prior to completion of Fourth WRF	Coordinate and oversee all teams and verify permit compliance
Fourth WRF operator	Prior to completion of Fourth WRF	Monitor and adjust processes to renew water
Fourth WRF mechanic	Prior to completion of Fourth WRFs	Maintain and repair equipment
Laboratory technician	Prior to completion of Fourth WRF	Analyze water samples for process control and permit compliance
Fourth WRF instrument technician	Prior to completion of Fourth WRF	Calibrate and maintain instruments used for process control and compliance
Fourth WRF facilities and grounds maintenance personnel	Prior to completion of Fourth WRF	Maintain the buildings and grounds
Purchasing and warehouse technician	Prior to completion of Fourth WRFs	Procure and warehouse equipment replacement parts
Engineering and project management	Prior to completion of Fourth WRF	Coordinate with regulators on permit development, plan and design process expansions and improvements, coordinate project construction and implementation

3.2.5.4 Pricing

Pursuing an aquifer recharge program will require the development of infrastructure to produce, convey, and recharge recycled water. As described previously, some of this infrastructure, such as the Third WRF, would also support the industrial reuse program. Table 3-20 presents the projects and pricing considerations for aquifer recharge projects, not including those that were already presented in Table 3-16.

Table 3-20. Projects and pricing considerations for aquifer recharge			
Anticipated Projects	Location	Project Completion Year	Projected Capital Cost [a]
Recycled water WRF	Fourth facility	2034	$80.9M
Pipeline/pump station Third WRF to aquifer recharge	TBD	2028	$31.9M
Pipeline/pump station Fourth WRF to aquifer recharge	TBD	2034	$31.8M
Aquifer recharge site	TBD	2030	$13.6M
Aquifer recharge site	TBD	2034	$21.9M

[a] *AACE Class 5 cost estimate (+100%, -50%)*

3.2.6 Opportunistic Products

The following sections give an overview of the investment options identified previously that are not a part of the preferred portfolio. The criteria against which they were analyzed showed that the benefits of implementing these options on the scales detailed did not outweigh the costs of construction and operation. However, these factors may change in the future as water becomes more valuable, the effects of climate change are felt more acutely in the Treasure Valley, and community expectations evolve. Therefore, the city may elect to implement some of these products on a smaller scale than originally envisioned to test their efficacy and inform future decision-making. The following sections describe situations and implementation levels where WRS could employ these opportunistic options.

3.2.6.1 Local Food Production

Class A recycled water can be used to produce food for human consumption. Early investigations into local food production analyzed two different methods of growing food using traditional agriculture and using greenhouses.

A greenhouse uses all three products, water, fertilizer, and energy; therefore, a small-scale system located close to one of the WRFs would be an optimal pilot testing approach. Figure 3-23 illustrates local food production as a consumer of water, biosolids, and energy. The cost for greenhouse food production is very high compared to traditional farming and does not provide an adequate “sink” for recycled water. In short, the greenhouses are too water efficient to provide an economical way to use reuse water.

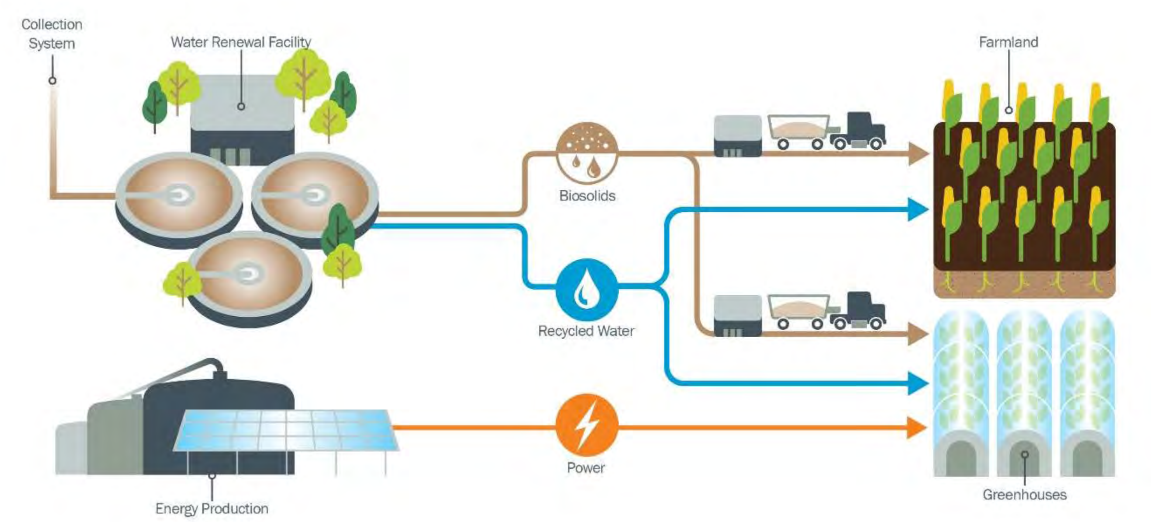

Figure 3-23 Overview of local food production

Large-scale food production uses both water and biosolids in large quantities. However, large-scale production also requires hundreds of acres of land, which are only available on the edges of Boise. A large pipeline would be needed to deliver water to the farmland. A WRF located closer to available land would make this option more feasible. The cost for greenhouses is more expensive on a per million gallons per day basis. At this time, it is not economically feasible to implement greenhouse farming on a scale greater than 0.1 mgd.

3.2.6.2 Closed-Loop and Decentralized Management

Closed-loop and decentralized facilities (Figure 3-24 and Figure 3-25, respectively) could be implemented in new planned communities where the city can work with developers from the start. This way, dual pipelines can be constructed at the same time the houses are built to avoid digging up paved roads to install recycled pipelines. Planning for a new WRF to service a new community should also occur before there are modifications to the existing collection system. This will prevent building extra capacity in the centralized system that will not be used.

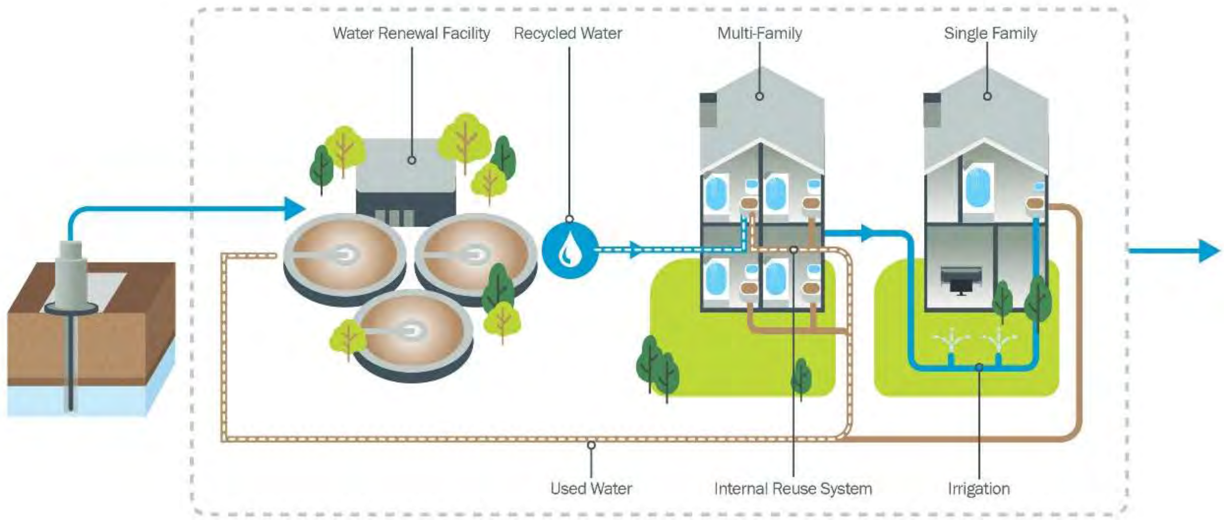

Figure 3-24. Closed-loop system water products

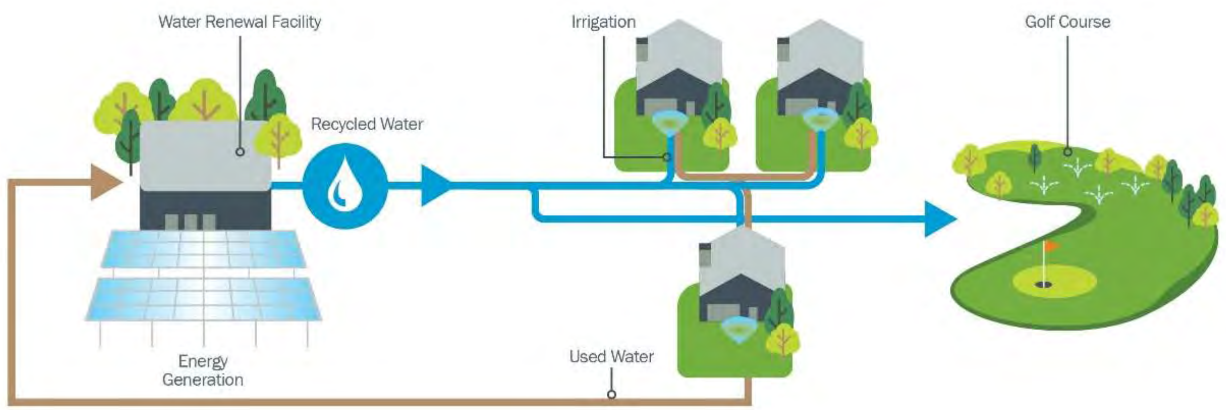

Figure 3-25. Decentralized management water products

Community support is already apparent for a closed-loop system—residents want help managing water conservation and see the use of recycled water for non-potable uses as an easy way to accomplish this goal. The city received this feedback from the second public survey as well as from the Advisory Group. However, when this option was presented to the Advisory Group, it understood it was only possible to build closed-loop and decentralized facilities in certain locations and that the cost per treated million gallons per day was much higher than building this capacity at the existing WRFs.

Based on the initial analyses of used water flow and typical irrigation demands for the planned developments in the area, potable water would still be needed to cover the non-potable uses. There is not enough recycled water to fill all the residences' needs for in-home use and irrigation in a closed-loop system.

An additional benefit of building new WRFs in areas of new growth is that these communities are being built south of the city, closer to areas highlighted as potential aquifer recharge sites as described in Section 3.2.5. Water from the decentralized facilities would be sent to aquifer recharge during the winter months since homes and businesses are not watering their lawns during the wintertime.

The closed-loop and decentralized options are more expensive than other options. Although more expensive, closed-loop and decentralized facilities provide additional benefits such as in-home use of recycled water. The final survey conducted asked residents about the investment options they support and showed the public strongly supports the closed-loop option. This option allows internal use of recycled water for non-potable uses such as toilet flushing and irrigation and gives the power of reuse to the people. These options maximize the use and reuse of resources contributing to community resiliency and more certain long-term regulatory requirements by limiting discharge to the Boise River.

Boise could become known for these progressive and innovative ways to treat and reuse water on a small, neighborhood-sized scale. Advisory Group members hypothesized that the implementation of these more innovative options could attract more environmentally and water conscious people to Boise.

3.3 Water Vision

The Utility Plan's Recommended Approach is a plan for Boise, built by Boise. It includes diversifying the uses of water and enhancing the health and quality of the Boise River. This approach offers flexibility for the city to adapt its strategy as conditions change in the future. It allows for a scalable approach toward recycled water that will allow the city to efficiently expand its recycled water options as the value of water increases. WRS believes this portfolio matches the community's values and will responsibly raise the level of service provided to the community for this and future generations.

The water products and projects described earlier in this section represent a dramatic shift in how Boise manages its water resources going forward. The Recommended Approach will incrementally divert water away from the status quo to focus on recycled water and aquifer recharge (Figure 3-26). This shift is expected to begin with the construction of a new WRF, the Third WRF, that focuses on the production of recycled water for industrial reuse and aquifer recharge by 2030. Bringing this facility online will shift flows away from the river discharge at the Lander Street and West Boise WRFs. Further in the future, additional recycled water will be produced and sent to aquifer recharge as growth continues. In parallel with these efforts to pursue recycled water, the city will continue to invest in enhancing the water quality and habitat for the Boise River to ensure the continued improvement for decades.

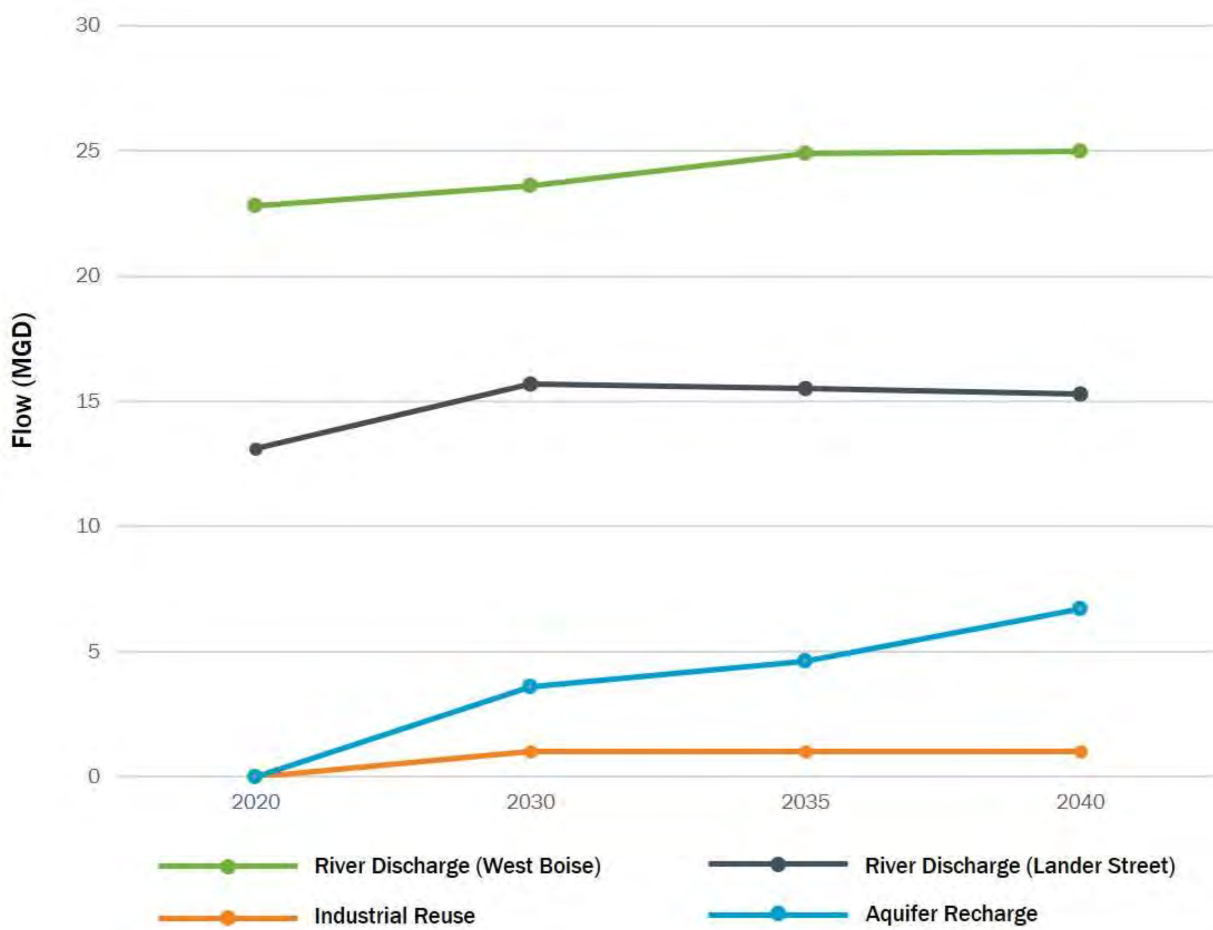

Figure 3-26. Time-series of flow to river, industrial reuse, and aquifer recharge

The Recommended Approach from the Utility Plan focuses new capacity on recycled water applications, specifically industrial recycled water and aquifer recharge. Additionally, community expectations suggest that investments should continue to be made that enhance the quality and use of the Boise River and go beyond meeting regulatory requirements. Figure 3-27 visually depicts the Recommended Approach with the emphasis on enhancing the Boise River, developing an industrial recycled water program, and pursuing aquifer recharge.

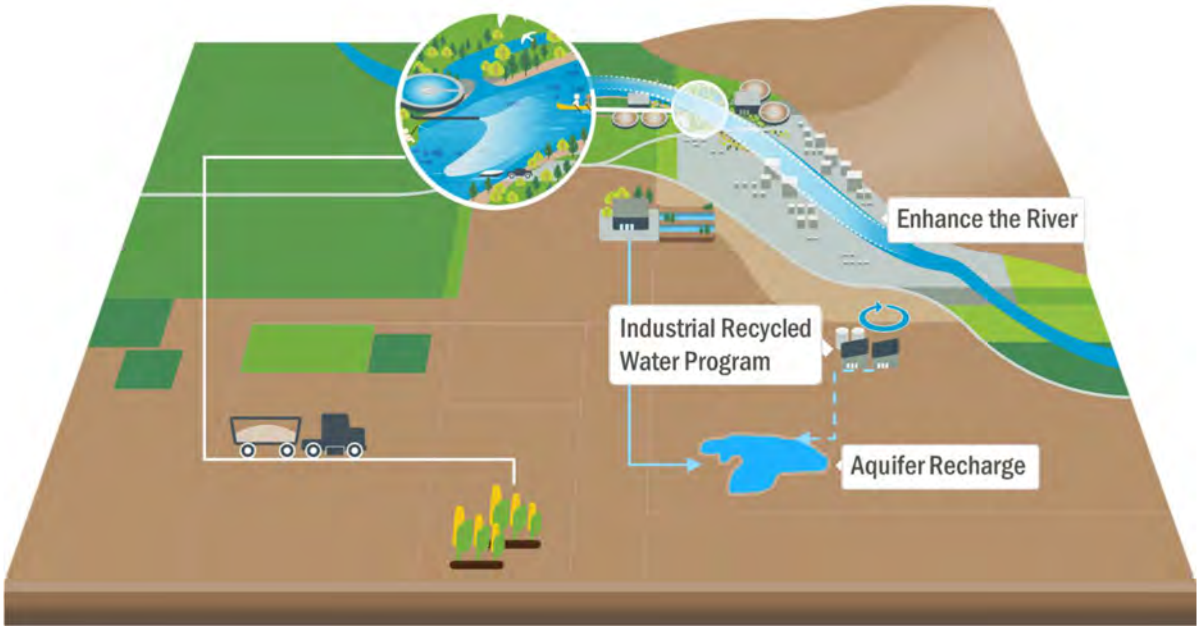

Figure 3-27. Recommended Approach

The Recommended Approach will manage and leverage growth in new ways. It is expected that proposed new water renewal facilities would be built closer to where growth is projected to occur and closer to areas for aquifer recharge and industrial reuse. This decentralized approach to water renewal management satisfies public concerns around centralized risk, makes better use of the water resources, and lowers the cost to transport recycled water to areas where it can be beneficially used. Utilizing the existing infrastructure at the Lander Street and West Boise WRFs also allows the city to maximize previous investments.

The Recommended Approach also positions the city to respond to future water challenges by diversifying what the city does with its renewed water. The results of the BCE demonstrated that this approach is the best option to manage near- and long-term risks. It also allows the city to be flexible to best manage water resources in the future as conditions continue to change. This plan can be viewed as a steppingstone that positions Boise to address future challenges without overinvesting in the near-term.

Inherent with the Recommended Approach is the commitment by the city to continue to be guided by community values. The development of the Utility Plan was built with over 2,700 interactions with the community. These efforts highlighted the community's expectations to protect the Boise River, diversify the uses of renewed water, and find economic solutions to challenges. The Recommended Approach is the embodiment of these expectations

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Section 4

Energy Products

The city's WRS utility carries a significant energy demand to power conveyance treatment processes. The treatment processes, and the land area at each WRF, also present opportunities to produce electricity, methane, and heat to help meet the energy demands across the WRS utility. In 2019, the city completed its landmark community-wide energy plan—Boise's Energy Future. In 2035, Boise's community energy will be generated from clean sources that deliver reliable and affordable energy to benefit the local economy, while enhancing the community's resilience to climate change.

Boise's Energy Future identifies two specific goals for electricity and thermal energy that support the vision:

- **Electricity goal:** 100 percent of the electricity used by the city's residents and businesses will be clean by 2035 while prioritizing affordability and access for all.
- **Thermal energy goal:** Make measurable progress on natural gas efficiency and geothermal expansion and identify a quantifiable goal by 2021.

Taking responsibility to lead by example in the implementation of the Utility Plan and achieve the identified goals, the city has also set a specific goal for municipal electricity usage:

- The electricity that powers the city's own facilities and operations will be 100 percent clean by the year 2030.

This section of the Utility Plan provides facility-specific information and an analysis of alternatives to purchase clean energy or produce electricity onsite and offsite using solar power systems. Utilization of digester gas for thermal and electrical energy generation and production of renewable natural gas or compressed natural gas has also been analyzed. Results of the analysis and considerations for solar energy and digester gas energy are described in detail in the following sections.

Expansion of the geothermal system is not considered as part of the Utility Plan since this utility is outside the purview of WRS. The city's existing geothermal system primarily serves the downtown area. WRS's major facilities are located several miles outside of this area at a minimum, a distance that makes transporting thermal energy difficult.

4.1 Current Energy Products

Digestion processes in the treatment system at the Lander Street and West Boise WRFs create biogas, which is currently used to provide heat energy for the digestion process and provide building heat at the Water Quality Laboratory. Approximately 55 percent of the biogas produced at each WRF is flared, and natural gas supplied by Intermountain Gas Company is used for any remaining heating needs at each WRF. The remaining 45 percent of biogas is used to heat boilers at the Lander Street and West Boise WRFs. Present thermal energy resource production and consumption are further described in Section 4.2.

Solar power is currently used at the TMSBAS for a building that houses the administrative offices, maintenance shop, parts warehouse, and mechanic shop. The new facility is a certified LEED GOLD building and the first commercial zero net energy facility in Idaho. The building uses solar panels to offset energy consumed onsite with energy produced onsite. The solar array at the TMSBAS consists of 199 individual panels mounted on the roof of the building. The solar energy produced from this array is net metered and sufficient to offset 100 percent of the building's electricity consumption.

4.2 Future Energy Products

The Utility Plan focuses primarily on the potential for further development of solar energy and biogas within WRS. There are multiple technologies and system arrangements available to make use of these resources at the WRFs and at greenfield sites. The Utility Plan discusses future energy products in terms of the expansion of existing systems and installation of new systems.

Beneficial reuse of digester gas at WRFs is a common practice with proven technologies at multiple scales and applications. At a minimum, WRFs with digesters typically use digester gas to fuel boilers currently employed by the city to create heat needed for digestion and other plant heating needs. Many facilities employ cogeneration, also known as combined heat and power systems, which beneficially use digester gas to create electricity and heat for the treatment processes via internal combustion engines or turbines. Alternatively, digester gas can also be used to produce compressed natural gas (CNG)—most commonly used to fuel fleet vehicles—or renewable natural gas (RNG), which can be injected into a natural gas pipeline and sold as a commodity.

Advances in solar power technologies have resulted in a trend of increasing energy production capacity and decreasing cost. Solar energy generation at the scale of the anticipated electricity usage of the WRS utility would require offsite solar arrays, due to the size of the installation required. Purchasing renewable energy credits from other utility-scale projects is another option for reaching renewable energy goals.

An overview of current and anticipated future WRS electricity usage is shown in Figure 4-1. The CIPs WRS has planned between 2020 and 2040 are anticipated to add approximately 68 gigawatt hours in annual electricity usage. Energy usage in 2020 provides the baseline for applying the approach laid out in Boise's Energy Future. The Utility Plan does not include plans for covering baseline electricity use with additional clean and renewable energy sources. Additionally, the energy source portfolio that provides the WRS baseline electricity usage already has a low carbon intensity relative to many other utilities nationally. Figure 4-1 demonstrates that increased electricity usage from the CIPs WRS brings online between 2020 and 2030 will be supplied by new city-owned installations and/or purchased clean energy, while increased usage between 2030 and 2040 will be met by capitalizing on IPC's increasing clean and renewable energy portfolio in combination with clean energy from city-owned projects or purchased energy. Anticipated energy usage and project timing for individual CIPs is discussed further in the following sections.

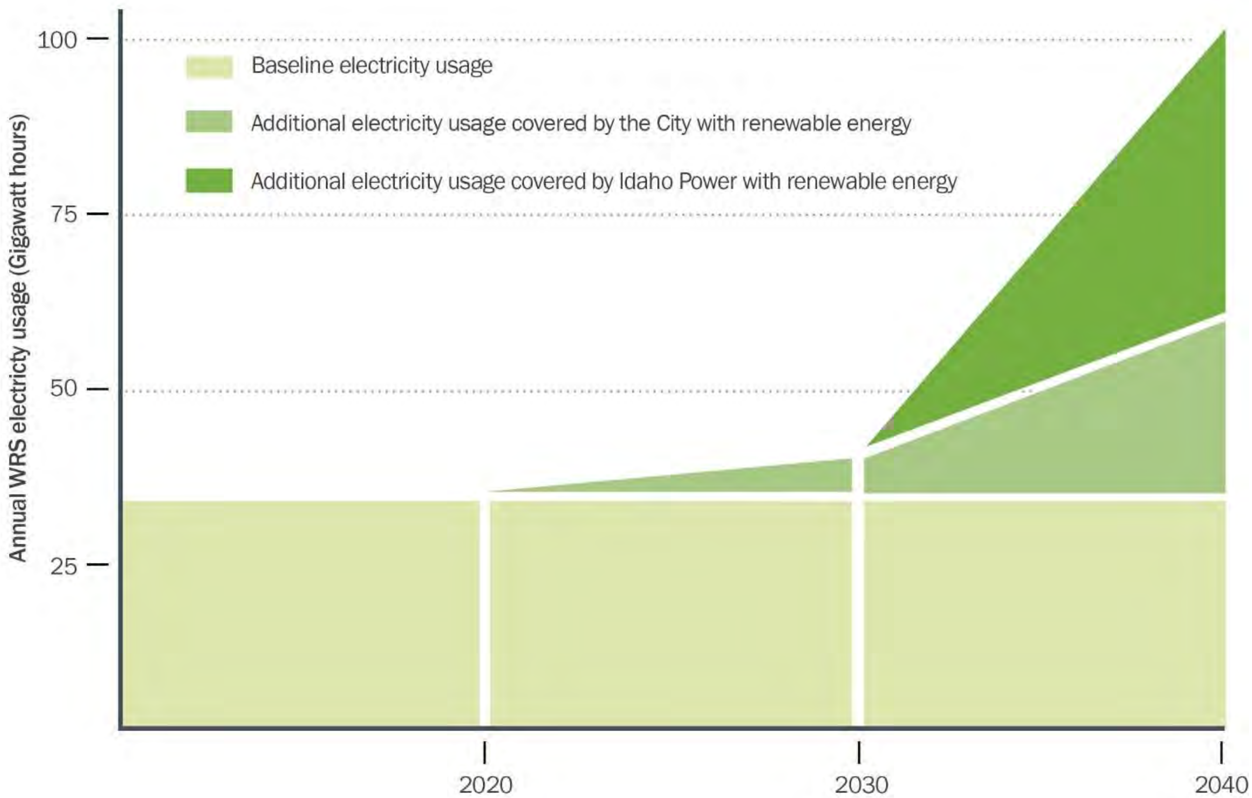


Figure 4-1. Implementing Boise's Energy Future plan to provide for growing WRS electricity usage

The water renewal utility as a whole has the potential to go beyond the scenario presented in Figure 4-1 to become energy neutral by optimizing energy efficiency, increasing the use of clean energy resources derived from the treatment process (such as digester gas), and through developing other energy generating sources, such as solar power generation using photovoltaic (PV) cells, for electricity or purchasing renewable energy from IPC.

Figure 4-2 is an illustration of renewable energy production opportunities available at multiple WRS facilities.

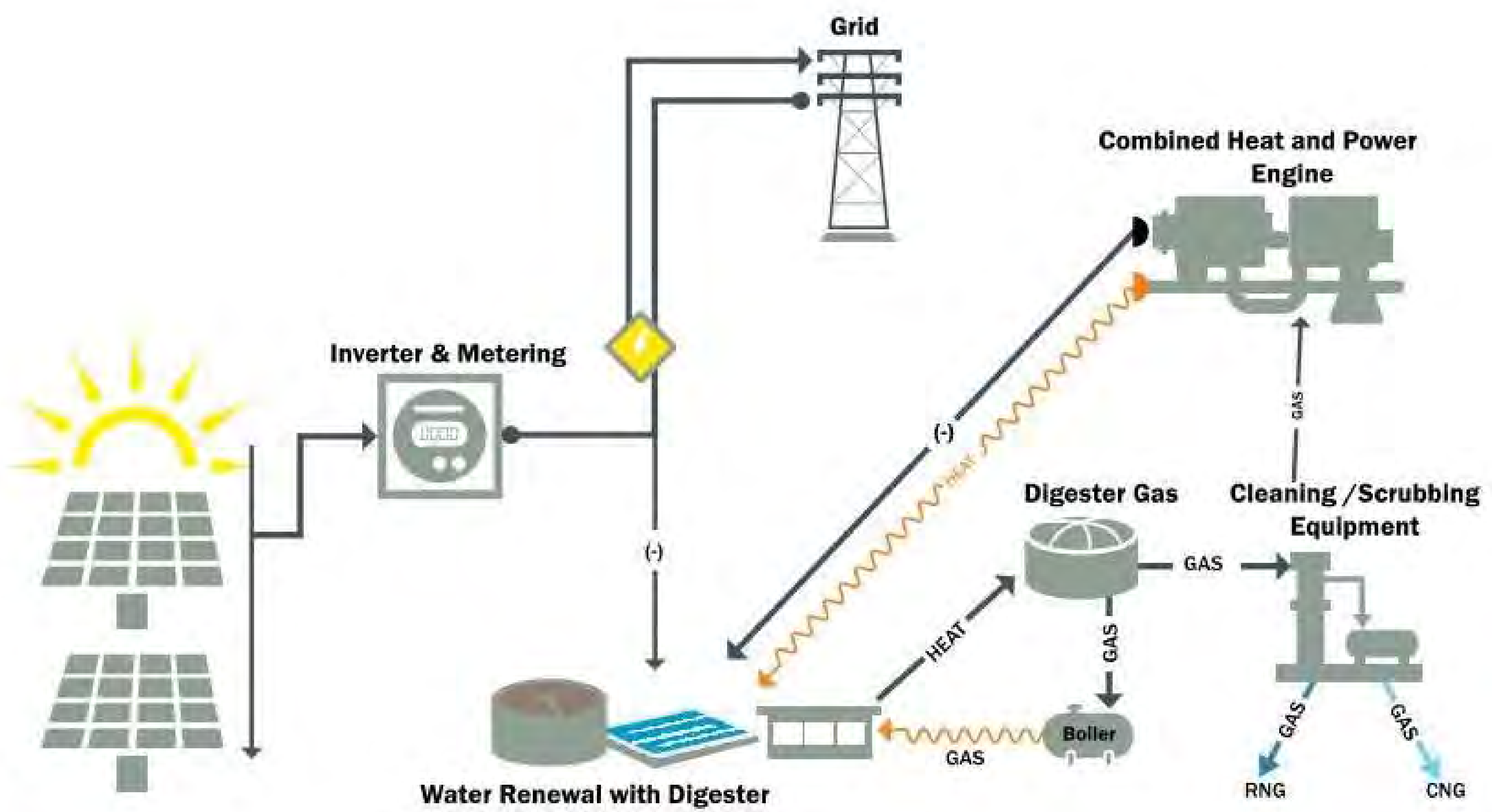


Figure 4-2. Utility Plan energy production opportunities and energy flow of potential systems

4.2.1 Energy Usage and Production Capacity

In this section, current and anticipated energy usage and production capacity are viewed collectively across WRS, with detailed consumption and production opportunities discussed at the WRF level.

4.2.1.1 Electricity Usage

Baseline annual electricity consumption for WRS totals just under 34,000 MWh annually. The CIPs WRS has planned between 2020 and 2040 have a significant impact on electricity demand. The major CIPs planned between 2020 and 2040 and preliminary estimates of annual electricity demand are listed below:

- Lander Street WRF digester gas improvements (anticipated in 2021): 1 MWh
- West Boise WRF capacity upgrades (anticipated in 2023): 2,269 MWh
- Lander Street WRF secondary clarifiers (anticipated in 2026): 1,235 MWh
- Lander Street WRF tertiary filtration (anticipated in 2026): 1,024 MWh
- West Boise WRF tertiary filtration (anticipated in 2026): 1,024 MWh
- Lander Street WRF primary clarifiers (anticipated in 2026): 255 MWh
- Third WRF (anticipated in 2030): 19,018 MWh
- Fourth WRF (anticipated in 2035): 9,837 MWh
- Lander Street WRF advanced treatment (2035): 33,507 MWh

Table 4-1 shows current electricity demand, the anticipated additional electricity usage, including all CIP projects, and the total for each of WRS's facilities by 2040.

Table 4-1. WRS electricity usage (MWh annual total)

	Lander Street WRF	West Boise WRF	Third WRF	Fourth WRF	Dixie Drain	TMSBAS	WRS Total
2019 usage	7,883	18,426	–	–	730	6,896	33,885
2020–2040 CIP added demand	36,000	3,300	19,000	9,800	–[a]	–[a]	68,200
2040 facility total demand	43,900	21,700	19,000	9,800	730	6,900	102,100

[a] *No significant CIPs included for the 2020–2040 period are included in the Utility Plan for these facilities.*

Figure 4-3 presents the information in Table 4-1 graphically, highlighting differences between each WRF and how each one contributes to electricity usage for WRS as a whole. It should be noted that the large increase in electricity use at the Lander Street WRF is driven by the current assumption that advanced treatment would be accomplished with an ozone treatment system. This assumption will require validation moving forward.

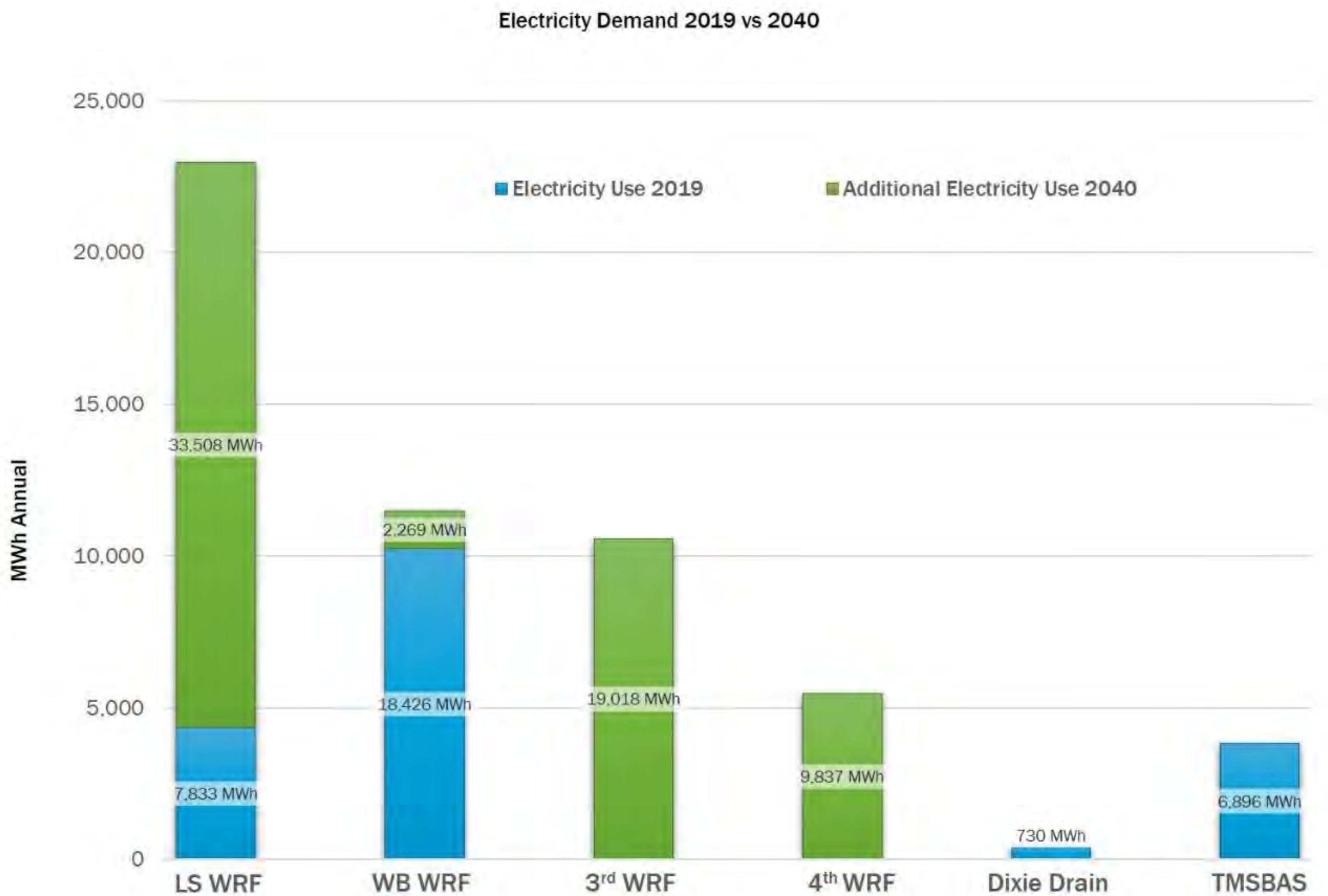


Figure 4-3. Electricity consumption for 2019 at existing facilities and anticipated future annual electricity usage

4.2.1.2 On-Site Clean and Renewable Electricity Production Capacity

Energy production capacity has been evaluated for WRS based on the potential of renewable energy generation using resources recovered from the water renewal processes, such as digester gas, and clean energy for resources inherent to the physical setting of each WRF, such as wind and solar energy. In line with Boise's Energy Future, goals for the Utility Plan are focused on meeting new electricity demands from WRS processes and facilities that are expected to be built between 2020 and 2040 using clean and renewable energy.

Digester gas is considered a renewable fuel. It can be used in place of natural gas as fuel for boilers and in building heating, ventilating, and air conditioning systems, as is currently done, or to fuel internal combustion engines or microturbines attached to electrical generators. The volume of digester gas available for electricity generation at each WRF may be better suited for use in an internal combustion engine than a microturbine. Therefore, anticipated electricity production from an internal combustion engine is used throughout this section. Once input parameters necessary for determining generator design are developed, a more detailed evaluation of generator technologies can be conducted. Heat produced by the internal combustion engines can also be captured and used to meet heating needs for treatment processes and buildings. Using the digester gas produced at each WRF, Table 4-2 provides estimates of the thermal energy and electrical production potential from generators powered by internal combustion engines using the available digester gas as fuel.

Table 4-2. Estimated digester gas energy production capacity (cogeneration)

	Lander Street WRF	West Boise WRF
Annual electricity output (MWh)	2,681	5,795
Portion of anticipated future electricity need [a]	12%	26%
Annual recoverable thermal energy (MMBtu)	12,600	24,100

[a] Portion of WRS future electricity need assuming a 70% IPC renewable energy sources portfolio.

MMBtu = one million British thermal units.

Solar and wind resources vary by location, and the ability to make use of each resource is limited by space—a horizontal surface area for solar panels and vertical clearance for wind turbines. Preliminary evaluations of solar resources indicate great potential for solar energy production through proven technology with flexibility for a variety of applications, reliable and predictable solar radiation in the Boise area, and sufficient surface area for solar array installations. Estimated solar energy production for each WRF is presented in Table 4-3 .

Wind resources (typically tracked as sustained average wind speeds) are lacking in the urban areas in which WRFs are, or will be, located. In general, wind speed increases with height and distance away from obstructions like trees, buildings, and towers. Economically feasible use of wind energy in and around Boise requires multiple turbines at heights between 100 and 200 feet. City and county codes typically limit structure heights to between 35 and 50 feet for parcels zoned as industrial use. Therefore, wind energy is not included in the alternatives assessments conducted for the Utility Plan. Further wind energy evaluations may be appropriate at a later date as CIP projects enter the planning and design phases.

Table 4-3. Estimated solar electricity production				
	Lander Street WRF	West Boise WRF	Third WRF	Fourth WRF
Annual electricity output (MWh)	196	980	98	98
Space requirement (acres)	1	5	0.5	0.5
Portion of anticipated future electricity need [a]	0.9%	4.4%	0.4%	0.4%

[a] *Portion of WRS future electricity need assuming a 70% IPC renewable energy sources portfolio.*

4.2.1.3 Thermal Energy Usage

The total gas used and produced during 2019 is shown for each WRF in Table 4-4. These totals highlight digester gas quantities available to offset natural gas usage and other beneficial reuse opportunities such as powering cogeneration systems, RNG, etc.

Table 4-4. Thermal energy consumption 2019		
Gas Quantities (MMBtu)	Lander Street WRF	West Boise WRF
Natural gas used	8,902	7,417
Digester gas used	9,435	13,616
Total gas used	18,336	22,592
Digester gas flared	11,595	17,956
Total digester gas produced	21,030	33,131

Annual thermal energy usage and production for 2019 are both shown in Figure 4-4, providing a visual comparison of digester gas use and surplus.

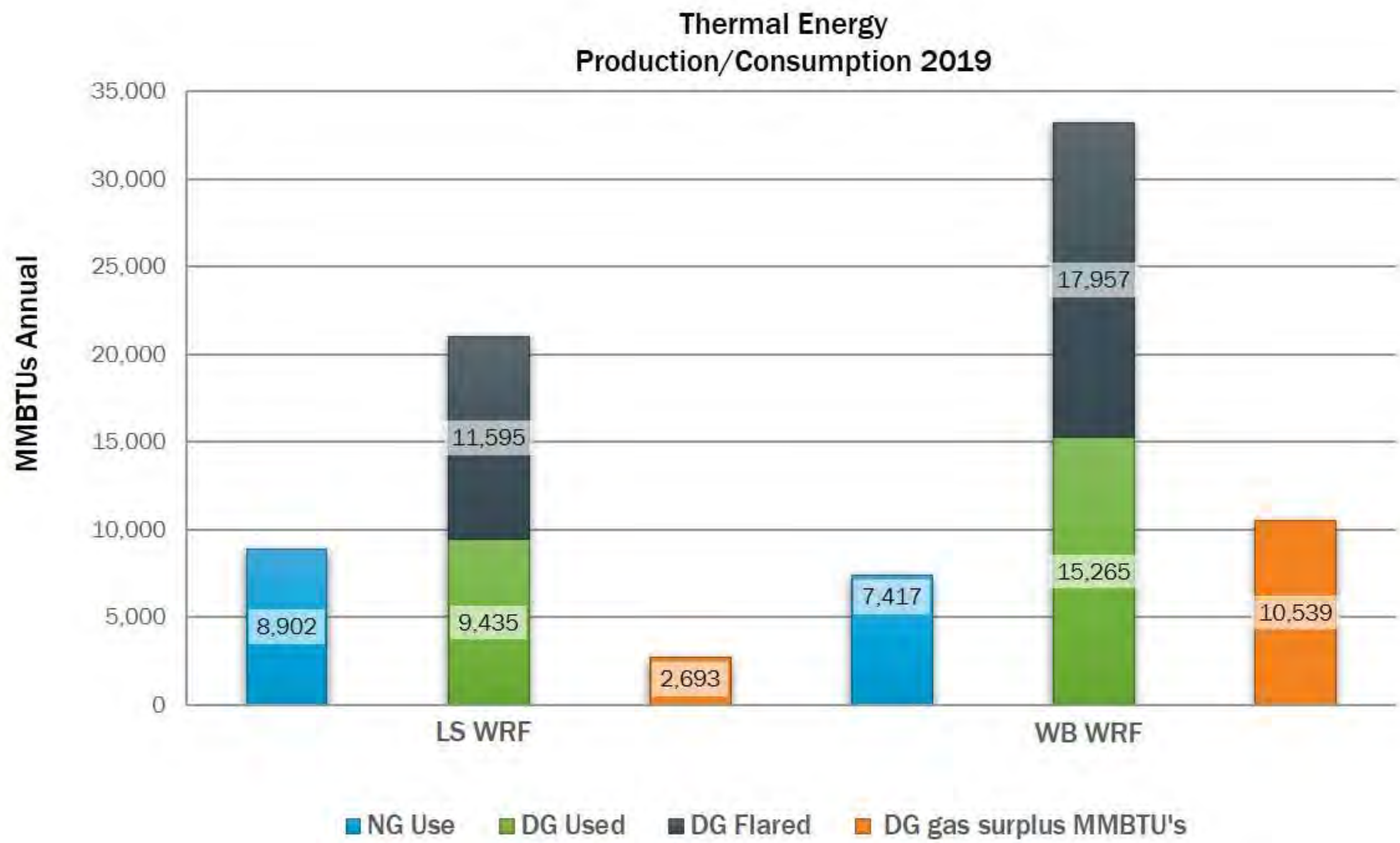


Figure 4-4. Thermal energy use profile and digester gas production for 2019 by facility

**Amount remaining if digester gas was used to offset 100 percent of the natural gas used*

4.2.1.4 Thermal Energy (Digester Gas) Production Capacity

Digester gas production is expected to increase at each WRF. Each WRF already captures and beneficially reuses digester gas to reduce natural gas used in the treatment process. The known and anticipated production capacity of digester gas is necessary to make reasonable assumptions for natural gas and/or electricity offset and needs to be evaluated on a facility-by-facility basis.

The primary factors influencing the amount of digester gas produced are the retention time in the anaerobic digestion reactor, the temperature of the digestion process, and the amount of readily digestible organic matter in the sludge. The digestibility of the organic matter is dependent on sludge types, sludge age, and other factors relating to the water renewal process. Because of this, changes in loads into each WRF and changes in treatment processes control the volume of digester gas produced, and the volume produced over any given time can be expected to fluctuate. For example, maximum monthly digester production is almost 50 percent higher than minimum month production at both WRFs.

Onsite digestion is not planned for the Third or Fourth WRFs. Waste activated sludge from the Fourth WRF is planned to be sent to the West Boise WRF, which will increase digester gas production there by a small percentage. Influent to the Third WRF will come primarily from industrial customers, and digesters are not planned for that treatment process. Solids from the Third WRF are planned to be landfilled. Because increases in digester gas production are expected to be small in comparison to current production volumes, future production potential does not change the alternatives evaluated for handling digester gas at either WRF.

Figure 4-5 illustrates energy generation potential at each WRF in comparison to anticipated energy usage. The deficits between generation capacity and energy use highlight the need for identification of a renewable energy offset strategy that goes beyond the boundaries of any one facility.

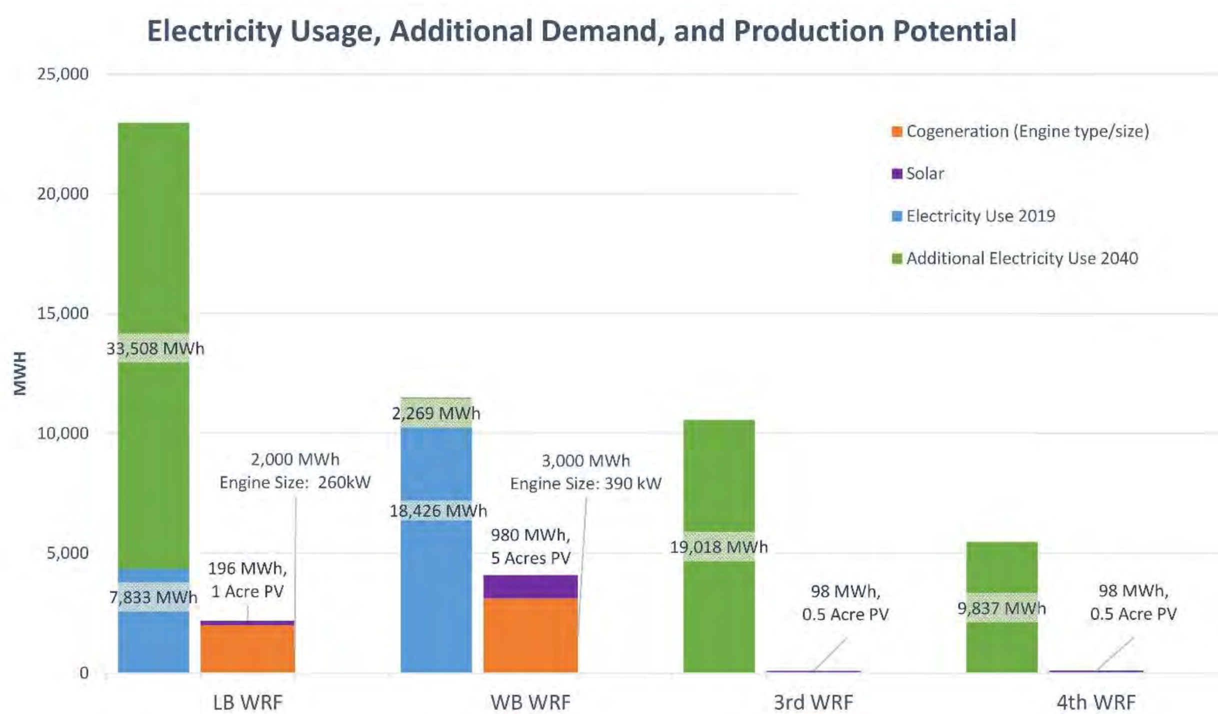


Figure 4-5. Electricity consumption for 2019 at existing facilities and consumption/production estimates for 2040, by facility

4.2.2 Energy Alternatives Assessment: Electricity

The electricity component of the energy alternatives assessment for the Utility Plan addresses the goals set out for the city in Boise's Energy Future plan. Alternatives evaluated include city-owned solar production, cogeneration using digester gas, and purchased clean electricity. The city will not be alone in providing clean and renewable energy for future electricity needs. By 2030, IPC anticipates having between 70 to 85 percent of its energy portfolio provided by clean renewable sources. By implementing Boise's Energy Future plan, the city will produce or procure the remaining 15 to 30 percent of required electricity generated from clean sources.

Figure 4-6 and Table 4-5 illustrate these contributions based on CIP timing and anticipated energy usage.

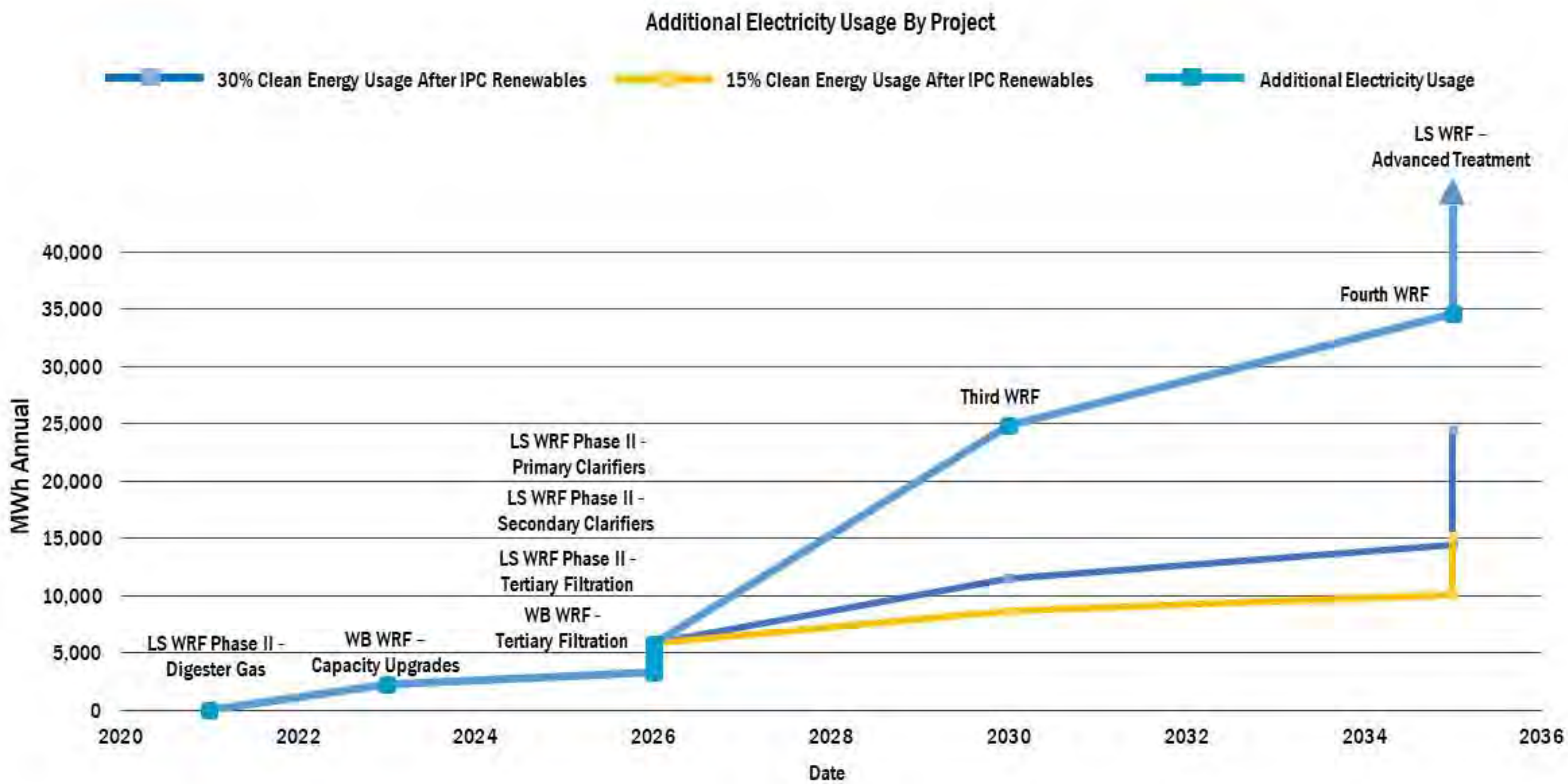


Figure 4-6. Additional electricity needed by the project over time with consideration of IPC's percent contribution to the Renewable Energy Source portfolio

Table 4-5. WRS's electricity usage (MWh annual total)							
	Lander Street WRF	West Boise WRF	Third WRF	Fourth WRF	Dixie Drain	TMSBAS	WRS Total
2019 usage	7,883	18,426	N/A	N/A	730	6,896	33,885
2020–2040 CIP added demand	**36,022**	**3,293**	**19,018**	**9,837**	**N/A**	**N/A**	**68,170**
2040 facility total demand	43,855	21,719	19,018	9,837	730	6,896	102,055
IPC's portfolio—70% offset scenario	23,455	N/A	13,313	6,886	N/A	N/A	43,653
IPC's portfolio—85% offset scenario	28,481	N/A	16,165	8,361	N/A	N/A	53,008
Electricity demand to offset	**7,541 – 12,567**	**3,293**	**2,853 – 5,705**	**1,476 – 2,952**	**N/A**	**N/A**	**15,163– 24,517**
Cogeneration	2,000	3,100	N/A	N/A	N/A	N/A	**5,100**
Onsite Solar	196	980	98	98	N/A	N/A	**1,372**
Offsite solar or purchased renewables							**8,691– 18,045**

4.2.2.1 Alternatives

Three clean or renewable energy production alternatives were considered in the alternatives assessment: solar, cogeneration with digester gas, and purchasing clean energy purchased through IPC. The following sections provide a brief description of each alternative and the types of technologies considered.

4.2.2.1.1 Solar Production

Solar energy collection continues to grow globally as one of the most viable options for clean energy. The most popular solar approach in the United States and most practicable for the city is the use of PV panels. These modular panels are linked in series and can be assembled in a multitude of array sizes. Various mounting options include roof mount, fixed ground mount, single-axis tracking mount, and two-axis tracking mount. The electricity generated peaks during mid-day, which often exceeds local system needs, then drops to zero at night, leaving a deficit. To account for this fluctuation, PV systems may be tied to the grid and receive financial credits or may employ battery systems for energy storage at the facility level. The economic feasibility of battery storage is quickly increasing with technological advancements. At the utility scale that the city would require, grid-tied systems were considered. For analysis of the solar energy production for the city, the characteristics of the single-axis tracking mount configuration were used. Further information on this type of system is located in Section 4.2.4.1.

4.2.2.1.2 Cogeneration with Digester Gas

Cogeneration would use digester gas captured from the West Boise and Lander Street WRFs to fuel a reciprocating internal combustion engine to power a generator. Waste thermal energy from the engine combustion process would be redirected for facility use. While efficiencies of electricity generation can range between 35 to 40 percent, and thermal energy efficiencies between 45 to 50 percent, the total efficiency of a cogeneration system is 60 to 90 percent. Digester gas could be captured and sent to a single location to power a larger generator, or as is the case in this assessment, a smaller cogeneration system could be installed at the WB WRF and LS WRF to use the generated heat and electricity onsite.

4.2.2.1.3 Renewable Energy Purchase

Rather than designing and constructing a clean energy project of its own, the city may opt to purchase clean energy provided by IPC. IPC's large clean and renewable energy purchase program allows customers to design a clean energy portfolio with products supported by local wind, solar, and geothermal projects. As the clean and renewable energy market grows in the northwest, there are likely to be more opportunities for clean energy purchase in addition to what is currently available through IPC.

4.2.2.2 Analysis

The components of each alternative are described in the following pages. The analysis focused primarily on capital, O&M, and R&R costs. With the information available at this early stage, risk and benefit costs like technology changes, resiliency benefits, and public perception represented the same level of service and were equal across all alternatives. Perhaps the most significant considerations for applying the results of this analysis are understanding the context within the Boise's Energy Future plan, as described at the beginning of Section 4, and the dynamic nature of the renewable energy technology market, which is discussed further in the summary and recommended approach.

Alternative 1: Make up 100 percent of the additional electricity needs with a combination of onsite solar development and a large offsite solar array.

Table 4-6. Alternative 1 components required

Components	Component Assumptions [a, b]
Lander Street WRF solar	98 kW system, 1 acre
West Boise WRF solar	491 kW system, 5 acres
Third WRF solar	49 kW system, 0.5 acres
Fourth WRF solar	49 kW system, 0.5 acres
Large offsite solar facility	11.6 MW system, 100.7 acres

[a] *Capacity factor of 22.7 percent based on city calculations for single-axis tracking PV.*

[b] *142,874 per acre cost based on National Renewable Energy Laboratory's (NREL's) 2018 benchmark data.*

Alternative 2: Make up 100 percent of the additional electricity needs with a combination of onsite solar and onsite cogeneration using digester gas to generate electricity and heat and a large offsite solar array.

Table 4-7. Alternative 2 components required

Components	Component Assumptions
Lander Street WRF solar [a,b]	98 kW system, 1 acre
Lander Street WRF cogen	340 kW average output system
West Boise WRF solar [a, b]	491 kW system, 5 acres
West Boise WRF cogen	735 kW average output system
Large offsite solar facility [a, b]	7.4 MW system, 74.8 acres
Third WRF solar [a, b]	49 kW system, 0.5 acres
Fourth WRF solar [a, b]	49 kW System, 0.5 acres

[a] *Capacity factor of 22.7 percent based on city calculations for single-axis tracking PV.*

[b] *142,874 per acre cost based on NREL's 2018 benchmark data.*

Alternative 3: Make up 100 percent of the additional electricity needs with purchased clean energy through IPC. Purchased clean electricity is represented as an annual O&M cost only.

Table 4-8. Alternative 3 components required

Components	Component Assumptions
Clean energy purchase	Electricity cost + 25%

4.2.2.3 Summary

A summary of the NPV results from the BCE is provided in Table 4-9. NPV is the present value of future costs. Because unique risks and benefits are not identified in this evaluation, the NPV and potential total cost of assets (PTAC) are equal. The BCE results indicate Alternative 1 as the lowest PTAC.

Table 4-9. Electricity energy BCE summary [a, b]

Alternative	Description	Capital	O&M	R&R	Cash NPV	PTAC
1	Solar only	$15,385,000	$470,000	$16,000,000	($47,332,000)	($47,332,000)
2	Solar and cogeneration	$23,616,000	$14,037,000	$29,528,000	($103,246,000)	($103,246,000)
3	Purchased clean energy	$0	$44,466,000	$0	($76,822,000)	($76,822,000)

[a] *Cells highlighted in green indicate the lowest cost portfolio for the conditions shown.*

[b] *Total costs shown in 2020 dollars represent the period 2020 through 2060 and are rounded to the nearest $1,000.*

The BCE favors Alternative 1 over Alternative 3 based on today's clean energy markets and a planning period that extends into 2060. Alternative 2 represents a much higher PTAC, primarily owing to high O&M and R&R costs. The gap between Alternatives 1 and 3 represents the difference in owning and maintaining the electricity generation (large solar power facility) and purchasing energy from an outside entity that owns and maintains the facility. Because large-scale electricity offsets for WRS are not anticipated until 2030 at the earliest, the gap between these alternatives could close to some extent depending on changes in the clean energy market in the next decade.

Figures 4-7, 4-8, and 4-9 present the assumed cash flow for each of the options considered. Of note, the cash flows for Alternative 1 and Alternative 2 are similar with early capital spending followed by ongoing O&M and R&R costs. Alternative 3 has a distinct cash flow that avoids the near-term capital costs. However, this is balanced by higher operating costs as the city continues to purchase renewable energy.

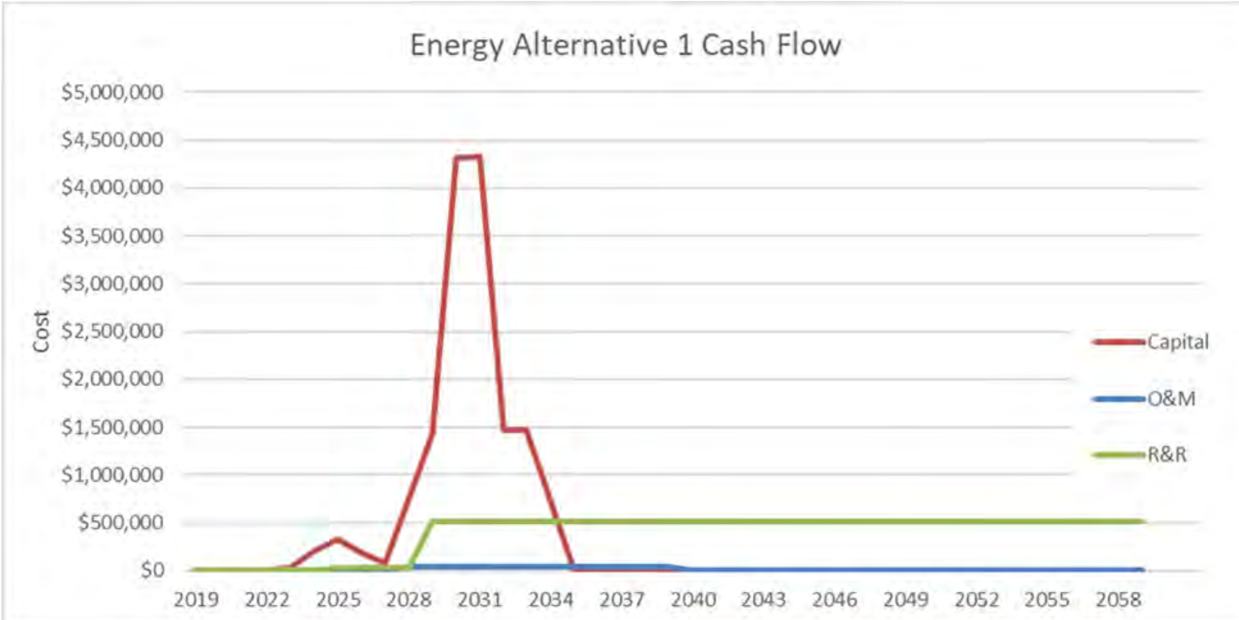


Figure 4-7. Energy Alternative 1 cash flow

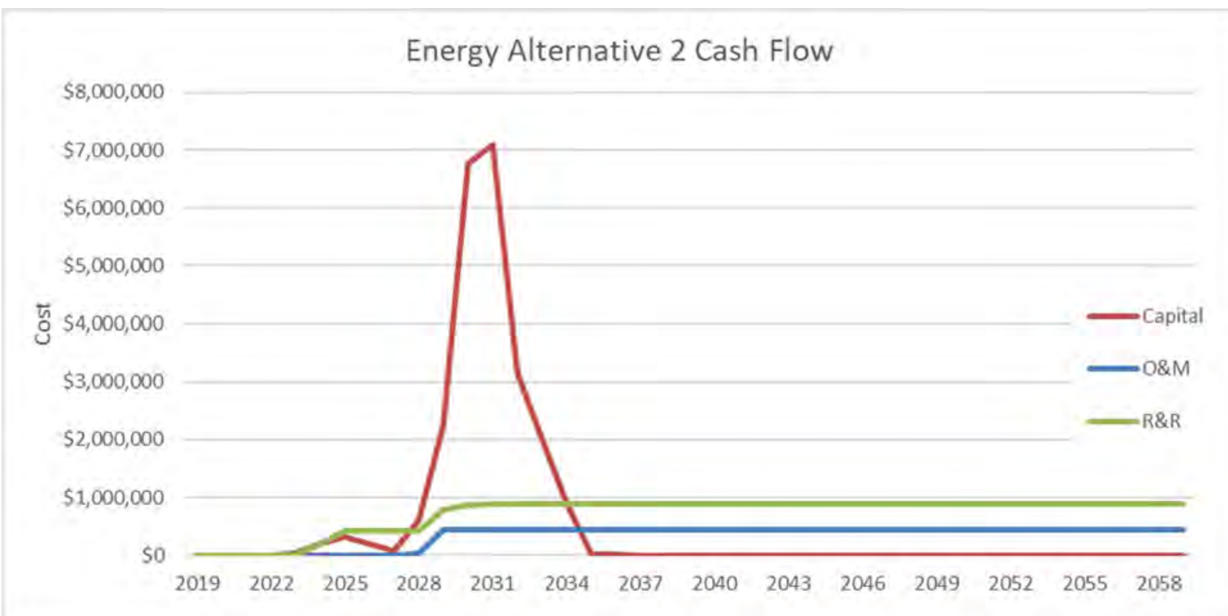


Figure 4-8. Energy Alternative 2 cash flow

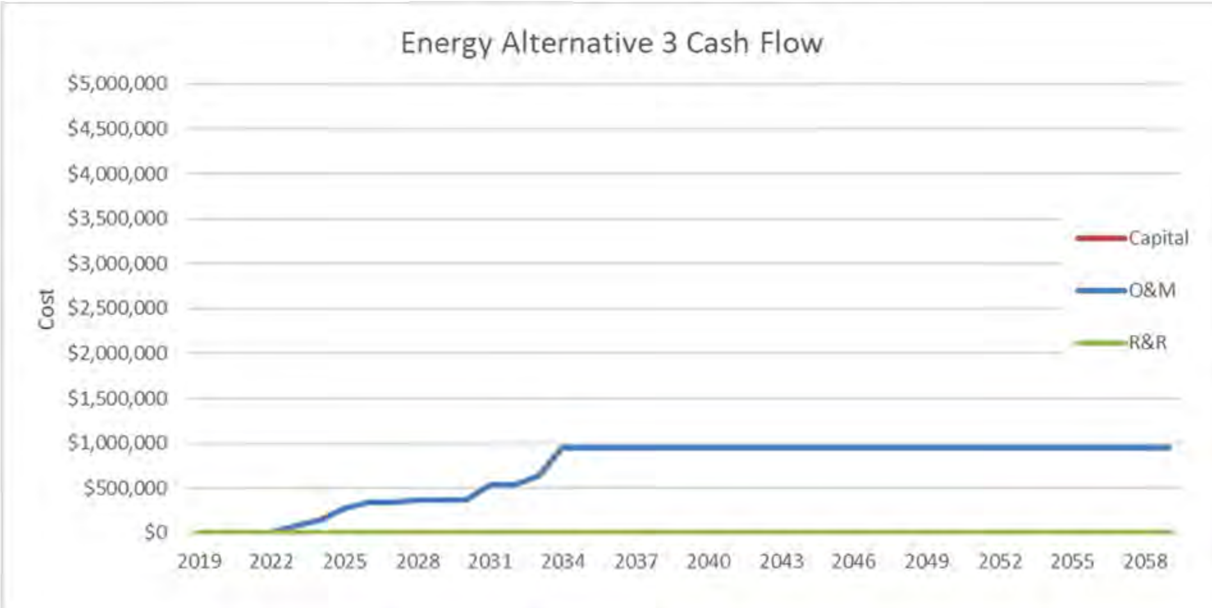


Figure 4-9. Energy Alternative 3 cash flow

4.2.2.4 Sensitivity Analysis

The BCE considers the sensitivity of the results to changes in inputs and assumptions to test the robustness and durability of the preferred alternative. Factors that are inputs to the BCE are adjusted, and subsequent results are evaluated for the level of impact to the decision. A sensitivity analysis helps indicate what inputs are driving factors for the BCE results.

The assumptions provided throughout the BCE were used to develop the estimated capital, O&M, R&R, risks, and benefits based on the projections, rates, etc. available at the time the BCE was developed. However, unknown future changes in the assumptions will affect the NPVs of the alternatives.

4.2.2.4.1 Capital Costs Sensitivity

The capital costs are Class 5 cost opinions and have an expected accuracy range of minus 50 percent to plus 100 percent, which also impact R&R costs. Alternatives 1 and 2 are the only alternatives impacted by this variable, and they have the largest impact. Table 4-10 provides capital costs that are 100 percent higher than the cost opinion and the resulting impact to the NPV. Table 4-11 provides capital costs 50 percent lower than the cost opinion and the resulting impact to the NPV.T

Table 4-10. High capital cost sensitivity [a]

Description	Capital [b]	Cash NPV	PTAC
Alternative 1: solar only	$30,768,236	($94,032,000)	($94,032,000)
Alternative 2: solar and cogeneration	$47,230,264	($182,616,000)	($182,616,000)
Alternative 3: purchased clean energy	$0	($76,823,000)	($76,823,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

[b] *Capital costs do not include general demolition of existing facilities.*

Table 4-11. Low capital cost sensitivity [a]			
Description	Capital [b]	Cash NPV	PTAC
Alternative 1: solar only	$7,692,059	($23,983,000)	($23,983,000)
Alternative 2: solar and cogeneration	$11,807,566	($63,560,000)	($63,560,000)
Alternative 3: purchased clean energy	$0	($76,822,000)	($76,822,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

[b] *Capital costs do not include general demolition of existing facilities.*

4.2.2.4.2 IPC Portfolio Sensitivity

IPC's electricity portfolio goal is to comprise between 70 to 85 percent renewables by 2030. The remaining 15 to 30 percent of the increased energy demand will need to be supplied by the city. To account for this gap, the sensitivity of the alternatives to IPC's portfolio makeup is displayed in Table 4-12 and Table 4-13.

Table 4-12. Eighty-five percent IPC renewables cost sensitivity [a]					
Description	Capital	O&M	R&R	Cash NPV	PTAC
Alternative 1: solar only	$9,559,000	$470,000	$16,000,000	($39,900,000)	($39,900,000)
Alternative 2: solar and cogen	$16,680,000	$14,070,000	$31,119,000	($97,150,000)	($97,150,000)
Alternative 3: purchased clean energy	$0	$28,638,000	$0	($48,892,000)	($48,892,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

Table 4-13. Seventy percent IPC renewables capital cost sensitivity [a]					
Description	Capital	O&M	R&R	Cash NPV	PTAC
Alternative 1: solar only	$15,385,000	$470,000	$16,000,000	($47,332,000)	($47,332,000)
Alternative 2: solar and cogen	$23,616,000	$14,037,000	$29,528,000	($103,246,000)	($103,246,000)
Alternative 3: purchased clean energy	$0	$44,465,000	$0	($76,822,000)	($76,822,000)

[a] *Amounts reflect present value 2020 dollars and rounded to the nearest $1,000.*

4.2.2.4.3 Best-Case Assumptions

Due to the large range in capital costs at a Class 5 cost opinion level, and the unknown future renewables portion of the IPC portfolio, BC applied best-case assumptions to the BCE to capture the high-end range of the NPV. The assumptions are summarized in Table 4-14. The resulting NPV under the best-case assumptions are summarized in Table 4-15.

Table 4-14. Best-case assumptions	
Parameter	Value
Capital costs	Low, -50% of cost opinion
IPC portfolio	85% of portfolio renewables
Purchased clean energy	Electricity Cost +5%

Table 4-15. Best-case assumptions PTAC summary [a]					
Alternative	Capital [b]	O&M	R&R	Cash NPV	PTAC
Alternative 1: solar only	$9,759,000	$632,000	$13,591,000	($23,983,000)	($23,983,000)
Alternative 2: solar and cogen	$15,024,000	$23,875,000	$24,661,000	($63,560,000)	($63,560,000)
Alternative 3: purchased clean energy	$0	$44,423,000	$0	($44,423,000)	($44,423,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

[b] *Capital costs do not include general demolition of existing facilities.*

4.2.2.4.4 Worst-Case Assumptions

Similarly, worst-case assumptions were applied to the BCE to capture the low-end range of the NPV. The assumptions are summarized in Table 4-16. The resulting NPV under the worst-case assumptions are summarized in Table 4-17 . All alternatives have a negative NPV when worst-case assumptions are applied to the BCE.

Table 4-16. Worst-case assumptions	
Parameter	Value
Capital costs	High, +100% of cost opinion
IPC portfolio	70% of portfolio is renewables
Purchased clean energy	Electricity Cost + 25%

Table 4-17. Worst-case assumptions PTAC summary [a]					
Alternative	Capital [b]	O&M	R&R	Cash NPV	PTAC
Alternative 1: solar only	$39,036,000	$470,000	$54,363,000	($94,032,000)	($94,032,000)
Alternative 2: solar and cogen	$60,096,000	$16,322,000	$98,645,000	($182,616,000)	($182,616,000)
Alternative 3: purchased clean energy	$0	$44,466,000	$0	($76,822,000)	($76,822,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

[b] *Capital costs do not include general demolition of existing facilities.*

4.2.2.5 Recommended Approach

The BCE identified Alternative 1, a solar-only option as the recommended approach for achieving the city's clean energy goals based on the PTAC. This is due to the 2060 planning horizon, for which the capital, O&M, and R&R costs for city-owned solar energy installations perform much better than purchased clean energy or a combination of solar energy and cogeneration. This alternative consistently demonstrated the lowest PTAC over a range of sensitivity analyses and scenarios. These results are based on the current understanding of costs.

The clean energy market is dynamic. Costs for solar systems continue to decrease and the market for purchased clean energy continues to evolve. Furthermore, the city continues to develop the broader implementation strategy for Boise's Energy Future. Given all of these factors, the recommended path forward is to align WRS's investments with broader city investments through the implementation of Boise's Energy Future. The alternatives analysis demonstrated that WRS should expect to invest at least $47M over the next 40 years to meet the goals of Boise's Energy Future. Close collaboration with the city's overall strategy will be needed to maximize this investment. Considerations for future investment include establishing a facility-by-facility approach to renewable energy decision-making, conducting a more in-depth evaluation of city ownership of a large offsite solar array, and determining availability of large-scale purchase of clean energy.

4.2.3 Energy Alternatives Assessment: Thermal Energy

The results of the energy alternatives assessment for electricity show that using digester gas in a cogeneration system as a component in electricity generation represents a high cost of asset ownership compared to the clean energy alternatives. However, digester gas is a valuable resource recovered through water renewal processes. The assessment in this section focuses on alternatives for the beneficial use of digester gas generated at WRFs without an emphasis on electricity generation.

As an alternative to cogeneration, digester gas can be cleaned and compressed for use as CNG for vehicle fuel or cleaned and used or sold as RNG, usually via pipeline injection. Energy production potential from digester gas is a function of the level of treatment it must undergo for its intended end use. For example, fueling a combustion engine requires a higher level of treatment than fueling a boiler, and even higher levels of treatment are required for developing marketable CNG or RNG. The following sections evaluate alternatives for digester gas treatment and its level of use.

Thermal energy used at the city's two existing WRFs in 2019 was 33,025 million British thermal units (MMBtus), with 70 percent originating from recovered digester gas considered a clean and renewable resource. Digester gas used for heating the digesters accounted for only 44 percent of what was produced, with the other 56 percent burned off in waste flares. Reevaluating uses of digester gas provides an opportunity for the city to offset its increased energy needs in accordance with goals identified in Boise's Energy Future plan.

Table 4-18. Digester gas thermal energy production, 2019

	Lander Street WRF	West Boise WRF	Total
Digester gas used (MMBtu)	9,435	13,616	23,051
Digester gas flared (MMBtu)	11,595	17,957	29,552
Total digester gas produced (MMBtu)	21,030	31,573	52,603
Percent digester gas excess	**55%**	**57%**	**56%**

4.2.3.1 Alternatives

As described in the Utility Plan's energy alternatives analysis for electricity, alternatives for the use of digester gas include cogeneration and producing RNG and CNG or continuing to fuel boilers and provide building heating.

Using digester gas to produce natural gas involves treating digester gas to meet standards for use in combustion engines and compressing it for local storage and distribution (CNG). It can also be treated to meet pipeline standards, then sold with Renewable Identification Numbers (RINs) to a pipeline operator (RNG). RINs function as renewable energy credits for upgraded natural gas. They are used for vehicle fuel, are classified by digested source material type, and attach significant value to the product gas.

To use digester gas beneficially for fleet vehicle or pipeline injection, various contaminants in the digester gas must be removed. Untreated digester gas typically contains significant amounts of hydrogen sulfide (H_2S), moisture (H_2O), siloxanes, and carbon dioxide (CO_2). In addition, the digester gas must be pressurized for onsite storage or pipeline injection.

The first treatment step removes H_2S followed by chilling the gas to separate out the digester gas condensate. This is followed by first-stage compression and siloxane removal. The gas is then compressed in a second stage and routed through one of three main categories of CO_2 separation which will remove most impurities (CO_2, H_2O, and residual siloxanes and H_2S).

Generally, untreated digester gas consists of a range of 55 to 65 percent methane and 35 to 45 percent CO_2 by volume and other low levels of impurities. For both technologies, the final product of digester gas must be at least 95 percent methane and less than 3 percent CO_2. Additionally, H_2S levels should not exceed 2.7 parts per million, and the water content shall be less than 7 pounds per 1 million cubic feet. Natural gas pipelines and vehicle fuel systems storage require pressures of up to several hundred pounds per square inch and 3,600 pounds per square inch, respectively. Fuel for fleet vehicle use also requires high-pressure on-site storage. Commercial gas pipeline companies have slightly different fuel quality requirements, and CNG engines have published fuel cleanliness or fuel quality standards.

4.2.3.2 Analysis

Alternative 4: Use all digester gas to develop RNG for sale as a commodity via pipeline injection. Components required are outlined in Table 4-19.

Table 4-19. Alternative 4 components required

Components	Component Assumptions
Lander Street WRF RNG	100 scfm input system
West Boise WRF RNG	200 scfm input system
Purchased clean electricity [a]	8,275 MWh

[a] Purchased clean electricity to offset electricity portion generated by cogeneration system in Alternative 6.

scfm = standard cubic feet per minute.

Alternative 5: Use all digester gas to develop CNG for vehicle fueling. Components required are outlined in Table 4-20.

Table 4-20. Alternative 5 components required

Components	Component Assumptions
Lander Street WRF CNG	100 scfm input system
West Boise WRF CNG	200 scfm input system
Purchased clean electricity [a]	8,275 MWh

[a] Purchased clean electricity to offset electricity portion generated by cogeneration system in Alternative 6.

Alternative 6: Use all digester gas to generate electricity and heat. Components required are outlined in Table 4-21.

Table 4-21. Alternative 6 components required	
Components	**Component Assumptions**
Lander Street WRF cogeneration	340 kW average output system
West Boise WRF cogeneration	735 kW average output system

Alternative 7: Use digester gas for fueling boilers, flaring surplus digester gas, and purchasing carbon offset credits for the amount of digester gas flared. Components required are outlined in Table 4-22.

Table 4-22. Alternative 7 components required	
Components	**Component Assumptions**
Purchased clean electricity	8,275 MWh

4.2.3.3 Summary

A summary of the BCE results is provided in Table 4-23. The BCE favors Alternative 4, using digester gas to produce RNG, slightly over Alternative 5, producing CNG from digester gas. Both alternatives have a significantly lower cost of assets when compared to Alternative 6, cogeneration, or Alternative 7, using digester gas to heat boilers and flaring surplus gas, which is the status quo. Alternatives 4 and 5 perform well primarily due to benefit costs associated with RIN values. Alternative 7 includes the lowest overall cash NPV, but risk costs for public perception related to flaring surplus digester gas increase total asset cost significantly over the period analysis. Figures 4-10 through 4-13 show the projected cash flows for the various alternatives.

Table 4-23. Digester gas energy BCE summary [a, b]								
Alt.	**Description**	**Capital**	**O&M**	**R&R**	**Cash NPV**	**Risks**	**Benefits**	**PTAC**
4	Digester gas to RNG: median RIN values [c]	$14,859,000	$28,791,000	$15,886,000	($97,200,000)	$0	$35,477,000	($35,944,000)
5	Digester gas to CNG: median RIN values [c]	$12,136,000	$29,072,000	$18,011,000	($97,840,000)	$0	$35,073,000	($37,281,000)
6	Digester gas to cogen	$11,396,000	$15,712,000	$14,440,000	($66,954,000)	$0	$0	($66,954,000)
7	Digester gas to boilers and flare	$0	$18,219,000	$4,231,000	($38,698,000)	$531,000	$0	($39,363,000)

[a] *Cells highlighted in green indicate the lowest cost portfolio for the conditions shown.*

[b] *Total costs are shown in 2020 dollars, represent the period 2020 through 2060, and are rounded to the nearest $1,000.*

[c] *RIN value represents the median price of $1.98/gallon ethanol equivalent (GEE)*

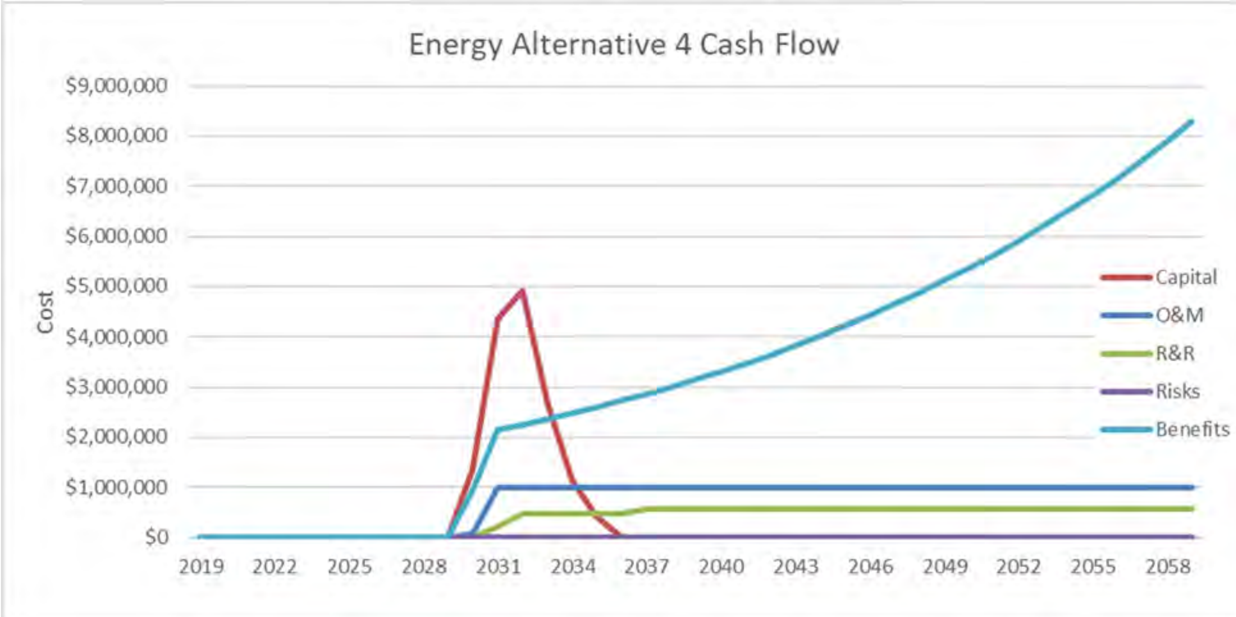


Figure 4-10. Energy Alternative 4 cash flow

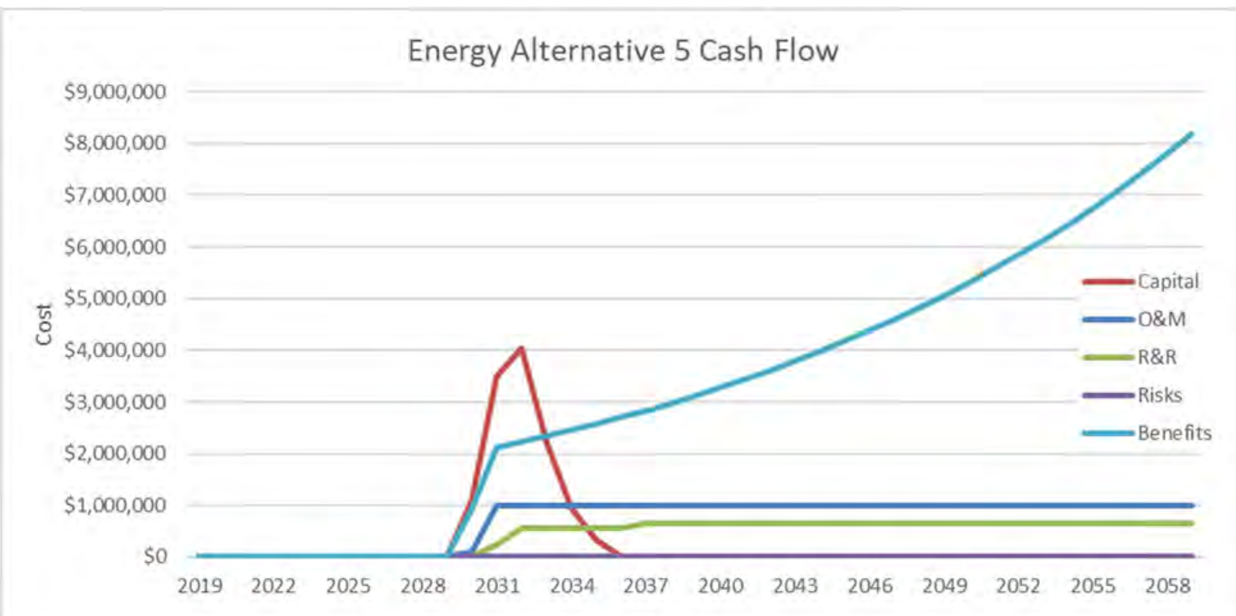


Figure 4-11. Energy Alternative 5 cash flow

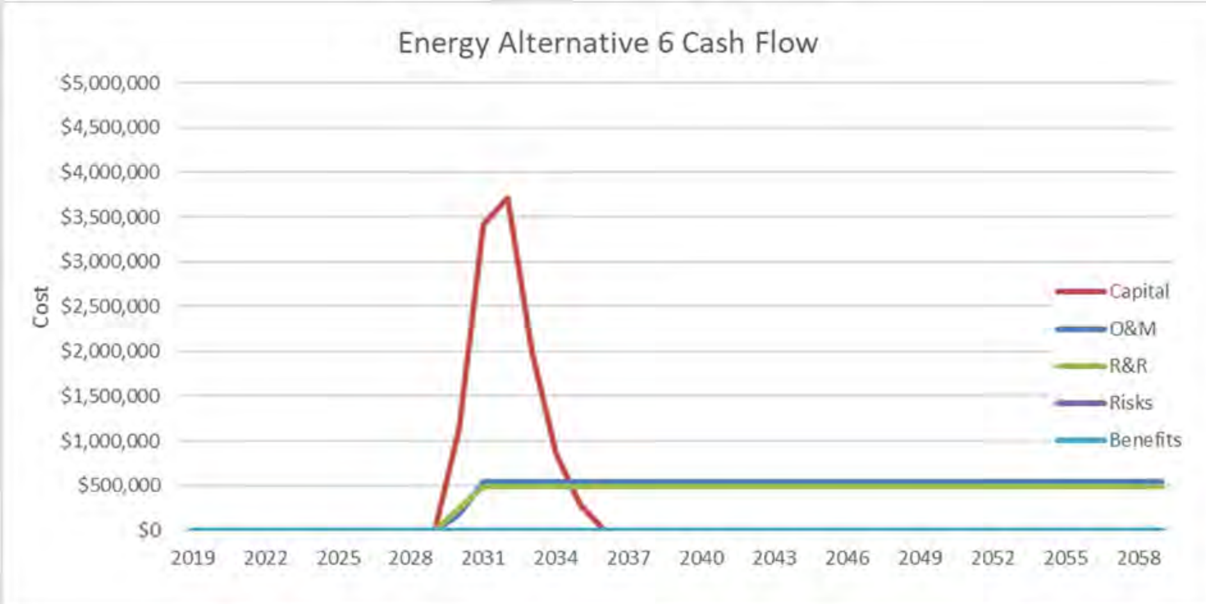


Figure 4-12. Energy Alternative 6 cash flow

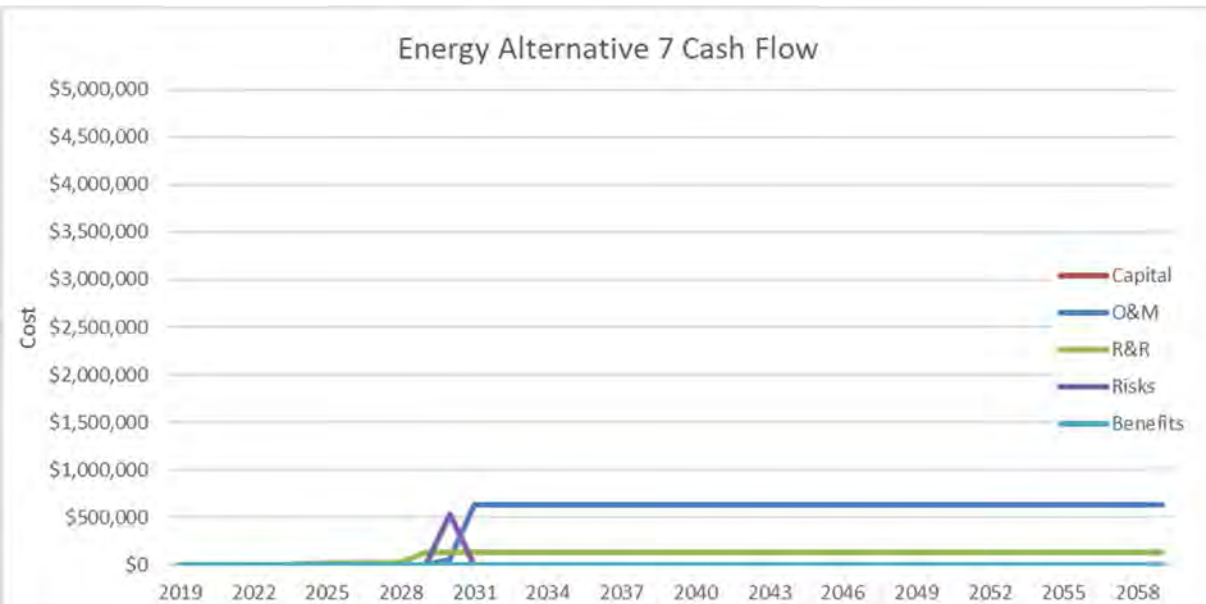


Figure 4-13. Energy Alternative 7 cash flow

The BCE favors Alternative 4, using digester gas to produce RNG, slightly over Alternatives 5 and 7. These three alternatives show a significantly lower cost of assets when compared to Alternative 6, cogeneration. Alternatives 4 and 5 perform well primarily due to benefit costs associated with RIN values. Alternative 7 includes the lowest overall cash NPV, and it carries the lowest PTAC in the scenario in which RIN values are below the current five-year median price, as described in the sensitivity analysis below.

4.2.3.4 Sensitivity Analysis

The BCE considers the sensitivity of the results to changes in inputs and assumptions to test the robustness and durability of the preferred alternative. Factors that are inputs to the BCE are adjusted, and subsequent results are evaluated for the level of impact to the decision. Sensitivity analysis helps indicate what inputs are driving factors to the BCE results.

The assumptions provided throughout the Utility Plan used to develop the estimated capital, O&M, R&R, risks, and benefits were based on the projections, rates, etc. available at the time the BCE was developed. However, unknown future changes in the assumptions will affect the cash NPVs and PTACs of the alternatives.

4.2.3.4.1.1 RIN Price Sensitivity

The RIN price fluctuates weekly and has the largest impact on the PTAC for Alternatives 4 and 5, with no impact to Alternatives 6 and 7. The RIN price has been dropping since the beginning of 2018. For the BCE, the median of RIN prices from June 2020 pricing to the peak of sale prices from 2015 to current data, $1.98 per gallon ethanol equivalent, were assumed. The future RIN price is unknown but is anticipated to increase as demand for renewable thermal energy increases. The impacts of a lower or higher RIN price on the NPV and payback period for Alternatives 4 through 7, with all other assumptions held constant, are summarized in Table 4-24. An upsurge in RIN prices increases the revenue from the sale of RINs, which results in a higher PTAC, and lowers the payback period, the length of time for the capital outlay costs to be recovered. Alternatively, a decline in RIN prices decreases the revenue from the sale of RINs, which results in a lower PTAC and an increased payback period.

Table 4-24. RIN price sensitivity

RIN Price, $/GEE	Notes	Alternative 4: RNG	Alternative 5: CNG	Alternative 6: Cogen	Alternative 7: Boilers/Flare
		PTAC [a]	PTAC [a]	PTAC [a]	PTAC [a]
$1.20	June 2020, current price	($57,648,000)	($58,985,000)	($66,954,000)	($39,363,000)
$1.98	Median price between June 2020 and peak price	($35,944,000)	($37,281,000)	($66,954,000)	($39,363,000)
$2.75	Peak price in past 5 years	($14,239,000)	($15,576,000)	($66,954,000)	($39,363,000)

[a] *PTAC in 2020 dollars and rounded to the nearest $1,000.*

4.2.3.4.1.2 Natural Gas Price Sensitivity

The prices of RNG and CNG are tied to the natural gas price due to the current regulatory environment. Natural gas prices are currently lower than in previous years, but a historical average price, $0.275 per therm, was assumed in the BCE. However, there is uncertainty around future natural gas prices, although fluctuations in price are significantly less than those of RIN values. The impacts of lower or higher natural gas prices on the PTAC and payback period for Alternative 4, with all other assumptions held constant, are summarized in Table 4-25.

The natural gas price has the smallest impact on PTAC of all other sensitive variables.

Table 4-25. Natural gas price sensitivity					
Natural Gas Price $/therm	Notes	Alternative 4: RNG	Alternative 5: CNG	Alternative 6: Cogen	Alternative 7: Boilers/Flare
		PTAC [a]	PTAC [a]	PTAC [a]	PTAC [a]
$0.248	10% price decrease	($36,641,000)	($37,908,000)	($66,954,000)	($39,363,000)
$0.275	Current average price	($35,944,000)	($37,281,000)	($66,954,000)	($39,363,000)
$0.303	10% price increase	($35,233,000)	($36,641,000)	($66,954,000)	($39,363,000)

[a] *PTAC in 2020 dollars and rounded to the nearest $1,000.*

4.2.3.4.1.3 Capital Costs Sensitivity

The capital costs are Class 5 cost opinions and have an expected accuracy range of minus 50 percent to plus 100 percent, which also impact R&R costs, and affect all alternatives. Table 4-26 provides capital costs 100 percent higher than the cost opinion and the resulting impact to the NPV. Table 4-27 provides capital costs 50 percent lower than the cost opinion and the resulting impact to the NPV.

Table 4-26. High capital cost sensitivity [a]		
Description	Capital [b]	PTAC
Alternative 4: RNG	$29,717,000	($83,258,000)
Alternative 5: CNG	$24,270,000	($84,748,000)
Alternative 6: cogen	$22,790,000	($106,748,000
Alternative 7: boilers/flare	$0	($46,499,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

[b] *Capital costs do not include general demolition of existing facilities.*

Table 4-27. Low capital cost sensitivity [a]		
Description	Capital [b]	PTAC
Alternative 4: RNG	$7,429,000	($12,286,000)
Alternative 5: CNG	$6,068,000	($13,547,000)
Alternative 6: cogen	$5,698,200	($47,057,000)
Alternative 7: boilers/flare	$0	($35,795,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

[b] *Capital costs do not include general demolition of existing facilities.*

4.2.3.4.1.4 Best-Case Assumptions

Due to the large range in capital costs at a Class 5 cost opinion level, and the unknown future prices of natural gas and RINs, BC applied best-case assumptions to the BCE to capture the high-end range of the NPV and PTAC. The assumptions are summarized in Table 4-28. The resulting NPV and PTAC under the best-case assumptions are summarized in Table 4-29.

Table 4-28. Best-case assumptions	
Parameter	**Value**
Capital costs	Low, -50% of cost opinion
RIN price	$2.75, maximum RIN sale price in 5 years
RNG price	$0.303, 10% increase from baseline assumption
Purchased Renewables	Electricity Cost + 5%

Table 4-29. Best-case assumptions PTAC summary [a]

Alt.	Capital [b]	O&M	R&R	Cash NPV	Risks	Benefits	PTAC
4	$7,429,000	$26,332,000	$7,943,000	($69,281,000)	$0	$48,460,000	$14,392,000
5	$6,068,000	$26,614,000	$9,005,000	($69,844,000)	$0	$48,015,000	$13,060,000
6	$5,698,200	$15,712,000	$7,220,000	($47,057,000)	$0	$0	($47,057,000)
7	$0$0	$15,760,000	$2,115,000	($30,867,000)	$531,000	$0	($31,533,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

[b] *Capital costs do not include general demolition of existing facilities.*

4.2.3.4.1.5 Worst-Case Assumptions

Similarly, worst-case assumptions were applied to the BCE to capture the low-end range of the NPV and PTAC. The assumptions are summarized in Table 4-30. The resulting NPV and PTAC under the worst-case assumptions are summarized in Table 4-31. All alternatives have a negative PTAC when worst-case assumptions are applied to the BCE.

Table 4-30. Worst-case assumptions	
Parameter	**Value**
Capital costs	High, +100% of cost opinion
RIN price	$1.20, current RIN sale price as of June 2020
RNG price	$0.206, 25% decrease from baseline assumption
Purchased Renewables	Electricity Cost + 25%

Table 4-31. Worst-case assumptions PTAC summary [a]							
Alt.	Capital [b]	O&M	R&R	Cash NPV	Risks	Benefits	PTAC
4	$29,717,000	$28,790,000	$31,770,000	($144,515,000)	$0	$22,502,000	($105,661,000)
5	$24,270,000	$29,072,000	$36,020,000	($145,307,000)	$0	$22,138,000	($107,081,000)
6	$22,790,000	$15,712,000	$28,879,000	($106,748,000)	$0	$0	($106,748,000)
7	$0	$18,218,000	$8,461,000	($45,833,000)	$531,000	$0	($46,499,000)

[a] *Amounts reflect present value 2020 dollars and are rounded to the nearest $1,000.*

[b] *Capital costs do not include general demolition of existing facilities.*

4.2.3.5 Recommended Approach

The BCE shows that using digester gas to produce RNG or CNG, Alternatives 4 and 5, respectively, represent the lowest PTAC, with RNG production slightly better than CNG production. However, Alternative 7 performs better than either RNG or CNG production when RIN prices are low.

The recommended approach based on this analysis is to plan capital investment decisions around the preferred alternative. Ultimately, the selected alternative should align with the city's strategy for implementing Boise's Energy Future and further evaluation of improvements that would increase capacity for beneficial reuse of digester gas at the WRFs.

Because BCE results for RNG and CNG are so similar, additional considerations and evaluation are needed prior to selecting which digester gas alternative to pursue. Further analysis and identification of additional risk and benefit costs related to the end uses of RNG and CNG may be necessary to support decision-making efforts. More information on each product is included in Section 4.2.4, which provides the basis for further consideration.

The ultimate decision for RNG or CNG production is also closely tied to the implementation of the thermal energy component of Boise's Energy Future plan, which is currently in development. Boise's Energy Future is currently being expanded to include a quantifiable goal for community-wide natural gas efficiency and geothermal expansion. As with clean energy targets for electricity, the city will lead implementation of thermal energy goals in Boise's Energy Future by working to integrate the plan into city energy usage and supply decisions.

4.2.4 Energy Products

Energy products recommended for future consideration are electricity from solar arrays and RNG and CNG for onsite and offsite use.

4.2.4.1 Solar

Solar power systems consist of individual PV panels arranged in an array that may consist of up to hundreds or thousands of panels. The solar array is scalable to the energy need and land area available at any given facility. Electrical current generated by a PV system is in the form of direct-current (DC) electricity. The DC output from a solar array must be routed through an inverter and changed to alternating-current (AC) electricity before it is sent on to the facility's electrical panel.

Figure 4-2 provides a conceptual diagram of the process these technologies use to generate electricity. No changes to existing treatment processes or other facility infrastructure are required to begin to use these technologies aside from installing the equipment and connecting it to the necessary electrical equipment (inverters, meters, and electrical panels).

Capacity factors used to calculate energy production were modeled using the National Renewable Energy Laboratory's System Advisor Model software and a capacity factor of 22.7 percent as provided by the city's Renewable Energy Analysis 2035.

4.2.4.1.1 Level of Service Connections

The solar energy generation alternative impacts the level of service goals as described in Table 4-32.

Table 4-32. Energy products connection to level of service goals

Level of Service Goal	Relationship to Energy Products
Recover, recycle, and renew water, energy, and other products from the materials we receive	Capturing clean, renewable energy from the sun, using solar panels that will be installed at WRS facilities, and/or at a larger offsite facility, makes use of a free energy source using proven technology.
Operate cost-effectively and maintain a resilient utility	Solar equipment and installation costs are on a downward trend as technologies and production processes improve, and solar energy is a consistent and reliable source given Boise's climate and latitude.
Support a robust, vibrant economy consistent with the city's vision	Solar energy generation aligns with objectives stated in Boise's Energy Future plan, including delivering "reliable and affordable energy that benefits our local economy."
Protect the health and safety of our community and staff	Solar energy generation is a clean and renewable alternative to energy sources that contribute to air pollution and produce greenhouse gas emissions.

4.2.4.1.2 Projects

Projects for consideration are the placement of panels at WRS's facilities or at alternative locations owned by the city at some larger scale. Three approach are considered for placement: an opportunistic and conservative approach of PV array installation at WRS facilities, an aggressive approach of installation at WRS facilities, or a utility-scale PV array installed at a single location.

Solar panels can be mounted and sited in a few different ways. Panels can be held in a fixed position, or they can be built with single- or dual-axis tracking mechanisms that move to track the motion of the sun throughout the day. Single-axis tracking systems generally track the movement of the sun each day by rotating along a North-South axis. Dual-axis tracking systems move to exactly align orthogonally to the sun throughout each day of the year. In addition to different mounting types, PV systems can be mounted on different siting locations. The three most common types of PV sites include ground mount, rooftop, and carport.

An opportunistic approach to PV array installation involves siting and mounting the solar array where extra space is available, minimal retrofit is required, and the PV system offsets a small amount of facility energy needs. An aggressive approach to solar array installation would include installing panels in a variety of ways to maximize solar energy generation at a given facility, without disrupting any other facility functions or treatment processes. Given the land area available and the energy required at each facility, even the aggressive approach is not likely to offset any single facility's entire energy needs. Net metering and/or battery storage would be sufficient for managing electricity generated at this scale.

The third project type is a large solar installation at which a large PV array would be used to generate significantly more energy than could be generated at any single WRS facility. A facility of this scale would require more substantial power transmission to distribute the electricity generated, which would most likely involve a connection to IPC's power grid. A large facility could also require construction of transmission infrastructure if the facility is not located close enough to an existing transmission line with sufficient capacity for the added load.

4.2.4.1.3 People

O&M considerations for solar PV systems are generally quite minimal as compared to most operating equipment at the WRFs. Typically, the only regular preventative maintenance for fixed tilt PV systems is periodic cleaning (washing) of the panels to remove dirt and other solar-blocking debris. This maintenance can occur as infrequently as twice a year, though for dustier environments, a monthly cleaning may be more appropriate. An additional consideration is keeping foliage and landscaping from growing too tall and shading the panels. For single-axis tracking systems, some additional preventative maintenance is required. These systems use gear-motors and actuators to move the panels, and these moving components typically require greasing on a monthly basis.

The city has vast experience operating, maintaining, and managing WRFs with complex mechanical, electrical, and biological processes. The people who make this happen have the skill sets required to perform the required O&M functions associated with solar arrays. Mechanics have knowledge and experience performing preventative and corrective maintenance on WRF assets that maintain them in operable condition. Purchasing and warehouse staff are required to coordinate the procurement and orderly storage of replacement parts.

Although some of these skill sets could be provided by contract workers, having these staff in house provides for greater coordination and ensures that the required skill sets will be available to complete the critical mission of water renewal.

4.2.4.1.4 Pricing

Pricing considerations for the implementation of solar arrays are based on the capital cost per acre of installed PV arrays (see Table 4-33).

Table 4-33. Projects and pricing considerations solar arrays

Project	Location	Anticipated Year Online	Capital Cost [a]
Solar: opportunistic (196 MWh, 1 acres)	Lander Street WRF	2024	$143,000
Solar: opportunistic (980 MWh, 5 acres)	West Boise WRF	2025	$714,000
Solar: opportunistic (98 MWh, 0.5 acres)	Third WRF	2032	$71,000
Solar: opportunistic (98 MWh, 0.5 acres)	Fourth WRF	2034	$71,000
Solar: offsite (23,135 MWh)	Large offsite facility	2029	$14,384,000

[a] *Capital costs represent level 5 estimates (plus 100%, minus 50%).*

4.2.4.2 Renewable Natural Gas

RNG production is an alternative available to beneficially reuse digester gas produced at the WRFs. RNG involves treating digester gas to remove contaminants and pressurizing the resulting gas for injection into an existing utility pipeline. The result would be the sale of the RNG to the utility, as well as the accompanying RINs that function as an added value/credit to gas from renewable sources.

4.2.4.2.1 Level of Service Connections

The RNG alternative impacts the level of service goals as described in Table 4-34.

Table 4-34. Energy products connection to level of service goals	
Level of Service Goal	**Relationship to Energy Products**
Recover, recycle, and renew water, energy, and other products from the materials we receive	Capturing RNG from treatment byproducts in a way that reduces necessary flaring to reduce greenhouse gas emissions from the WRF.
Operate cost-effectively and maintain a resilient utility	RNG provides a source of revenue from treatment byproducts to offset capital and operation costs for WRFs.
Support a robust, vibrant economy consistent with the city's vision	RNG aligns with objectives stated in Boise's Energy Future plan, including delivering "reliable and affordable energy that benefits our local economy."
Protect the health and safety of our community and staff	RNG is a renewable alternative to energy sources that originate from non-renewable sources.

4.2.4.2.2 Projects

There are multiple technologies available that can be used to remove the CO_2 from digester gas to treat it to pipeline quality or for use as vehicle fuel. At the sizes expected for this analysis, the two main types are membrane systems and pressure swing absorption (PSA) systems. Both types are described below.

A PSA type of biogas upgrade system consists of the following unit operations: feed gas compression, PSA, vacuum pumping, tail gas combustion in a thermal oxidizer, and buffer vessels. Removing CO_2 from the digester gas using membrane technology requires a compressor to force the digester gas through a membrane, and a thermal oxidizer or waste gas burner is required to combust the CO_2 that passes through the membrane. Membranes are a thin semi-permeable barrier that use pressure as the driving force to selectively pass CO_2 more quickly than methane through the membrane, while most of the methane continues through. The unit uses a high pressure on the process side with a low pressure on the waste side. H_2S and siloxanes must be removed upstream of the membrane process. Dual-pass systems are available and allow for better methane capture compared to single-pass membrane systems. A dual-pass process will improve methane recovery significantly, compared to a single-pass system. Methane recovery is expected to be about 95 percent with dual pass systems.

Noise attenuation may need to be included to minimize noise level at the facility's property line. The noise level from the compressor and vacuum pump may be about 80 A-weighted decibels (dBA) at 10 feet. The depressurization noise from the buffer vessels in a PSA system is 90 dBA at 10 feet. Any preliminary design should consider including 12-foot high sound attenuation barrier walls around the entire system.

PSA has a methane capture rate ranging from 80 to 90 percent. The West Boise WRF produces digester gas at an average flow rate of 152 standard cubic feet per minute (scfm) (2015 data). Assuming a lower heating value of the digester gas of 550 BTU per cubic foot, annual average available fuel energy would be approximately 5,025 one thousand British Thermal Units (MBtu) per hour. For comparison, diesel fuel contains about 138,000 BTU per gallon. Compressed biomethane would be produced at a rate of approximately 30 diesel-equivalent gallons (DGE) per hour at the calculated digester gas production rates assuming an 83-percent methane capture rate. The Lander Street WRF has a lower gas flow rate of 83 scfm which would yield approximately 16 DGE per hour. Note that in both cases, the DGE would increase if the digester gas flow rate were actually higher than reported here.

As noted previously, a dual stage membrane system has a methane capture rate of about 95 percent, which would allow for even greater DGE compared to a lower efficiency upgrade system.

The addition of fats, oils, and grease (FOG) via a FOG receiving station could increase digester gas production, and thus the number of DGE and vehicles fueled by at least 50 percent, and in some cases even further. The addition of FOG and other high-strength wastes to the digesters should be considered in greater detail in alternate technical memorandums.

4.2.4.2.3 People

Due to the amount of equipment, controls, and coordination with the utility or balancing product gas delivery with production, RNG facilities are generally more complex than a comparably sized cogeneration facility. The equipment includes compressors, pumps, blowers, media beds and tanks, automated valves, storage tanks, thermal oxidizer, and other items. Most vendors offer an O&M service with remote monitoring and scheduled maintenance and training.

4.2.4.2.4 Pricing

Pricing is based on the size of the system necessary to treat a quantity of gas slightly above the average digester gas produced from the digesters in order to treat during periods of higher than average digester gas production. Projects and their estimated capital costs are listed in Table 4-35.

Table 4-35. Projects and pricing considerations RNG

Project	Location	Anticipated Year Online	Capital Cost
100 scfm input RNG system	Lander Street WRF	2031	$6,827,000
200 scfm input RNG system	West Boise WRF	2032	$8,032,000

[a] Capital costs represent level 5 estimates (plus 100%, minus 50%).

4.2.4.3 Compressed Natural Gas

CNG production is an alternative available to use digester gas produced at the WRFs with digesters and uses most of the components of the RNG system previously discussed. The difference is only the final compression and storage of the product gas, as well as sale pricing.

4.2.4.3.1 Level of Service Connections

The CNG alternative has the same impacts on the level of service goals as RNG (see Section 4.2.4.2.1.

4.2.4.3.2 Projects

CNG includes the same operation considerations and equipment operations required as part of an RNG upgrade system, except that product gas is compressed and stored onsite instead of being injected into a pipeline. Additional equipment and operation considerations for CNG projects are detailed below.

CNG for vehicle fuel requires very high pressures for storage in onsite storage tanks or for hauling with tube trailers and requires compression in addition to the compression added by the treatment systems previously described. The final compression and CNG fueling system compress the upgraded biogas product gas to about 3,600 pounds per square inch gage for tube-trailers or onsite high-pressure storage. The blowers are mounted in the system downstream of the treatment equipment and can be supplied with variable flow operation. The final compression and CNG fueling system consist of three main parts:

- **Final compressor:** The final compressor will compress the product gas while simultaneously fueling from the storage system when storage is full. The compressor should be furnished with a sound attenuating enclosure.

- **High-pressure storage:** High-pressure onsite storage will provide a few hours of storage time and typically consists of six to eight high-pressure storage tubes.
- **CNG fuel dispensing:** The final product gas must be transported via a tube trailer to the nearby CNG fuel dispensing station if there is no onsite fueling station.

The final compression and CNG fueling system is provided with a priority panel that will direct compressed product gas to the CNG dispenser if a tube trailer is connected and filled, or to onsite high-pressure storage if no tube trailer is connected.

4.2.4.3.3 People

Due to the amount of equipment, controls, and coordination with the utility, or balancing product gas delivery with production, RNG facilities are generally more complex than a comparably sized cogeneration facility. The equipment includes compressors, pumps, blowers, media beds and tanks, automated valves, storage tanks, thermal oxidizer, and other items. Most vendors offer an O&M service with remote monitoring and scheduled maintenance and training.

4.2.4.3.4 Pricing

Pricing is based on the size of the system necessary to treat and compress a quantity of gas slightly above the average digester gas produced from the digesters. Projects and their associated estimated capital costs are listed in Table 4-36.

Table 4-36. Projects and pricing considerations CNG

Project	Location	Anticipated Year Online	Capital Cost
100 scfm input CNG system	Lander Street WRF	2031	$5,373,000
200 scfm input CNG system	West Boise WRF	2032	$6,762,000

[a] *Capital costs represent level 5 estimates (plus 100%, minus 50%).*

4.3 Energy Vision

WRS has an important role in the implementation of Boise's Energy Future. The WRS utility is the largest energy user operated by the city, but it may also be the user with the most potential clean and renewable energy production. By capitalizing on resources recovered during treatment processes (e.g., digester gas) and investing in solar energy generation and/or clean energy purchase, WRS can become a net zero energy utility, leading the way in meeting Boise's Energy Future's electricity and thermal energy goals.

Boise's Energy Future will contribute to decision-making and guide implementation of an integrated clean and renewable energy generation strategy across all WRS facilities. Through collaboration with community energy suppliers such as Intermountain Gas Company and IPC, WRS seeks to develop innovative solutions to achieve thermal and electrical energy goals. Continued engagement with the community and investment in sustainable energy solutions will contribute to a resilient utility that is economically viable and environmentally responsible, reducing greenhouse gas emissions and protecting the health of the community and conserving natural resources.

Section 5

Other Products

The city produces two additional residual products from the WRF processes in addition to the renewed water: treated biosolids and harvested struvite. This section describes the expectations moving forward for managing these two additional products.

Anaerobically digested biosolids are produced at both the Lander Street and West Boise WRFs. The anaerobic digestion process results in Class B biosolids that can be beneficially used per the EPA Part 503 biosolids rules. The anaerobically digested biosolids from the Lander Street WRF are currently pumped nearly 30,000 feet to the West Boise WRF, where the treated solids from both plants are combined and dewatered to form a Class B biosolids cake. The biosolids are transported by trucks to the city owned and operated TMSBAS. The city intends to continue the solids management practice of producing Class B biosolids for beneficial reuse at the TMSBAS facility.

The filtrate from the solids dewatering process is treated at the West Boise WRF struvite harvesting process. This struvite product is bagged and sold back to the struvite harvesting equipment manufacturer.

The existing biosolids pipeline for pumping digested biosolids to the West Boise WRF is over 30 years old and is experiencing physical defects, suspected struvite accumulation/obstructions, and unsustainable pressure increases/flow loss. With extensive rehab or replacement likely required, the city wanted to evaluate alternatives to replacing the pipeline.

5.1 Current Solid Products

The current practice of dewatering all digested biosolids from both plants at the West Boise WRF results in a combined Class B biosolids cake product produced at the West Boise WRF, which is then hauled to the TMSBAS to grow crops. WRS meets regulatory requirements when applying biosolids to the TMSBAS.

Struvite is also harvested from the nutrient-rich filtrate from the dewatering process at the West Boise WRF. The struvite product is treated to Class A equivalent standards and loaded into bags for collection. The city has an agreement to sell the struvite back to the struvite harvesting equipment manufacturer, that collects the bagged product from the West Boise WRF.

5.2 Future Solid Products

Future solids products will be the same as the current products. Class B biosolids cake and harvested struvite will be produced from the West Boise WRF. The Lander Street WRF could produce a separate Class B biosolids cake product if a new dewatering facility is constructed there, which is one of the alternatives considered in the assessment below. This arrangement would be handled the same way and trucked to the TMSBAS along with the biosolids from the West Boise WRF.

5.2.1 Biosolids Alternative Assessment

The city will continue to produce Class B biosolids cake for use at the TMSBAS to support its level of service goals. The question being addressed by the biosolids alternative assessment is whether treated biosolids from the Lander Street WRF should continue to be pumped to the West Boise WRF (status quo), or whether the Lander Street WRF should process the treated biosolids onsite and produce a separate Class B biosolids cake product.

Onsite dewatering for the Lander Street WRF would also produce a nutrient-rich recycle stream at the Lander Street WRF that must be treated through a sidestream treatment facility or through the WRF's secondary treatment process. The alternatives assessment considered the financial and operational impact of the recycle stream from the Lander Street WRF's dewatering.

This section describes the biosolids alternative assessment. Refer to the Reference Documents for a complete discussion of the solids dewatering approach BCE.

5.2.1.1 Alternatives

This section summarizes the scope of each alternative considered in the BCE. The major assumptions regarding the scope of the evaluation are listed below:

- Only capacity-related improvements were included. Condition-related costs that are typical across all alternatives are assumed to be captured elsewhere (the pipeline replacement cost is included because it is specific only to some alternatives).
- WRF liquid stream scope items, except for the impact of the recycle stream from dewatering (otherwise assumed to be the same across alternatives and costs covered elsewhere), were included.
- No upgrades/improvements to the Lander Street or West Boise WRFs' digestion systems were included.
- Due to capital improvement planning constraints, new facilities (such as the pipeline and the Lander Street WRF's dewatering) will not be online until 2035 (with a 5-year capital outlay starting in 2030).

5.2.1.1.1 Alternative 1 (Status quo): West Boise WRF Solids Handling Only

Alternative 1 is a continuation of the status quo. In this alternative, operations continue as they are now, with digested biosolids from the Lander Street WRF being sent to the West Boise WRF for dewatering and centrate treatment. The existing biosolids transfer pipeline conveying digested biosolids from the Lander Street WRF to the West Boise WRF is nearing the end of its service life and requires replacement in this alternative.

This alternative includes the following components:

- Biosolids transfer pipeline
- Biosolids transfer pumps
- Biosolids grinders
- Demolition of the existing digested biosolids pump station pumps/piping

Advantages to this alternative include the fact that operations at both WRFs remain the same, and there will be no new WRF processes to construct or to maintain. The main drawback to this alternative is the inherent risk of long-distance biosolids pumping. Figure 5-1 shows a process flow diagram for Alternative 1.

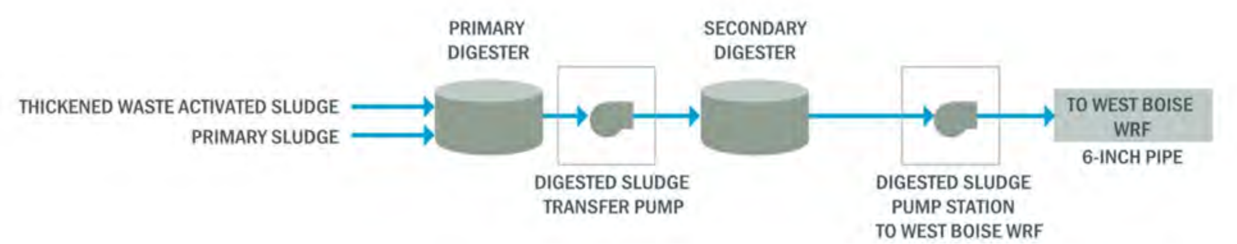


Figure 5-1. Solids alternative 1: Lander Street WRF process flow diagram

5.2.1.1.2 Alternative 2A: Add Dewatering at the Lander Street WRF and Manage Centrate Onsite

Alternative 2A involves installing a biosolids dewatering and truck loading facility, an odor control facility, and a centrate pump station at the Lander Street WRF. The existing digested biosolids pumping station will also be demolished, and the biosolids pipeline will be abandoned.

The main focus of this alternative is to construct facilities that allow the Lander Street WRF to treat its biosolids and centrate onsite. Process modeling using flow and load projections presented in *TM T-35 Flow and Loads* (2020) indicated that by 2035 (when the new Lander Street WRF dewatering facility would be going online), sidestream treatment would not be needed for this alternative. A relatively small amount of acetate is needed in 2035, which gradually decreases to no acetate by 2050.

This alternative includes the following components:

- Biosolids dewatering and truck loading facility at the Lander Street WRF
- Dewatering feed pumps and grinders
- Odor control facility
- Centrate pumps
- Centrate wet well structure
- Demolition of the existing digested biosolids pump station and capping/abandonment of the biosolids transfer pipeline

The main advantage to this alternative is it avoids replacing the pipeline and the inherent risks associated with long-distance biosolids pumping. Other advantages include freeing up the West Boise WRF's dewatering system capacity and not needing to operate the blending tank upstream of dewatering. Another modest benefit of dewatering at the Lander Street WRF is a slight reduction in recycle nutrient loading at the West Boise WRF, which results in some supplemental acetate reduction at the West Boise WRF.

Some other considerations for this alternative include introducing additional truck traffic at the Lander Street WRF for biosolids hauling (which is currently not needed) and reducing struvite harvesting potential at the West Boise WRF by not capturing the Lander Street WRF digested sludge filtrate there. Figure 5-2 shows a process flow diagram for Alternative 2A.

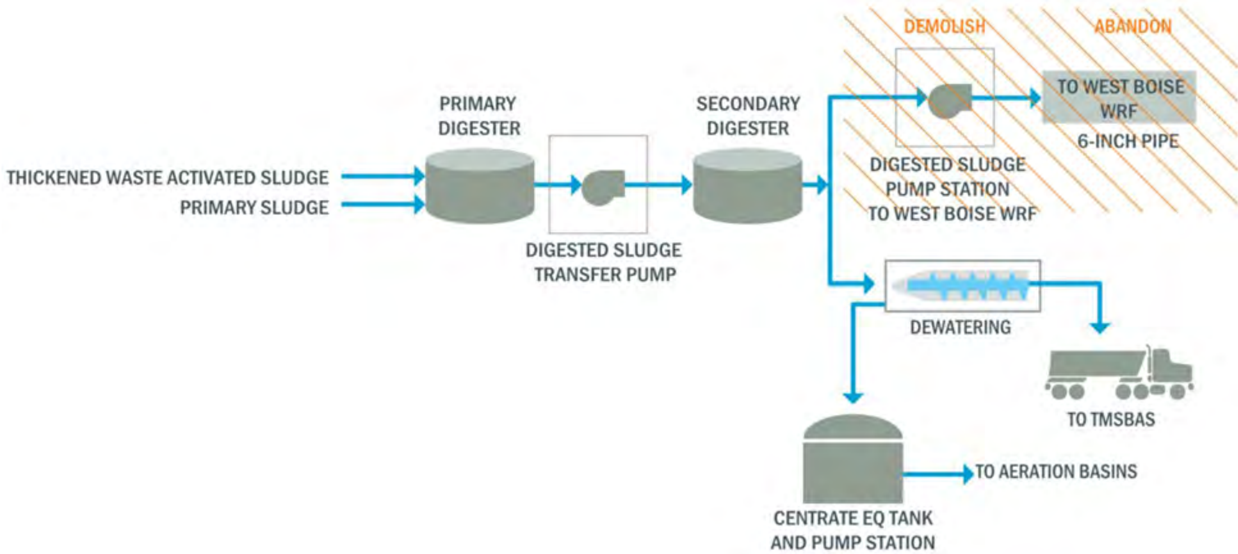


Figure 5-2. Solids alternative 2A: Lander Street WRF process flow diagram

5.2.1.1.3 Alternative 2B: Add Dewatering at the Lander Street WRF and Pump Centrate to the West Boise WRF

Similar to Alternative 2A, Alternative 2B involves installing a biosolids dewatering facility, along with the associated feed pumps and grinders, and an odor control facility at the Lander Street WRF. Differing from Alternative 2A, a new centrate pipeline will be installed to replace the existing biosolids pipeline. A centrate wet well and associated pumps will also be installed to convey centrate from the Lander Street WRF to the West Boise WRF. Additionally, the existing biosolids pumping station will also be demolished. After biosolids is processed at the Lander Street WRF, the associated centrate will be pumped to the West Boise WRF.

This alternative includes the following components:

- Biosolids dewatering and truck loading facility at the Lander Street WRF
- Dewatering feed pumps and grinders
- Odor control facility
- Centrate pumps
- Centrate wet well structure
- Centrate pipeline (replaces biosolids pipeline)
- Demolition of the existing biosolids pump station and biosolids transfer pipeline

This alternative reduces some of the risks associated with long-distance biosolids pumping, but the inherent risk of the pipeline being accidentally hit is not eliminated. By sending the centrate to the West Boise WRF, there is no risk of requiring sidestream treatment at the Lander Street WRF or impacting the Lander Street WRF's liquid stream process. Other advantages include freeing up the West Boise WRF's dewatering system capacity and not needing to operate the blending tank upstream of dewatering. The West Boise WRF will continue to handle all of the centrate treatment and struvite harvesting. Similar to Alternative 2A, multiple new facilities must be constructed, operated, and maintained at the Lander Street WRF. Traffic may be impacted around the Lander Street WRF due to the introduction of biosolids hauling operation. Figure 5-3 shows a process flow diagram for Alternative 2B.

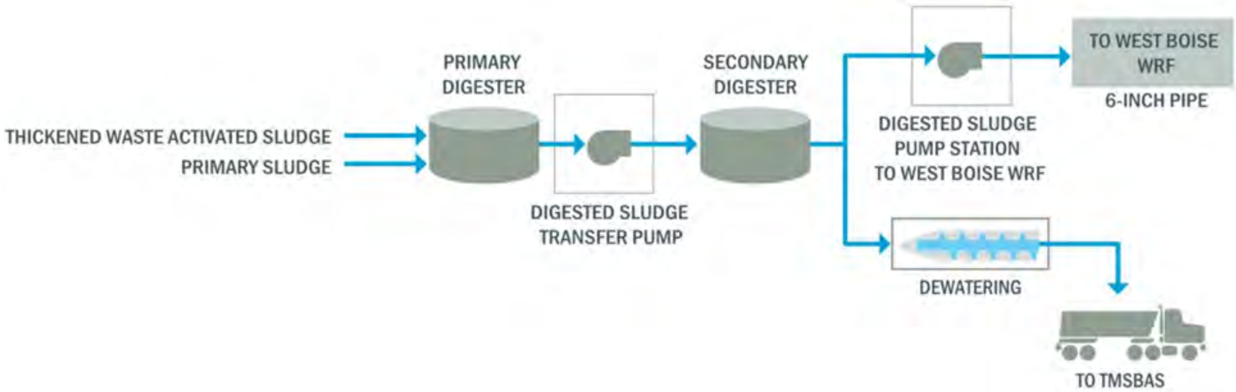


Figure 5-3. Solids alternative 2B: Lander Street WRF process flow diagram

5.2.1.2 Summary and Recommended Approach

Table 5-1. summarizes the results of the BCE for biosolids dewatering approach. The BCE included capital, O&M, and R&R costs. Risk and benefit costs were also quantified and included in the analysis.

Table 5-1. Biosolids dewatering approach alternative summary [a, b]

Alternative and Description	Capital	O&M	R&R	Cash NPV	Risks	Benefits	PTAC
1. Status Quo	$9,069,000	$1,876,000	$1,375,000	($16,279,000)	$1,154,000	$0	($17,803,000)
2A. Add dewatering at the Lander Street WRF, centrate processed at the Lander Street WRF	$13,216,000	$2,242,000	$3,259,000	($24,967,000)	$928,000	$865,000	($24,747,000)
2B. Add dewatering at the Lander Street WRF, centrate pumped to the West Boise WRF	$21,169,000	$1,953,000	$4,314,000	($36,392,000)	$1,115,000	$0	($37,863,000)

[a] *Cells highlighted in green indicate the lowest cost alternative for the conditions shown.*

[b] *Total costs are shown in 2020 dollars, represent the period 2020 through 2050, and are rounded to the nearest $1,000.*

The PTAC is the metric that is used to inform the decision about which alternative represents the city's preferred choice. Alternative 1 (status quo) has the most favorable NPV and PTAC and is the recommended approach moving forward. The next closest is Alternative 2, which is approximately $7 million higher by PTAC. This result is driven by Alternative 1 having the lowest capital, O&M, and R&R costs, which greatly outweigh the lower risk cost and higher benefit of Alternative 2.

5.2.2 Solids Products

This section summarizes the direction for handling solids products for the recommended alternative, the level of service connections, and the associated projects and pricing.

5.2.2.1 Definition and Level of Service Connections

The city will continue to produce Class B biosolids cake for disposal at the TMSBAS to support its level of service goals. Struvite will continue to be harvested at the West Boise WRF. Replacing the biosolids pipeline is necessary to continue the current operating practice. Continued disposal of biosolids at the TMSBAS has the following connections to the level of service goals listed in Table 5-2..

Table 5-2. Solid products connection to LOS goals	
LOS Goal	**Relationship to Solid Products**
Recover, recycle, and renew water, energy, and other products from the materials we receive.	Class B biosolids application recovers the solids product and diverts the product from landfills. Beneficial reuse of the biosolids/nutrients as a fertilizer at the TMSBAS fully supports this level of service goal.
Operate cost-effectively and maintain a resilient utility.	The city has invested in producing a Class B biosolids product that can be beneficially reused and owns and operates the reuse site in the form of the TMSBAS. Continuing to send biosolids to the TMSBAS makes use of existing assets and realizes expected return on the investments. It also provides cost-effective biosolids management, as the forage crops at the TMSBAS are sold to farmers.
Support a robust, vibrant economy consistent with the city's vision.	The city provides cost-competitive forage crops grown at the TMSBAS to local farmers.
Protect the health and safety of our community and staff	The existing biosolids transfer pipeline is beyond its useful life. Replacing the pipeline reduces the risk of pipeline failure and public exposure to treated biosolids.

5.2.2.2 Projects

To be successful in meeting the level of service goals, replacing the biosolids pipeline and the Lander Street WRF digested biosolids pumping station is expected.

5.2.2.3 People

Since pipeline replacement is a continuation of the status quo, no staffing changes are anticipated.

5.2.2.4 Pricing

The biosolids pipeline and pumping station replacement are anticipated to come online in 2035, as shown in Table 5-3. However, the city is in planning stages for the biosolids pipeline replacement because of its failing condition and the critical nature of the asset. The city is looking at a phased approach for the replacement, and, therefore, portions of the pipeline may be replaced ahead of the schedule shown.

Table 5-3. Projects and pricing considerations for biosolids products			
Project	**Location**	**Year Online**	**Cost**
Biosolids pipeline Lander Street WRF digested biosolids pump station replacement	Lander Street WRF/biosolids pipeline alignment	2035	$9.1M

Section 6

Policies

The city will be using a combination of levels of service and policies to guide WRS activities as the Utility Plan is implemented. WRS leaders, managers, and staff will rely predominantly on levels of service to guide daily actions, measure progress toward plan outcomes, and communicate performance to others. Policies, which are intended to serve internal stakeholders, will be used to largely define expectations and communicate key operating guidelines with decision makers. They will also be used to assure consistency with broader city-wide objectives. Most often, levels of service are used to frame needed policies as illustrated in Figure 6-1.

Figure 6-1 Relationship between levels of service and policy

The planning effort completed to develop the Utility Plan purposely contained an outreach effort to receive broad community input for shaping the plan and top tier (i.e. external) levels of service. These external levels of service were shared with the community to validate what was heard and how WRS planned to characterize them. The external levels of service will be further developed during Utility Plan implementation to include internal managerial and staff tiers.

The Utility Plan is a living document that requires levels of service and supporting policies be updated periodically as WRS adapts to a changing community and continues to deliver on the long-term strategy. This section summarizes WRS levels of service and briefly describes the organizational efforts WRS will undertake to institutionalize them as different elements of the plan are implemented. Accordingly, this section also highlights potential policy areas WRS may want or need to address with elected officials and/or executive leadership as the Utility Plan is implemented.

6.1 Levels of Service

Levels of service are a utility best practice to help communicate performance and demonstrate compliance with community expectations. They help the utility focus efforts and resources to areas that make the most impact. Levels of service goals for Boise are unique to Boise. These goals should be periodically adjusted in response to performance and community interests, but not so frequently that adjustments interfere with organizational consistency. Continually maintaining this community communication connection is one of the key reasons for formalizing a level of service framework. Additionally, this framework provides a rationale for decision-making across the utility.

WRS used city-wide strategic initiatives coupled with community input to initiate external levels of service goal development. This ongoing alignment of WRS external levels of service is imperative to overall program sustainability and success. As customers more clearly understand WRS benefits and outcomes, they will offer additional input that better supports decisions. Similarly, as customers understand how levels of service and cost are closely related, they will often support higher levels of service.

Levels of service for WRS have external and internal application. They provide an organizational framework to progress goals and objectives to the entire staff. After the Utility Plan is adopted, WRS will begin developing internal levels of service to align managerial and staff activities to the external goals as illustrated on 6-2.

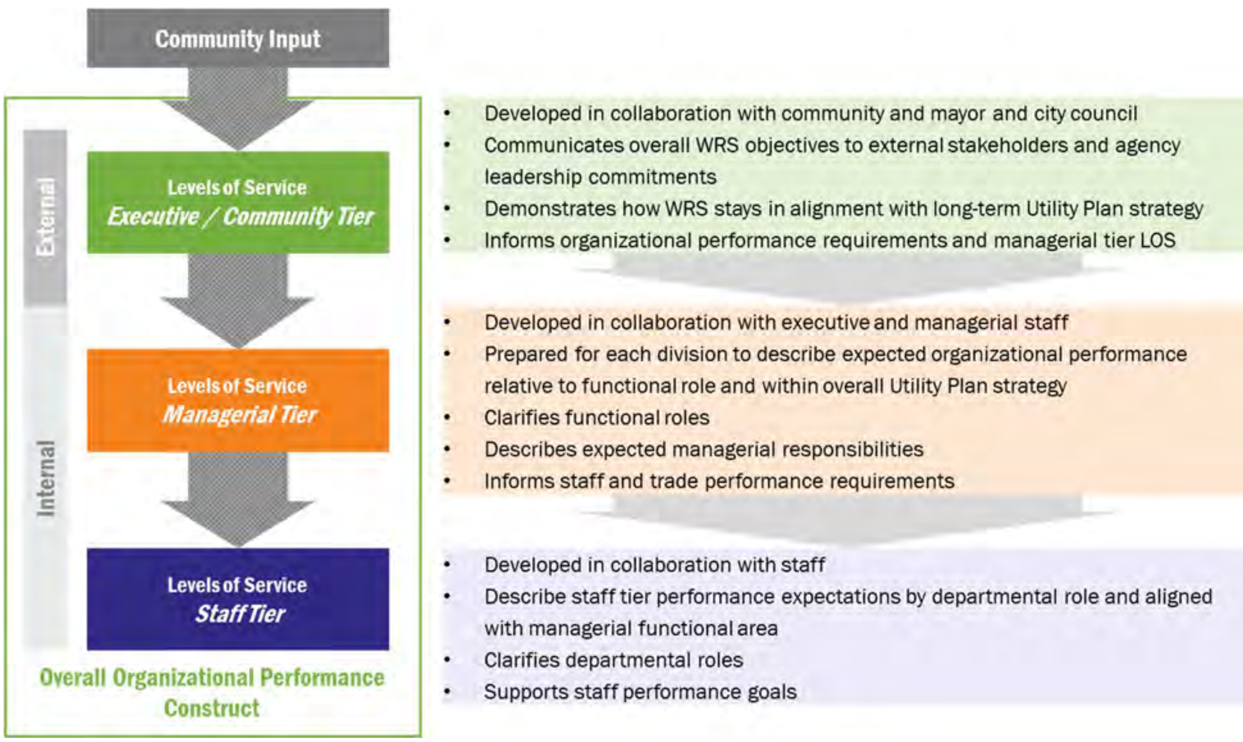


Figure 6-2 Level of service organizational progression

6.1.1 Level of Service Goals

External levels of service goals were identified during the planning process with input from the Advisory Group, general public, and elected officials. These levels of service goals are presented below. WRS will be developing quantitative measures, narratives, and reporting frameworks for each of these goals in the year following Utility Plan adoption. These levels of service will be validated with the community and elected officials.

- Help sustain Lower Boise River quality to support multiple community uses
- Recover, recycle, and renew water, energy, and other products from the materials we receive
- Act and communicate transparently
- Operate cost-effectively and maintain a resilient utility
- Support a robust, vibrant economy consistent with the city's vision
- Develop partnerships to effectively solve community issues
- Protect the health and safety of our community and staff
- Attract and retain engaged, thriving employees
- Provide high-quality customer service

6.2 Accompanying Policies

The Utility Plan outlines WRS's preferred strategy for managing the city's renewed and recycled water in accordance with community levels of service goals for the next 20 years. These levels of service will be used to guide WRS activities and organizational construct.

The Utility Plan is a living plan with ongoing, but less intensive, planning activities. The preferred strategy includes, among other items, a prioritized series of programmatic investments over time to align WRS actions and facilities to meet these needs. WRS will continually adjust investments to best optimize overall system efficiency and maximize potential community benefits. Equally instrumental in achieving the long-term goals outlined in the Utility Plan will be the supporting policy framework. Similarly, policies will need to be routinely developed and adjusted.

The Utility Plan proposes several different ways used water and byproducts will be managed long-term. Some of the proposed actions sustain current practice and policies; however, with Utility Plan adoption, WRS will begin a deliberate transition to recover a higher proportion of material it receives by recycling and/or transforming it into multiple products. For instance, WRS will begin to recycle water for consumptive use and aquifer storage. As recycled water is made more widely available, new policies and ordinances may be needed to guide how it is distributed and prioritized for users. This action may also include modifying WRS operating and business practices. Consequently, the city should expect to make policy adjustments over the next several years to fully implement the preferred strategy and optimize WRS actions.

City decision makers are responsible for determining the policies for accomplishing the Utility Plan objectives as well as best balancing community risks and benefits. It is recommended that policy development be executed at the lowest practical level in the organization.

The purpose of this section is to highlight likely key policy areas that may need attention during initial Utility Plan implementation and describe the rationale behind them. Following the Utility Plan adoption, WRS will move into the implementation phase for the planning effort. The purpose of this phase is to develop the policies and procedures necessary to ensure the successful implementation of the planning effort. It is expected that this phase will take several years of focused effort to enable the organizational changes necessary to enact the recommendations of the Utility Plan.

For convenience, policy considerations have been grouped into categories. It should be noted that these policies do not cover financial policies related to funding, which will be further considered as part of the ongoing cost of service analysis. Table 6-1. contains an overview of these key policy issues.

Table 6-1. Potential utility plan policy summary				
Policy Category	**Description**	**Purpose**	**Key Considerations and/or Assumptions**	**Timing**
Operating and Capital Planning	Capital contingency allowance	Simplify and optimize how capital resources are applied/managed.	Program based (percentage of total capital budget) or project based contingency fund (percentage of each project capital cost).	WRS discretion
	Reserve capacity	Define how much unused capacity WRS retains to best respond to changing demands and how reserved capacity is measured. The City leverages unused capacity to support economic and emergency interests. The city pledges access to unused capacity to support new customers.	Unused capacity has been invested in but does not generate revenue; as reserve capacity increases, cost recovery can fall on fewer customers. Some reserve capacity is required to minimize potential moratoriums. Utility Plan recommends shifting to a time-based measure (e.g., period it takes to add new capacity) versus a fixed quantity (e.g., gallons or pollutant mass load).	During Utility Plan adoption/initial implementation action item. Immediate and long-term actions are scaled and paced based on this value.
	Capacity management	Provide a consistent representation of the used and available capacity (system and facility).	How capacity is assigned may change user rate construct and could alter charges for historical customers.	Prior to developing any new rate structure for commercial/industrial customers
	Capital planning cycle and reporting	Identify the frequency and content of capital budget formation.	Supporting capital budget preparation requires dedicated effort and resources. Capital projects require multiple years to implement. Determine most appropriate cycle for developing capital budgets.	WRS discretion but may require coordination with other city departments. Currently an annual process.

Table 6-1. Potential utility plan policy summary				
Policy Category	**Description**	**Purpose**	**Key Considerations and/or Assumptions**	**Timing**
Resiliency and Sustainability	Redundancy: system	Regulatory compliance strategy, level of service functionality, and manage non-revenue/sunk assets.	Designated critical facilities and assets. Describe how core functions are supported during different scenarios, e.g., extended outage, climate change.	Plan sets initial guideline, adjust as major facilities are added/upgraded.
	Redundancy: process/facility	Emergency response, operational flexibility, regulatory compliance strategy, and level of service functionality.	Each unit process is an element of the entire system. Clarify role of key elements to assure overall system performance and acceptable risk.	Ongoing.
	Boise River enhancements	Describe the scope of potential enhancements that are acceptable to use WRS resources on.	River enhancements can have direct and/or indirect water quality, recreational, and environmental benefits. Clarify conditions under which the WRS resources can be deployed on river enhancements.	Prior to new investment in river discharge/at WRS discretion.
	Energy recovery	Clarify WRS role/expectations in meeting city overall energy sustainability objectives. Define how WRS energy recovery investment allocations will be recovered by WRS customers and others.	Used water processing consumes energy but has the potential to be a net renewable energy producer. Describe guidelines for investments, partnerships, and or revenue/cost sharing given the beneficiaries.	Revisit as WRS major investment opportunities are considered.
	Aesthetics	Increase visibility and community acceptance of WRS facilities and actions.	Visual integration with neighborhoods, communication/education/arts integration with facilities, odor control.	Ongoing system-wide approach revisited prior to adding new facilities or major retrofits to existing vertical facilities.
	Affordability	Demonstrate how level of service commitments will be made across socioeconomic groups.	Describe how different socioeconomic groups are represented in consideration of WRS investments.	City discretion (coordinated with large community dialogue).
	Communications and Education	Sustaining public interest and input into a living plan.	Role of internal and external groups to help shape operating and capital planning.	WRS discretion but may be advantageous to do as early as possible to set and sustain utility Plan outreach.
Product Management	Recycled water availability	Describe guidelines for how access to recycled water will be administered (reclaimed and/or industrial reuse).	Address both the spatial limits (e.g., proximity to a designated source) and required use of the supply for designated users (e.g., in developing areas such as East Boise Urban Gateway).	Prior to investment in recycled water infrastructure.
	Recycled water cost and rate structure	Generate revenue to offset costs.	Recycled water rates are often less than potable water rates and, consequently, seldomly generate revenues to fully offset costs. However, recycled water is a drought-proof water supply.	Prior to distributing recycled water.

Table 6-1. Potential utility plan policy summary

Policy Category	Description	Purpose	Key Considerations and/or Assumptions	Timing
			Consideration for the various pricing factors will be needed to establish recycled water rates.	
	Recycled water end user agreement conditions	Describe operation performance expectations regarding recycled water delivery.	Volume of water available, when and where water is available. Describe how interruptible the supply is, maximum demand and peaking factors (storage requirements), and minimum/maximum delivery. May consider different user classes.	Prior to distributing recycled water.
	Recycled water long-term storage (aquifer recharge)	Clarify ownership, applicable legal framework, and intent to use.	Stored water will have a fixed life cycle, describe how it is monitored to protect interests and assure access to water. If used for other purposes, e.g., mitigation, clarify intent and extent of control.	Prior to storing in the aquifer.
	Solids	Clarify the priority for beneficial use of solids recovered from used water: biosolids, struvite, and/or others.	Solids recovery economics seldomly recover costs and usually mitigate risk. Describe what types of offsets will be considered and how they will be equitably allocated.	Ongoing.
	Food production	Clarify any limitations on food resource development, distribution, and revenue/cost allocations.	Consider how food products may influence local agriculture economics and competition. Describe what qualifies as support for food production, any product restrictions, product marketing, and social/equity distribution.	Prior to implementing food production.
Community Engagement	Ongoing community engagement approach	Define approach to ongoing community engagement to sustain the recommendations of the Utility Plan will require constant communication and feedback from the community.	Determine how community feedback can best be gathered to inform ongoing capital planning decisions.	Ongoing.
	Capital project community engagement	Gather community feedback to inform major capital project decisions.	Further community feedback will be needed to inform capital projects that change how renewed water is managed in Boise or change how WRS interacts with the community.	Prior to decisions on major capital projects.
Governance	Overlapping jurisdiction/reciprocating agreements	Shared mutual outcomes more easily achieved by coordinated joint actions (e.g., Boise River water quality) with separate resources/costs.	Contribution/use of assets (shared and separate), revenue/cost sharing, operational/administrative jurisdiction, decision-making authority.	As needed when opportunity manifests itself.
	Interlocal agreements/ partnerships	Similar to above with joint assets and resources.		

Section 7

Implementation

The Utility Plan is different from historical Water Renewal Services plans. The Utility Plan recognizes WRS now operates in a more dynamic set of external and internal conditions. The Utility Plan describes long-term goals and how those are founded on community interests and values. However, the Utility Plan recognizes the precise investments WRS will need to undertake will require adapting to changing community needs. This section describes how WRS will continually adapt investments and actions to achieve those goals, including capital investments, organizational adjustments, business processes, and data collection.

7.1 Introduction

The Utility Plan is a programmatic versus prescriptive plan. Consequently, the preferred alternative relies on continual monitoring and planning with smaller, incremental additions of new capacity and asset replacement. This approach provides ample opportunity to adapt the program to match actual demands and more easily advance product management.

Utility Plan implementation will require WRS to adapt some of its current business practices and will drive different staffing and operational considerations. This section briefly describes how WRS will initiate these changes and continually adapt activities to support the Utility Plan. Whenever possible, WRS will leverage existing capital and operating budgeting business processes to assure the Utility Plan is continually current.

7.2 Levels of Service Guiding Implementation

The previous section described how WRS developed levels of service and how those will be used as part of its overall utility management and policy framework. Core community values generally remain consistent over long periods and are needed to guide implementation. As a representation of core community values, levels of service may not be entirely congruent in all circumstances. For instance, the goal of utility efficiency may conflict with recovering more products from the used water. WRS will develop business processes and tools to assist with preparing and evaluating opportunities to balance these tradeoffs. Table 7-1 summarizes the levels of service and implications for implementation

Table 7-1. Level of service goals and implementation considerations

Level of Service Goal		Tie to Implementation
	Help sustain Lower Boise River quality to support multiple community uses	Many projects planned in the 20-year CIP will improve the quality of the Boise River with increased treatment at the WRFs and improvements targeted at enhancing the water quality and habitat.
	Recover, recycle, and renew water, energy, and other products from the materials we receive	The projects and policies laid out in the Utility Plan focus on managing the products produced at WRFs. These projects include pursuing opportunities for recycled water, identifying opportunities to recover energy, and working towards a path to 100 percent clean energy.
	Act and communicate transparently	The Utility Plan lays out what WRS plans to pursue over the next 20 years. Inherent with the Utility Plan is a commitment for ongoing feedback and collaboration with the community.
	Operate cost-effectively and maintain a resilient utility	By prioritizing asset management and developing reporting on level of service goals, WRS can keep utility rates lower by getting ahead of large capital investments and planning for future expenditures more accurately.
	Support a robust, vibrant economy consistent with the city's vision	Industrial reuse and recycled water management lay the framework for supporting local businesses by providing recycled water at competitive rates to encourage recycled water use in Boise.
	Develop partnerships to effectively solve community issues	Making recycled water available for industrial customers will build partnerships with industries, community groups, and other municipalities and can incentivize other industries to Boise. Partnerships will also be necessary to further river enhancement and innovation.
	Protect the health and safety of our community and staff	The ongoing asset replacement projects included in the CIP minimize the risk of asset failure and support the safe operation of treatment processes. Maintaining assets allows for continued treatment and protection of public health and safety as well as the health of the river.
	Attract and retain engaged, thriving employees	Implementing the Utility Plan will require organizational changes to how WRS is managed, how projects are delivered, and how level of service goals are met. This will provide opportunities for employee growth and engagement.
	Provide high-quality customer service	The Utility Plan embodies a shift towards product management and will lead to WRS providing several new products for community use, such as recycled water. This shift comes will come with new expectations for how WRS interacts with these customers to deliver these products.

7.3 Keeping the Utility Plan Continually Up to Date

The Recommended Approach represents a new approach for WRS in managing renewed water. This approach brings with it many benefits including creating a drought-proof water supply and enhancing the Boise River habitat. However, the benefits are predicated on WRS continually delivering capital projects predictably and efficiently. The Recommended Approach relies on continual monitoring and ongoing planning. The areas to be monitored include the following list:

- Community values and expectations: ensure alignment of WRS actions with community expectations through continued community outreach
- Asset management: maintain asset condition assessments to predictively anticipate repair and maintenance activities and extend the effective useful life.
- Available capacity: track available reserve capacity for treatment and conveyance facilities.
- Performance against forecasts: measure system flows and loadings, revenues, and product recovery rates.
- Regulatory requirements: monitor changing regulatory requirements and conditions for products (e.g., river discharge, recycled water, etc.).
- Fiscal performance: track revenues, expenses, and project performance against plan.

7.3.1 Stages of a Project

The Utility Plan is founded in the approach of an adaptable and nimble utility that executes smaller projects to maintain alignment with community expectation and accommodate changing conditions. This approach will require finishing multiple complete and separate projects aligned towards the same end goals across the entire water renewal system. This is true whether it involves creating a new water renewal facility or a straightforward pipeline rehabilitation. Each project progresses through the same series of development stages covering a project’s entire life cycle from its earliest concept to operation. Each stage moves the project closer to implementation and represents a commitment of financial resources. Table 7-2 describes the typical project stages and relative financial commitment for each stage in chronological order top to bottom.

Table 7-2. WRS project stages		
Stage	**Description**	**Proportion of capital cost (%)**
Conceptualizing	Identify a need or idea, which leads to creating a project definition request for evaluation. The need may be identified from a number of sources including asset management tools, staff planning and analysis, regulatory requirements, growth, or community expectations. In concert with the Concept or Define stages, WRS will conduct community engagement for projects that change how renewed water is managed in Boise or change how WRS interacts with the community.	<1%
Defining	Prepare a project definition report identifying facility concepts and potential locations are identified. Initiate a programmatic evaluation, including an initial BCE. Identify preliminary approaches for financing, environmental compliance assessment, preliminary design, permit needs, and property rights. Project prioritized based on business case results.	2–5%
Capitalizing	Project is included and approved in the CIP. Secure property and financing. Prepare preliminary design, complete any necessary environmental processes, and secure key permits. Advancing from this stage assures project completion absent sudden dramatic shifts in system requirements.	5–10% (not including land)
Designing	Final engineering design. Complete plans, specifications, and estimates; request bids; and secure all permits to allow construction.	8–20%
Constructing	Award construction contract, complete construction, commission facility /assets.	60–80%
Operating	Project is complete, and associated facilities are repaired and maintained through the asset management program for the expected life cycle.	50–400%

The preferred portfolio with a more incremental approach will result in a larger number of projects. Further, as the system continues to age and large portions reach the end of their useful life in the next 20 years, the overall size of the capital program will increase by nearly 100 percent. Recognizing these factors, combined with the progressing level of organizational and financial commitment through the project life cycle and a desire to be more adaptive in its actions, will likely necessitate some changes for WRS in four distinct areas:

- People and organizational roles
- Policies and business processes
- Pricing and financial strategies
- Projects types and scale

7.3.2 Capital Project Implementation

Refining the decision process to rely more clearly on actual measured conditions and short-range forecasts (program management) has the potential for minimizing cost and risks when compared to making long-term, large-increment capacity decisions that rely on long-range forecasts. The small increments greatly reduce the financial burden of building more than is needed. However, small, more frequent, “just in time” project reliance presents a new risk: “not quite just-in-time” projects (project management). Therefore, WRS will focus its effort during the initial program implementation period to assure the organization is best prepared to consistently and sustainably deliver projects.

Although WRS envisions only 2 to 3 years to prepare final design and construct a single project, several years of preliminary planning and permitting are needed (Conceptualizing, Defining, and Capitalizing stages) before the final Designing and Constructing stages begin. The time between when a project is first conceived and when it becomes an operating reality can be managed to both provide certainty of completion and control cost (project management function with delivery capacity monitoring). It is quite possible to expect situations where there will be multiple new project demands occurring over a few years. To successfully respond to changing needs, this means WRS will require a suite of projects under various stages of development simultaneously, with any one being able to advance as needed.

This new method for planning and deploying capital investments integrates and compares information from several sources. Consequently, environmental analysis and public engagement will be integral and continuous activities. WRS will adapt current activities to develop systematic and objective business processes for tracking where and when products, treatment, and conveyance system capacity must be available, when asset reinvestments are most prudent, and when regulatory requirements demand investment. Each of these will be triggered by measured conditions. Adding small increment projects requires continuous attention but doing so will return many benefits and assure WRS is able to adapt more quickly to changing community needs.

7.3.3 Structuring a WRS Capacity Management System

Historical facility plans employed comparatively large, often “single plant” solutions to meet 20-year used water management requirements. While costly, this approach offers a high level of certainty during the first 50 percent of the planning period that capacity availability will not be an issue. To offer similar available capacity reliability, the Utility Plan requires that small capacity increments are ready to be implemented with increased demands. This requirement suggests several projects must be poised either at, or nearly at, completion of the Capitalizing stage (see Table 7-2) to assure adequate response to changing conditions. Rather than one project at a time, the Utility Plan demands a measured, thoughtfully paced program of near-term projects to be able to adjust to shifting requirements. Both program management and project management principles become important success factors.

This approach will be critical over the next decade as the city looks to meet the demands of a growing population. The approach to meeting these pressures over the next decade is highlighted here to demonstrate the continual capital process the city will be required to execute moving forward. As presented in Section 3, it is envisioned that the city will construct a new WRF focused on producing recycled water in the southeastern area of the city. Implementing this project is expected to require nearly a decade (see Figure 7-2 later in this section for details). However, recent growth has created additional capacity demands before the completion of this project. To keep pace with growth, the city plans to address the current capacity bottlenecks at the Lander Street and West Boise WRFs (see Section 2). This project is expected to include enhancements to the secondary treatment system at the West Boise WRF and the secondary treatment and secondary clarification systems at the Lander Street WRF. These projects will be brought online in consecutive years during the middle part of this decade. Their completion will increase the capacity of the Lander Street and West Boise WRFs to 17 mgd and 25 mgd, respectively, and provide sufficient capacity to bridge the needs until the new WRF is brought online.

In the details of this approach, are several key considerations that demonstrate the nuanced approach to capacity management that will be required by WRS. First, the capacity assessments completed during the development of the Utility Plan allow an understanding of both current treatment process bottlenecks and the expected capacity gains that can be achieved with targeted investments. Secondly, the city will increase the capacity of the Lander Street WRF to 17 mgd, which is slightly higher than projected buildout condition. This improvement allows the city to provide sufficient capacity over the course of the next decade and will provide additional flexibility in the future configuration, which demonstrates the final nuance: the city’s WRFs act as an interconnected system and must be planned for as such. Shifts in flows and loads to the two existing WRFs when the new WRF is brought online will change the expected influent used water characteristics at the existing facilities, especially the Lander Street WRF. At the Lander Street WRF, future loadings are expected to increase while expected flows will gradually decrease. Understanding and tracking hydraulic and treatment capacities within the system through the nuanced understanding and considerations highlighted here will become the norm moving forward.

7.3.4 Factors Influencing Capital Investments

As facilities approach the end of their useful life or capacity, WRS will need to consider several factors to determine what new facilities are required. These factors include regulatory and physical elements as described in this section.

7.3.5 Capacity Thresholds

The IDEQ requires that water renewal facilities and mechanical conveyance facilities begin planning and designing new facilities when average annual flows reach 85 percent of their maximum rated or permitted condition. The remaining 15 percent buffer is called reserve capacity. This rule provides necessary time to plan and construct new facilities before exceeding the capacity of existing facilities and assures public health protection during declared emergencies. For water renewal facilities, pump stations, and lift stations, the condition is exceeded when the actual flows are compared to the design capacity of the facility or process (often with the redundancy criterion of the largest unit out of service). To minimize costs, the Utility Plan will take a more system-based capacity and redundancy approach, and new WRFs may largely rely on reserve capacity at the West Boise WRF. This shift will afford the new WRFs to be designed, rated, and operated near their full capacity with all units in service. Similar criteria exist for gravity sewers and interceptors as described in the reference documents.

Capacity criteria for recycled water and other recovered products have not yet been developed. These criteria will be governed by the capacity of the end users, such as the total amount of demand for recycled water from industrial users. The capacity criteria will be reflected in the metrics to be developed for the levels of service.

7.3.6 Environment

During the planning effort the community repeatedly reinforced that environmental protection is a significant public value relative to WRS activities. This value is reflected by the strong support for enhancing the river and recovering products from used water. This also means consistency with adopted environmental regulations, standards, and policies. Environmental considerations can affect capacity through limiting the size or footprint of a constructed facility, limiting the discharge quantity or quality, and/or affecting facility operation.

Environmental regulations or standards influencing capacity may include surface water and groundwater quality standards, city and/or county sensitive/critical areas ordinance requirements, and state and federal wildlife protection requirements. In some cases, these regulations are likely to be applicable only during construction, but other regulations, particularly surface water and groundwater quality standards, will require an ongoing compliance program.

Surface water monitoring within the Boise River will continue in a manner similar to current practices. Permit conditions will stipulate when, where, how often, and what parameters will be monitored, along with a series of required steps if water quality standards or permit conditions are not met. Receiving water quality standards such as phosphorus and temperature standards could be a significant determinant in allowable discharge volumes, affecting capacity needs in other parts of the system.

7.3.7 Population and Employment/Development

Anticipated increases in the population and employment over 2 to 5-year periods will be used to identify the number, size, and location of new facilities and new capacity increases. State population and employment growth forecasts for the Ada County area estimate approximate annual growth rates of 2 percent over the next several years. Section 7.3.3 highlights the strategy to accommodate this growth within the system.

7.3.8 Facilities Performance

WRF performance is an essential criterion in estimating the number and life cycle of used water treatment, product recovery and conveyance facilities. This is particularly true for new unit treatment processes and facilities. Without operating data, WRF performance can be only estimated. Conservative estimates of the facility performance are necessary to ensure that operational objectives can be achieved at the design flow conditions. This results in larger implementation phases and treatment "module" sizes. Since facilities will be implemented to satisfy 2- to 5-year phases, actual treatment and recycling facilities' performance can be measured prior to adding additional increments of capacity. Consequently, new existing facilities will operate nearer to maximum limits.

7.3.9 Implementation Schedule/Time Requirements

The Utility Plan relies upon small projects deployed just-in-time; consequently, construction and siting permit issues for facilities will control the schedule and ultimately determine the amount of reserve capacity WRS will need to carry. Preliminary work on facilities may be conducted several years in advance of the Designing and Constructing stages. How far in advance will be determined by the "shelf life" of a permit, time it takes to secure the permit, and the time it takes to deliver the project—reinforcing project management principles. Siting any new facility requires substantial public input. By reducing the size of individual facilities and creating opportunities for public amenities, WRS believes delivery time will be reduced. Locating new facilities in areas already zoned for commercial or industrial uses can also mitigate some of these concerns.

WRS will continually be in an implementation mode. The level of activity will be dependent upon the predicted need for new capacity, system condition/asset life cycle replacement, regulatory investments, shifts in community expectations, and the project stage as described in Table 7-2.

7.4 Near-Term Actions

The planning effort completed the initial assessment and consideration of these factors to select a preferred portfolio and set the stage for implementation. Figure 7-1 shows a programmatic schedule for anticipated near-term WRS activities. These actions are shown grouped by the people (organizational needs), policies (business processes), pricing (financial strategy), and projects.

A primary focus for 2021 will be selecting the preferred revenue approach for expected capital expenditures. The city has begun work on a cost of service analysis to better understand the implications of various funding models. A future decision will be needed on the preferred funding model.

An instrumental part of the 2021 effort is beginning to assess, train, and align the organization to deliver. This effort includes reassessing staff roles, organizational capacity, and departmental functions to optimize business processes and target training needs for staff to excel and grow. Similarly, with a greater focus on product recovery, energy sustainability, and recycling, WRS will need to begin framing several policies in advance of producing them.

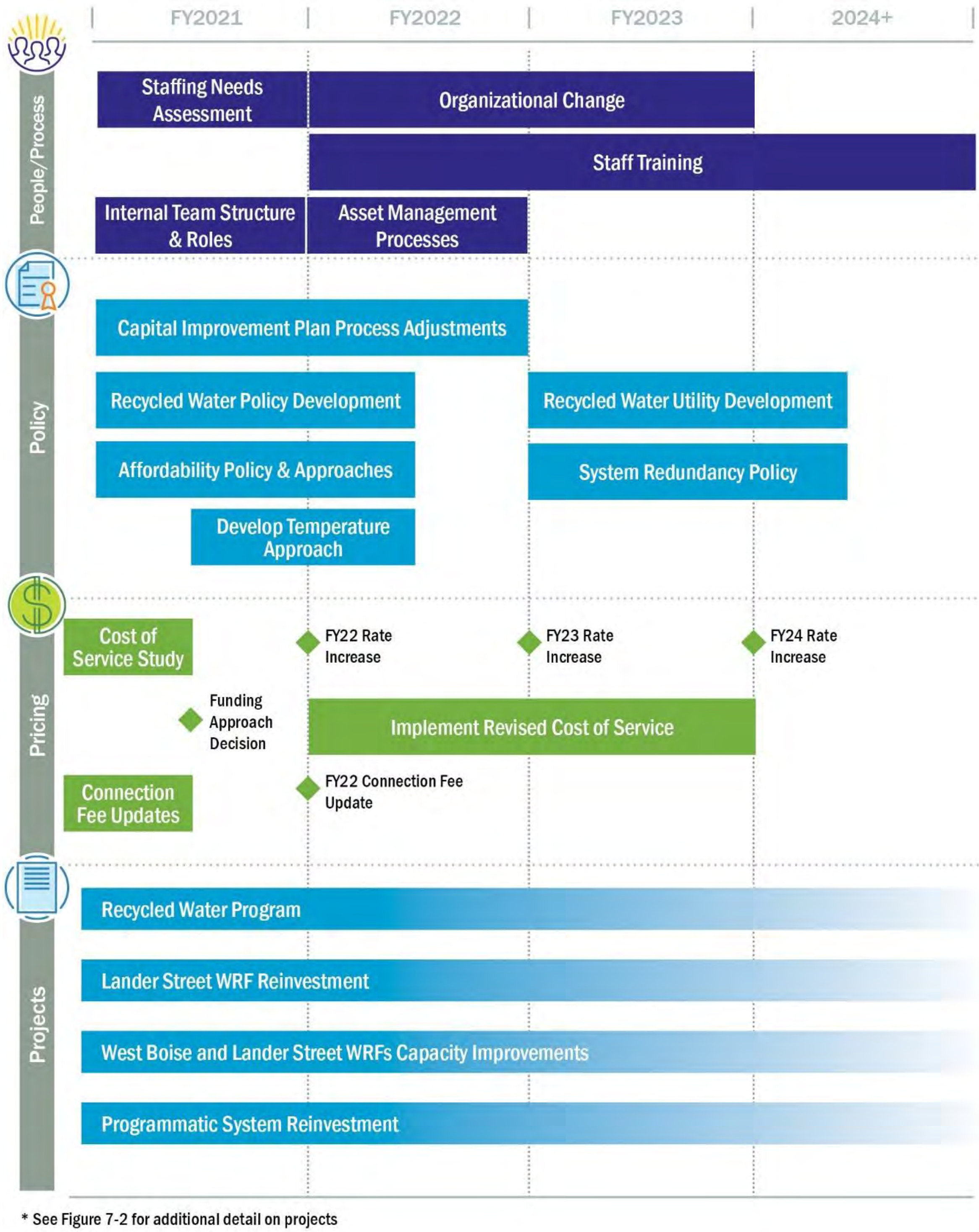


Figure 7-1. Near-term implementation schedule

7.5 People: Focusing on Organizational Health and Change

The Utility Plan represents a change from what WRS has historically been responsible for. The people in the organization will ultimately be the ones who will deliver these community goals. Over the last couple years, WRS has focused on what will be accomplished and why it was necessary to do so as it established broad reaching goals. WRS will now begin to shift attention to how these goals will be accomplished through the organization. As one of the first implementation steps, WRS will begin adapting the organizational functions, departments, and individual roles to empower staff and achieve these community goals. This process represents arguably the most important phase of the Utility Plan.

7.5.1 Aligning the Organization

One of WRS's primary objectives has been stellar regulatory compliance and reliability. While regulatory compliance remains a requirement, the community clearly indicated it expected more than that during the planning process. Consequently, WRS will begin shifting from compliance-centered goals to ones that work towards broader outcomes, developing and managing recovered products, as expressed in its levels of service and the city's vision of "Creating a City for Everyone." This shift in mentality will drive organizational changes. Even with the inspiring goals, organizational change always offers challenges as historical norms are adjusted.

Another driver for organizational change is the forecast nearly doubling WRS's project delivery capacity as the annual capital improvement plan value increases $30M per year to over $55M per year over the next several years to account for replacing, repairing, and refurbishing aging infrastructure. These higher expectations coupled with higher demand will place new stresses on WRS and make continued focus on organizational health equally important.

As illustrated at the top of Figure 7-2, there are several early steps to begin the organizational alignment, these include assessing the current staff capacity, inventorying skills, and comparing them to the future needs. Inevitably there will be new opportunities and training needed.

7.5.2 Empowering Staff

The Utility Plan's focus on smaller, more nimble steps to adapt to changing community and environmental conditions will require the organization to adapt roles and responsibilities, which will provide new progression paths for staff to learn, grow, and advance. It will also require WRS to focus on staff recruitment and retention to meet the increased project and product demands.

7.5.3 Innovation, Research, and Development

Efficiently meeting the broader outcomes and goals WRS has established will be dependent upon strategically deploying developing technologies. Leading agencies through the United States dedicate a portion of their resources to researching innovative technologies to help them meet their goals and also provides a benefit to staff as they collaborate and learn from industry peers. WRS will build on its past research, bench testing, and pilot testing experience to continue investing in targeted research and development.

7.6 Policies and Business Practices

Table 7-1 outlines several of the recommended early levels of service and policies for WRS to address as the Utility Plan moves to implementation. These policies were sequenced based on upcoming project needs. Key policies are listed below:

- Establishing metrics and reporting dashboards for levels of service

- Defining the approach for programmatically evaluating asset management needs and addressing those that pose the highest risk to the system
- Creating a basis for establishing and managing reserve capacity for different aspects of the system
- Establishing a recycled water utility and associated recycled water use
- Establishing community and individual affordability guidelines

As mentioned in Section 6, levels of service should guide WRS organizational behavior and inform policies. And, both levels of service and policies should be developed at the lowest appropriate organizational level. The appropriate level being largely driven by the level of inter-departmental coordination needed and/or impact on other city activities.

7.6.1 Asset Management

Approximately half of the capital expenditures during the planning horizon will be dedicated to repairing, replacing, and refurbishing assets. There are ongoing efforts to better understand system condition based on field condition assessments, define the risk the failure specific assets pose to the utility, and prioritize investments in those assets deemed most critical. These efforts resulted in the facility condition information presented in Section 2 and have informed planned expenditures presented in Figure 7-2. Continued development and advancement of the WRS asset management program is necessary to optimize and reduce costs.

7.6.2 Reserve Capacity

As described earlier in this section, reserve capacity describes the buffer system capacity to provide for changes in demand and opportunities to add customers. Regulators also monitor reserve capacity to trigger planning and performance actions. Many agencies provide reserve capacity in large steps through major plant expansions and sewer extensions. These offer needed capacity out to 20 to 30 years. Under the Utility Plan, reserve capacity is proposed to be managed more closely.

WRS will monitor and manage several types of capacity, in order of importance, to effectively implement the Utility Plan:

- **Resource recovery capacity.** These capacities are markets and facilities for distribution and end use of the recovered products: struvite, recycled water, biosolids, energy. There are distinct categories of resource use capacity in the system:
  - Permitted capacity discharged to the Boise River.
  - Cumulative consumptive use of the recovered product. For instance, recycled water including industrial reuse and aquifer recharge. The capacity of each is limited based on seasonal factors and, in the case of water recycling, the characteristics of the end use. Similar considerations can be made for the agronomic capacity of the soils for continued application of biosolids.
  - Market acceptance of the recovered products and associated contractual limits, if any.
- **Treatment capacity.** This capacity represents the net capabilities of the WRFs to produce and/or recover the targeted products. Treatment capacity will be provided at the existing Lander Street WRF, West Boise WRF or proposed satellite facilities.
- **Conveyance capacity.** These facilities provide regional transport or “conveyance” of collected used water to treatment centers. Conveyance capacity varies through the system. WRS will balance the need for additional conveyance capacity with opportunities to develop recycled water and available treatment capacity.

7.6.3 Recycled Water Utility

The Utility Plan specifically identifies producing and distributing recycled water as a key outcome, which will require establishing a separate entity to manage it, not unlike the geothermal system. Before a program can be launched, the following factors will need to be resolved:

- Further community involvement to understand community perspectives of recycled water and expectations for a recycled water utility.
- Reconciling how the recycled water program will interact with local water rights depending on how recycled water is distributed, applied, and/or recovered.
- Recycled Water Permit development. The city will need to secure a municipal reuse permit to allow for implementing a recycled water program per IDAPA 58.01.17. These permits are administered through the IDEQ.
- End User Agreements to stipulate how recycled water will be delivered and what conditions the end user must comply with. These are important features to enable WRS to efficiently manage reserve capacity.

7.7 Pricing and Financial Considerations

Commensurate with the adoption of the Utility Plan, WRS will develop a comprehensive finance strategy to sustain fiscal resources to implement the Utility Plan in 2020. This part of the implementation sequence will include a systematic consideration of the cost of service model, associated fees and user rates, customer classes, and affordability considerations. As shown in Figure 7-1, there are several key milestones in 2021, including determining the preferred funding method and further developing an affordability approach for WRS.

One key action for 2022 will be deciding to modify the cost recovery framework for users discharging nitrogen and phosphorus into the system. Although already part of the cost of service structure, the nitrogen component has not been levied across all users historically. However, as the city works towards implementing recycled water, WRS costs for operating and building facilities have and will become more sensitive to the amount of nitrogen being discharged. This rate adjustment will enable WRS to recoup charges from users proportional to this impact.

Other key financial factors to address in the context of the Utility Plan during 2021 and 2022 are listed below:

- Program reserves to support financing, operations, and emergency management.
- Programmatic contingencies used for entire program portfolio implementation rather than for individual projects. These have the advantage of offering implementation flexibility and require oversight guidelines to assure effective administration but provide for the systematic investment in the assets.
- Connection fees.
- Affordability and rate and fee assistance.

7.8 Projects and the Initial Capital Improvement Program

One of the key outcomes from the Utility Plan is a prioritized CIP. As described earlier in this section, this investment strategy will adapt over time to enable WRS to more effectively meet goals, recover reusable products, and protect the river. This strategy includes smaller incremental investments that may be adjusted to allow WRS to pivot projects as they proceed through the project life cycle, especially the initial steps of Conceptualizing, Defining, and Capitalizing (see Table 7-2). However once projects enter the Designing stage, they should be presumed effectively implemented as the costs to pivot to another option past that stage will likely be prohibitive.

The Recommended Approach is composed of investments to establish a recycled water program, meet increasingly stringent regulatory requirements, repair or replace aging infrastructure, and accommodate future residential, commercial, and industrial growth. Going forward as WRS implements the plan, the CIP and operating budgets are intended to act as a formal Utility Plan update. Operating under this living plan model, WRS should not need to engage in a lengthy planning process for 15 to 20 years. The initial CIP included in this Utility Plan is prepared with a 10-year outlook to support financial planning and the intention of WRS; however, resource commitments are contingent on the project stage over the next 2 to 3 years. Projects outside of the 2- to 3-year window that are not currently in Designing, Constructing, or Operating stages may be adjusted based on measured community and market factors. The detailed CIP for the 2020 to 2030 period is shown in Table 7-3.

The CIP is a prioritized compilation of recommendations from eight facility master plans prepared in conjunction with the Utility Plan. The CIP development was performed for each existing and planned major facility. The development process considers both new assets and repair and replacement as illustrated below. The major facility areas that have supporting master/facility plans are listed below:

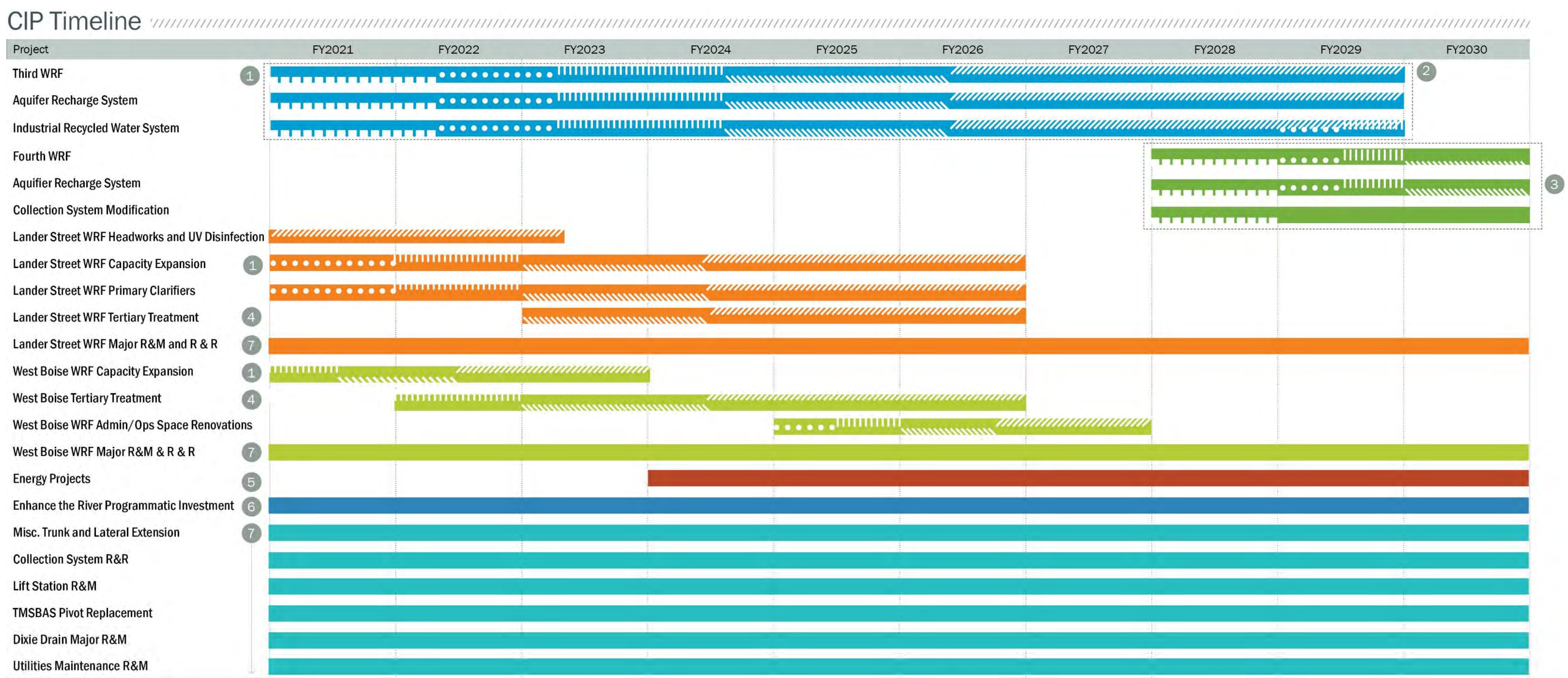
- Lander Street WRF Facility Plan
- West Boise WRF Facility Plan
- Dixie Drain PRF Facility Plan
- Third WRF Facility Plan
- Twenty Mile South Biosolids Application Site Facility Plan
- Collection System Master Plan
- Recycled Water Master Plan

The master/facility plans identify specific projects and outcomes (e.g., river enhancement, industrial reuse, aquifer recharge). They also contain limited detail regarding basis of design, implementation timeline, and projected costs for each facility to support advancing the projects to the Defining and Capitalizing project stages. For greenfield projects like the Third and Fourth WRFs, it is expected implementation from Conceptualizing through Constructing stages will require approximately 8 to 10 years. The extended length is to conduct site selection, property acquisition, environmental documentation, and permitting.

Many of the projects slated over the next 10 years will establish the city's recycled water program to provide industrial users with recycled water and begin recharging the aquifer. The first step in fulfilling industrial reuse and aquifer recharge is to construct the Third WRF. Other projects slated for construction prior to 2030 will provide the city with needed treatment capacity at the Lander Street and West Boise WRFs.

Figure 7-2 shows the preferred programmatic project timeline for the next decade. This arrangement was prepared to highlight what financial sources, e.g., rates or fees, may be relied upon more during certain periods. The timeline is representative for implementing projects. Table 7-4 shows the preferred portfolio projected programmatic cash flow for 2020–2040 grouped by major investment areas.

Table 7-3. CIP for next ten years (2020 dollars, in millions)											
Planned Project	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	TOTAL
Third WRF	$1.1	$1.4	$2.7	$3.0	$5.5	$11.0	$11.0	$11.0	$8.2	$0.0	**$54.9**
Aquifer Recharge System	$0.9	$1.1	$2.3	$2.5	$4.6	$9.1	$9.1	$9.1	$6.8	$0.0	**$45.6**
Industrial Recycled Water System	$0.2	$0.3	$0.6	$0.7	$1.2	$2.4	$2.4	$2.4	$1.8	$0.0	**$12.1**
Fourth WRF	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$3.3	$5.0	$8.3	$13.3	**$29.9**
Aquifer Recharge System	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.0	$3.0	$5.0	$8.0	**$18.0**
Collection System Modifications	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.7	$1.1	$1.8	$2.9	**$6.5**
Lander Street WRF Headworks and UV Disinfection	$20.2	$2.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$22.2**
Lander Street WRF Capacity Expansion	$1.5	$5.6	$6.4	$12.9	$9.6	$3.2	$0.0	$0.0	$0.0	$0.0	**$39.3**
Lander Street WRF Primary Clarifiers	$0.0	$3.1	$3.1	$7.0	$14.0	$2.3	$0.0	$0.0	$0.0	$0.0	**$29.5**
Lander Street WRF Tertiary Treatment	$0.0	$2.5	$1.6	$7.0	$14.0	$2.3	$0.0	$0.0	$0.0	$0.0	**$27.4**
Lander Street WRF Major R&M and R&R	$2.9	$1.5	$0.4	$0.5	$0.5	$0.5	$5.9	$18.4	$15.1	$7.6	**$53.3**
West Boise WRF Capacity Expansion	$0.7	$6.4	$5.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$12.4**
West Boise WRF Tertiary Treatment	$0.0	$2.3	$7.0	$1.8	$10.5	$6.6	$0.0	$0.0	$0.0	$0.0	**$28.2**
West Boise WRF Admin/Operations Space Renovations	$0.0	$2.2	$0.0	$0.0	$1.0	$4.0	$4.0	$0.0	$0.0	$0.0	**$11.2**
West Boise WRF Major R&M and R&R	$0.6	$0.6	$0.7	$0.7	$0.7	$2.0	$3.3	$7.1	$10.9	$5.9	**$32.5**
Energy Projects	$0.0	$0.0	$0.8	$1.2	$1.9	$3.1	$3.9	$3.1	$1.5	$0.0	**$15.4**
Enhance the River Programmatic Investment	$0.3	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	**$9.3**
Misc. Trunk and Lateral Extension	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	**$5.0**
Collection System R&R	$4.2	$6.0	$6.0	$6.0	$6.0	$6.0	$6.0	$6.0	$6.0	$6.0	**$58.2**
Lift Station R&M	$0.1	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	**$2.1**
TMSBAS Pivot Replacement	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	**$2.2**
Dixie Drain PRF Major R&M	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	**$1.1**
Utilities Maintenance R&M	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	**$0.5**
TOTAL	**$33.6**	**$37.2**	**$39.0**	**$45.2**	**$71.7**	**$54.7**	**$53.7**	**$68.2**	**$67.6**	**$45.9**	**$516.9**



NOTES

1. The city plans to make incremental investments to increase overall system capacity over the next decade. As described in Section 7.3.3, this will include projects at the Lander Street and West Boise WRFs and is anticipated to include the construction of the Third WRF.
2. WRS will focus on the development of a recycled water program to deliver industrial reuse and aquifer recharge over the next decade. Given the interconnectedness of this process, it is expected that the development of these systems and the planning, design, and construction of the third WRF will be executed as a single program.
3. In keeping with the just in time approach to adding capacity, early work on the planned Fourth WRF and accompanying aquifer recharge system will begin in the latter portions of this decade. This will allow for new capacity to be brought online by 2035.
4. Both the Lander Street and West Boise WRFs will require further investments in tertiary treatment to meet the TP limits described in Section 2. It is anticipated that these investments will leverage the combined mass loading approach.
5. WRS's implementation of energy projects will be guided by Boise's Energy Future. Section 4 describes the anticipated investments WRS will make to meet the objectives described in Boise's Energy Future.
6. Programmatic enhance the river investments will focus on improving the water quality and habitat of the Boise River.
7. WRS will continue to programmatically reinvest in existing infrastructure throughout the implementation of the Utility Plan. This programmatic reinvestment will be guided by the city's asset management program.

KEY

Figure 7-2. CIP Timeline

Table 7-4. CIP (2020 dollars, in millions)																					
	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	FY 2032	FY 2033	FY 2034	FY 2035	FY 2036	FY 2037	FY 2038	FY 2039	FY 2040	TOTAL
Lander Street WRF	$24.6	$14.7	$11.5	$27.3	$38.2	$8.4	$5.9	$18.4	$15.1	$9.0	$9.8	$26.0	$30.2	$23.8	$5.8	$12.3	$11.0	$3.5	$7.3	$7.0	$310
West Boise WRF	$1.4	$11.6	$13.0	$2.5	$12.3	$12.7	$7.4	$7.1	$10.9	$8.9	$6.7	$11.9	$23.1	$32.8	$20.9	$8.2	$4.6	$11.3	$18.1	$9.1	$235
Collection System	$4.8	$6.7	$6.7	$6.7	$6.7	$6.7	$7.4	$7.8	$8.5	$9.6	$14.3	$13.6	$12.2	$10.7	$10.7	$10.7	$10.7	$10.7	$10.7	$10.7	$187
Third WRF	$1.1	$1.4	$2.7	$3.0	$5.5	$11.0	$11.0	$11.0	$8.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$55
Fourth WRF	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$3.3	$5.0	$8.3	$13.3	$16.6	$13.3	$6.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$67
2040+ Capacity	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$3.3	$5.0	$8.3	$13.3	$16.6	$13.3	$6.7	$67
Industrial Reuse	$0.2	$0.3	$0.6	$0.7	$1.2	$2.4	$2.4	$2.4	$1.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$12
Aquifer Recharge	$0.9	$1.1	$2.3	$2.5	$4.6	$9.1	$11.1	$12.1	$11.8	$8.0	$10.0	$8.0	$4.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$86
Enhance the River	$0.3	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$73
Energy Projects	$0.0	$0.0	$0.8	$1.2	$1.9	$3.1	$3.9	$3.1	$1.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$15
TMSBAS	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$4
Dixie Drain PRF	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$2
Total	**$33.6**	**$37.2**	**$39.0**	**$45.2**	**$71.7**	**$54.7**	**$53.7**	**$68.2**	**$67.6**	**$50.2**	**$58.9**	**$74.2**	**$77.5**	**$72.0**	**$52.7**	**$49.8**	**$49.9**	**$52.5**	**$59.7**	**$43.8**	**$1,112**

Section 8

Limitations

This document was prepared solely for the City of Boise in accordance with professional standards at the time the services were performed and in accordance with the contract between City of Boise and Brown and Caldwell dated November 18, 2015. This document is governed by the specific scope of work authorized by City of Boise; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by City of Boise and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Section 9

Reference Documents

1. Wastewater Customer Awareness, Evaluation & Priorities DRAFT
2. UM-05 Asset Management Approach TM
3. UM-06 Field Condition Assessment Report
4. UM-07 Collection System Desktop – SPORE Assessment TM
5. UM-08 Facility Desktop Assessment TM
6. UM-12 Water Renewal Focus Groups Summary
7. TM-01 Flow and Load Generation Methodology TM
8. TM-02 Population and Employment TM
9. TM-03 Flow and Load TM
10. TM-04 Modeling Assumptions TM
11. TM-05 Model Calibration TM
12. TM-06 Hydraulic Capacity Update TM
13. TM-07 DRAFT Lander Street WWTF Capacity Report
14. TM-08 DRAFT West Boise WWTF Capacity Report
15. TM-35 Flow and Loading 2018 Update
16. R-01 Phosphorus Trading Analysis TM

Boise Office

950 West Bannock Street | Suite 350
Boise, ID 83702
T 208.389.7700

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