WATER | ENERGY | LIFE

CITY OF RIVERSIDE

PUBLIC UTILITIES

CITY OF RIVERSIDE PUBLIC UTILITIES Groundwater Atlas

2024

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CITY OF RIVERSIDE PUBLIC UTILITIES

Groundwater Atlas

2024

CONTENTS

INTRODUCTION

The Groundwater Atlas aims to provide a comprehensive report on the water quality and quantity conditions of the groundwater basins that provide potable and non-potable water supplies to Riverside Public Utilities' (RPU) customers. This Atlas will support RPU's groundwater management strategies and activities related to managing water supplies in a sustainable and resilient manner.

RPU provides potable, non-potable, and recycled water to the City of Riverside (City). Serving a population of approximately 299,800 residents through 69,340 service connections, the RPU service area spans 75 square miles. In addition, RPU provides surplus potable and non-potable water to Western Municipal Water District, which serves City residents outside of the RPU service area. A small amount of potable water is also supplied to the City of Norco via a wholesale agreement. Since 2009, all of the City's potable water demand has been supplied solely from local groundwater rights as established by the court's Western-San Bernardino 1969 Judgment.

The condition of the groundwater basins is dynamic and influenced by various factors beyond RPU's control, including groundwater contamination from historical agricultural, industrial, and defense practices, natural variations in weather patterns, actions by other agencies, and evolving State and Federal regulations. These basins are shared with other water providers and their associated water infrastructure, such as well fields, groundwater recharge facilities, and wastewater treatment plants. The operation of these facilities combined with regional hydrologic variance adds to the complexity of managing these resources. To ensure a reliable and sustainable water supply for both current and future generations, RPU closely tracks annual groundwater basin conditions. This 2024 edition of the Groundwater Atlas presents data collected from January 1, 2024, to December 31, 2024, and provides insights into groundwater hydrology, production, recharge, levels, and quality.

The purpose of this Groundwater Atlas is to:

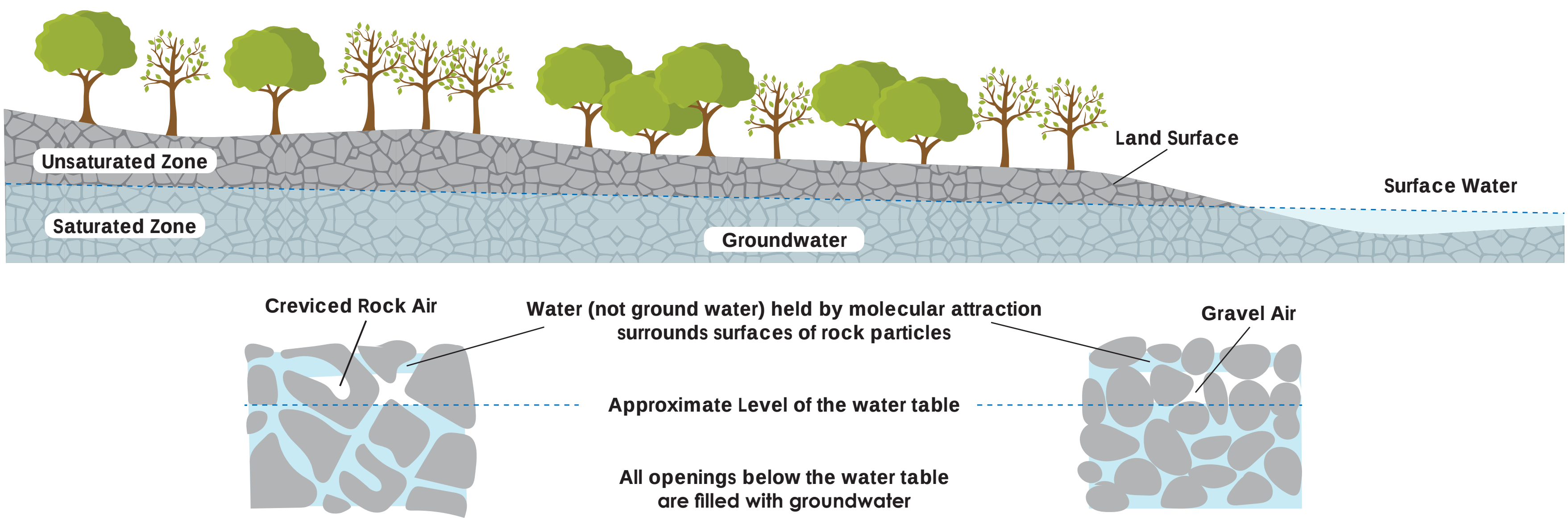
- Characterize groundwater basin conditions and how they change over time.
- Provide readable and reliable data to customers, elected officials, executive management, and staff.
- Provide information and analysis to RPU staff for use in managing the City's water supply.
- Protect RPU's strong water supply position and financial stability.

Fairmount Park Monument Sign

ABOUT OUR GROUNDWATER BASINS

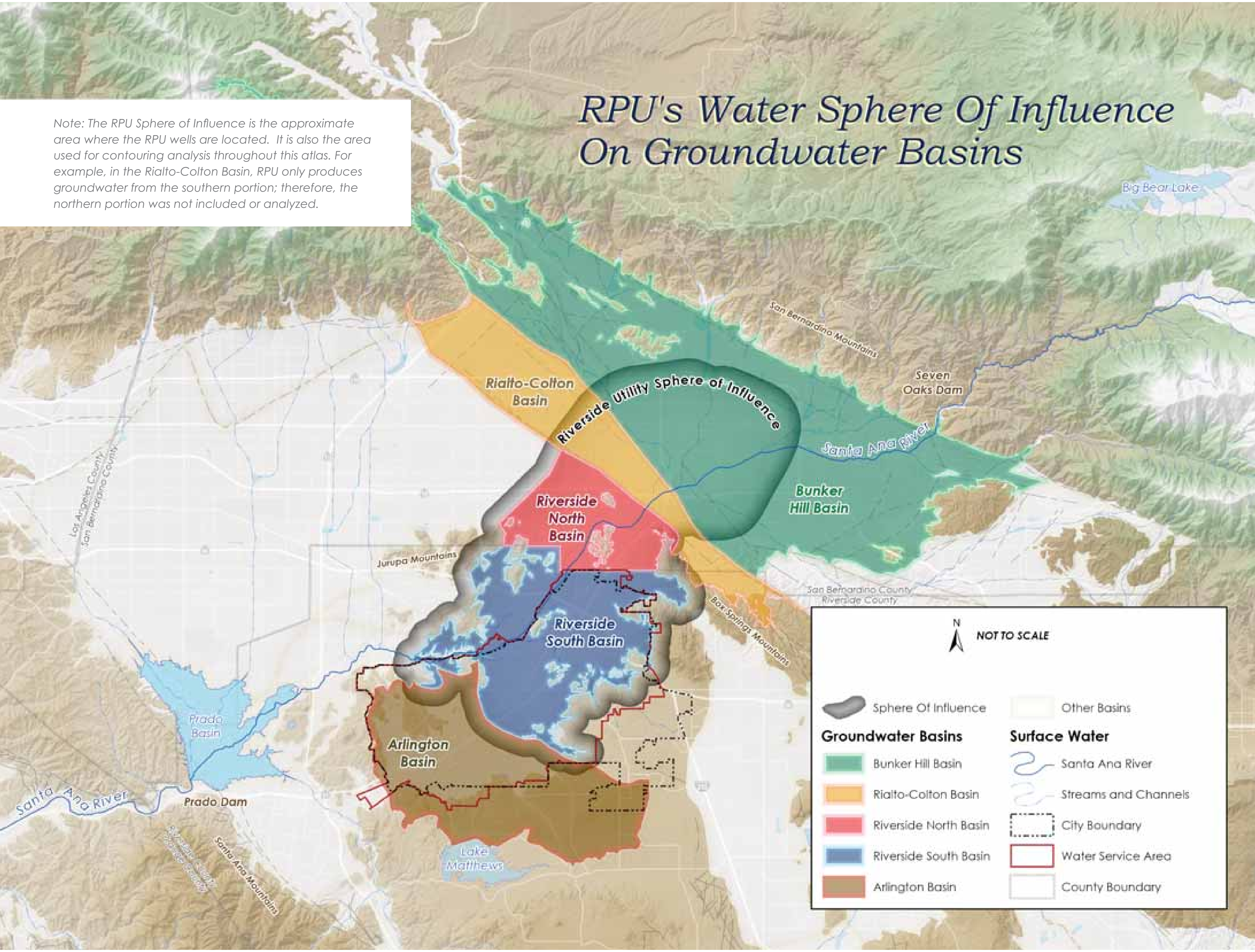
The City of Riverside was developed around the once prolific water supply of the Santa Ana River. Our groundwater basins are significantly influenced by the tectonic forces of the San Andreas and San Jacinto faults. The San Jacinto fault limits the movement of groundwater and forces shallow groundwater to the surface. The San Jacinto Fault, in conjunction with semi-confining clay zone's helped to pressurize portions of the groundwater beneath the City of San Bernardino. As the surface water flows from the Santa Ana River diminished from weather patterns and regional development in the late 1800s, RPU took advantage of the seismically-influenced groundwater basins to drill and construct artesian wells. The artesian wells acted as a conduit, allowing pressurized water to escape freely from the ground. As these pressures and high groundwater levels decreased in the early 1900s, RPU began equipping these groundwater wells with pumps. Today, groundwater levels and pressures have subsided to some of the lowest levels in recent times. However, the aquifer remains a prolific and productive source for local groundwater.

RPU's water supplies come from groundwater basins consisting of underground geologic formations called aquifers that are fed by rain and snow melting in the San Bernardino Mountains and local foothills and is illustrated in the graphic below. RPU produces water from four groundwater basins adjacent to the Santa Ana River including the Bunker Hill, Rialto-Colton, Riverside North and Riverside South Basins as shown in the figure on the adjacent page. Over the years, RPU has constructed infrastructure that enables efficient groundwater management, achieving complete independence from imported water supplies since 2009.



RPU's Water Sphere Of Influence On Groundwater Basins

Note: The RPU Sphere of Influence is the approximate area where the RPU wells are located. It is also the area used for contouring analysis throughout this atlas. For example, in the Rialto-Colton Basin, RPU only produces groundwater from the southern portion; therefore, the northern portion was not included or analyzed.



Enhanced Recharge Project

01 HYDROLOGIC CONDITIONS

1

HYDROLOGIC CONDITIONS

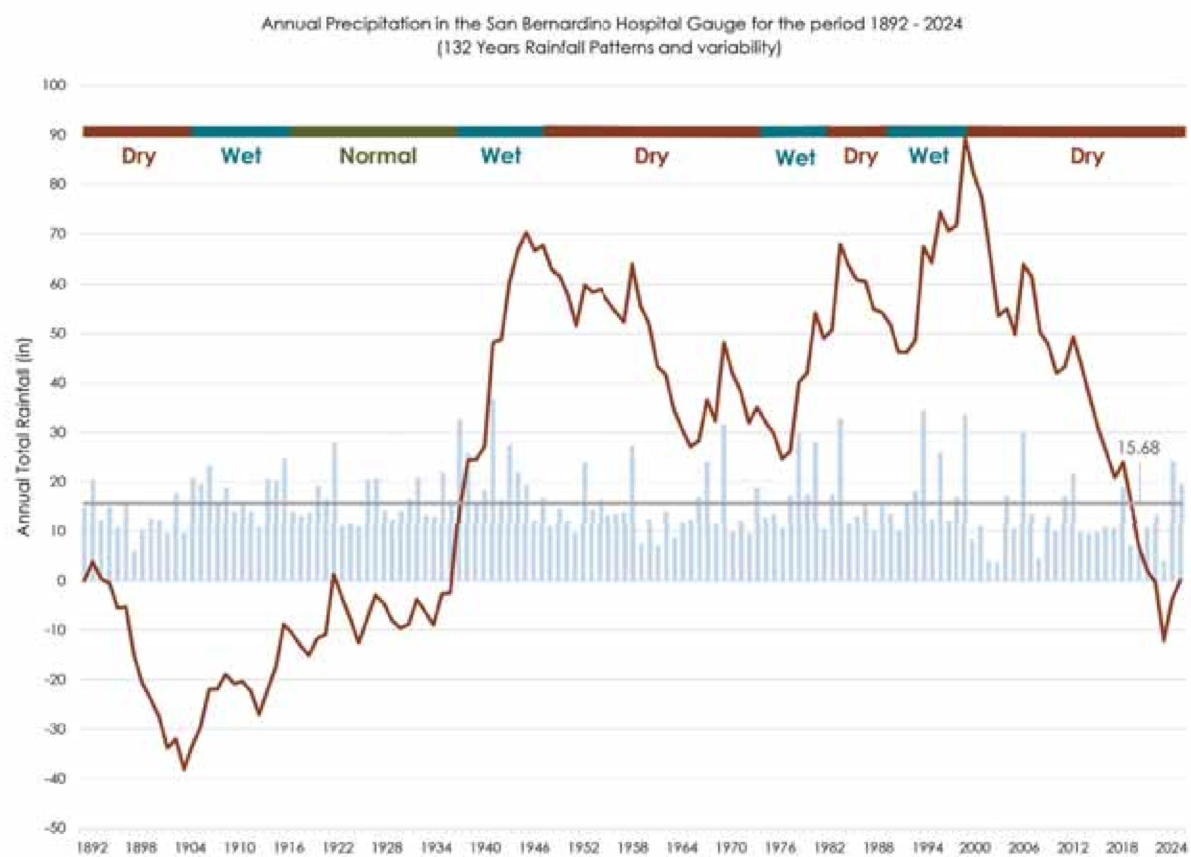
Both regional and local hydrologic conditions fluctuate year to year. Understanding the relationships between meteorological, surface water, groundwater, and biological factors that influence the flow, quality, and recharge of water in a groundwater basin is important and can have significant impacts on local water supplies.

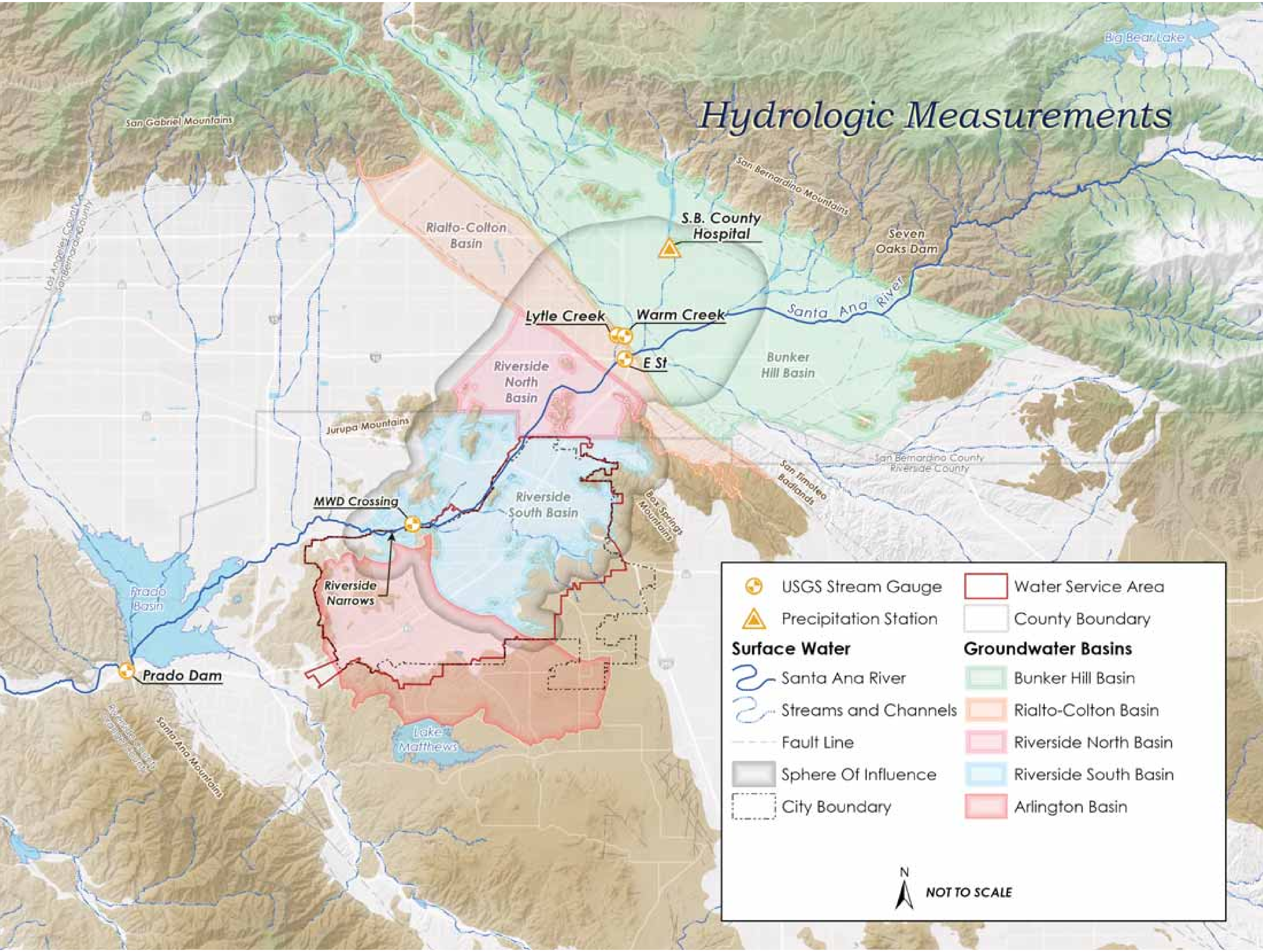
RPU participates in monitoring the hydrologic conditions of the region through measurements of precipitation and flow in the Santa Ana River and its tributaries. The primary source of recharge to the groundwater basins is precipitation. The region uses a precipitation gage of San Bernardino County to characterize long-term meteorological conditions. The average annual rainfall over historical record was about 15.68 inches and 10.6 inches in the last 10 years (2014 -2024) during an extended dry period. The following chart shows the cumulative departure from mean (CDFM) precipitation. The CDFM plot characterize the occurrence and magnitude of wet upward trend), dry (downward trend), and normal periods (flat trend). These trends are labeled at the top of the chart. The period from 1999 until 2024 shows a 26-year dry period with eight wet years during this period.

Historical Annual Precipitation

(San Bernardino County Hospital Gage)

San Bernardino's average annual precipitation over the last 132 years is 15.68 inches.

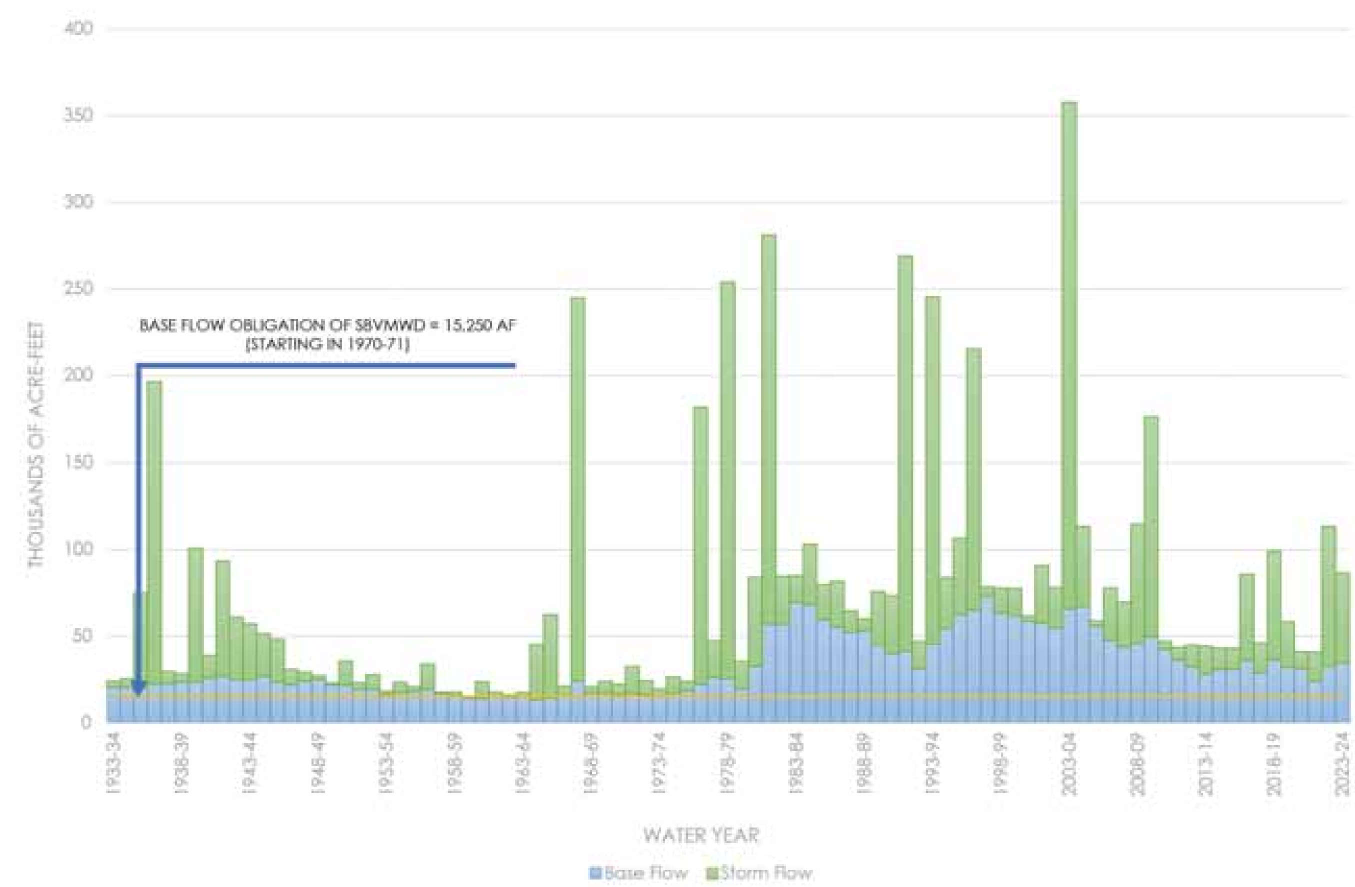


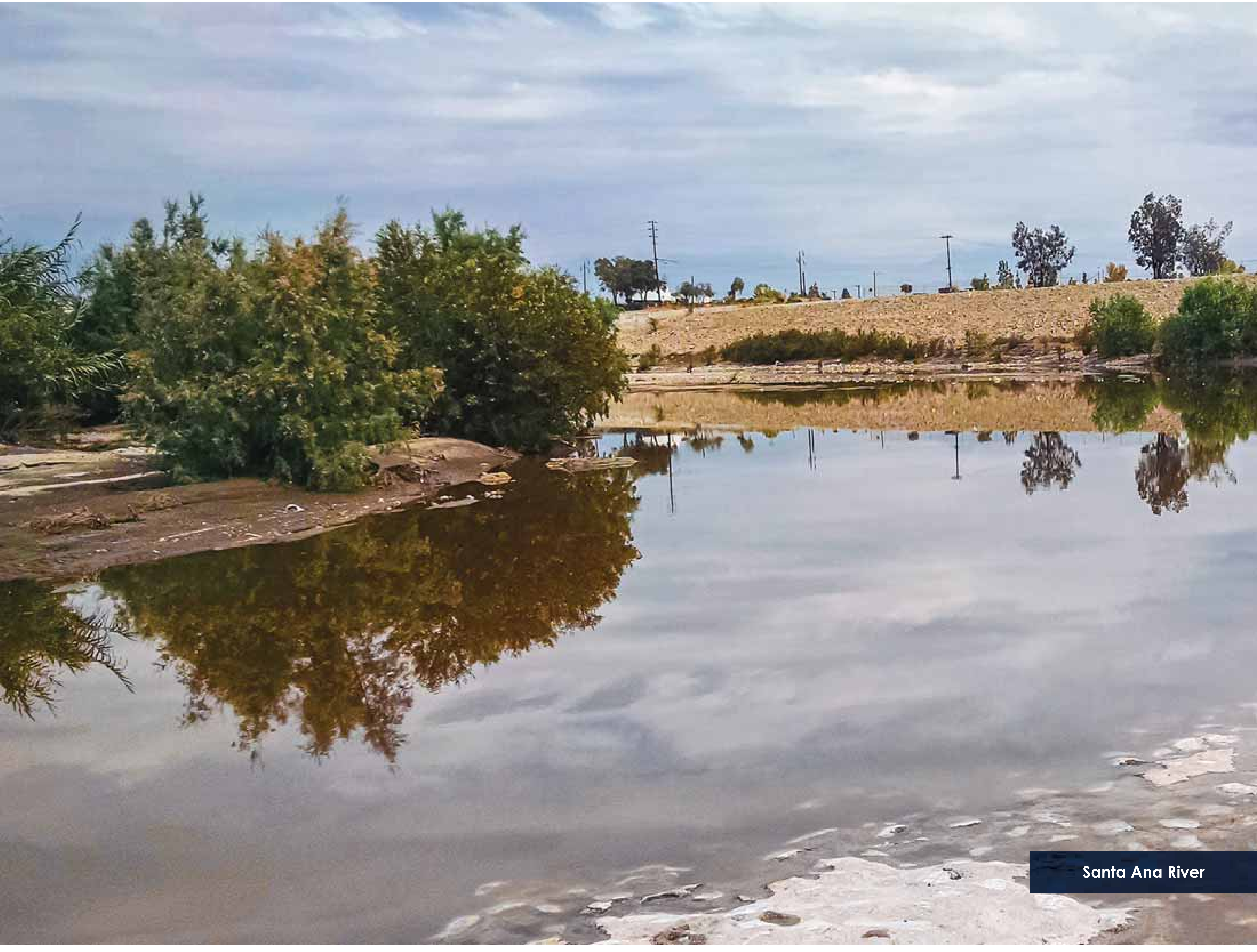


Hydrologic Measurements
San Gabriel Mountains
Big Bear Lake
San Bernardino Mountains
Seven Oaks Dam
S.B. County Hospital
Rialto-Colton Basin
Lytle Creek
Warm Creek
Santa Ana River
E St
Bunker Hill Basin
Riverside North Basin
Jurupa Mountains
Los Angeles County
San Bernardino County
Riverside South Basin
San Bernardino County
Riverside County
San Timoteo Badlands
Box Springs Mountains
MWD Crossing
Riverside Narrows
Prado Basin
Prado Dam
Lake Matthews
Santa Ana Mountains
USGS Stream Gauge
Precipitation Station
Surface Water
Santa Ana River
Streams and Channels
Fault Line
Sphere Of Influence
City Boundary
Water Service Area
County Boundary
Groundwater Basins
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
Riverside South Basin
Arlington Basin
N
NOT TO SCALE

The Santa Ana River Watermasters characterize the hydrology in the region by quantifying the flow in the Santa Ana River at Riverside Narrows, and RPU monitors the data. The flow is measured by the United States Geological Survey (USGS) at a gaging station named Santa Ana River at MWD Crossing (USGS-11066460) near the Riverside narrows. The chart below illustrates the annual time series of the baseflow and stormwater flow at the MWD Crossing station. Baseflow is the portion of streamflow that is sustained between precipitation events and primarily consists of effluent from municipal wastewater treatment plants located along the river as well as groundwater rising to the surface due to shallow bedrock. Minimum baseflow discharges were identified by water managers in the 1960s to ensure that everyone along the Santa Ana River had enough water supplies for beneficial uses. The data is utilized to measure compliance with water rights, ensuring that the Orange County agencies have the quantity and quality that was agreed to in the 1969 Judgment.

Discharge of Santa Ana River at Riverside Narrows starting with 1934-35




Santa Ana River

Canyon Crest Booster Station

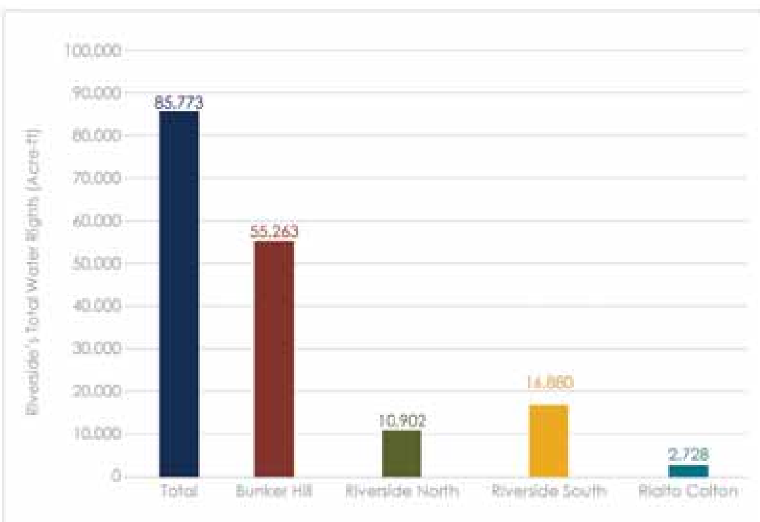
02 GROUNDWATER RESOURCES MANAGEMENT

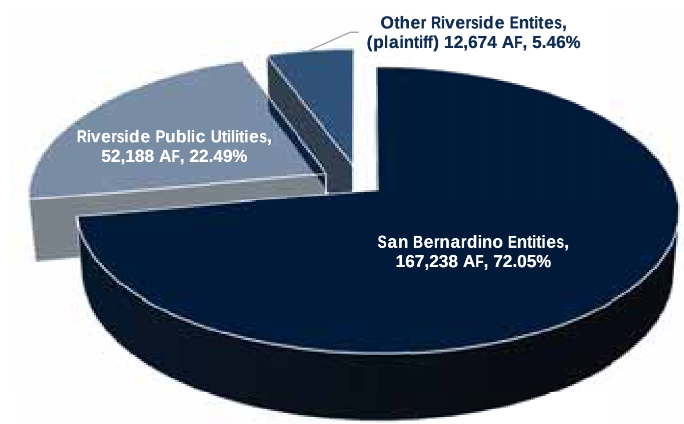
2 GROUNDWATER RESOURCES MANAGEMENT

The City started developing water supplies from the region in the 1870s. Since this time, RPU and its customers/owners have continually improved its water conveyance system and have strategically and cost-effectively developed the City's water supply from key locations within the groundwater basins.

RPU keeps its customers and decision-makers informed with the best available data and management practices. In turn, this has preserved the City's strong regional water rights and superior water quality by holding responsible parties accountable. The City actively defends its water rights, which were clearly defined "through the adjudication process of" the 1969 Judgment. RPU management maintains a close dialogue with the Western-San Bernardino Watermaster to ensure groundwater compliance with the Judgment is maintained. As the groundwater conditions continue to change and new challenges emerge, RPU continues to assess the groundwater conditions and inform its customers and public representatives of the conditions and the best management practices to move the City forward with a reliable water supply portfolio of local water supplies. As a plaintiff party to the Western-San Bernardino Judgment, the City 's total water right and base period production is 85,773 AF.

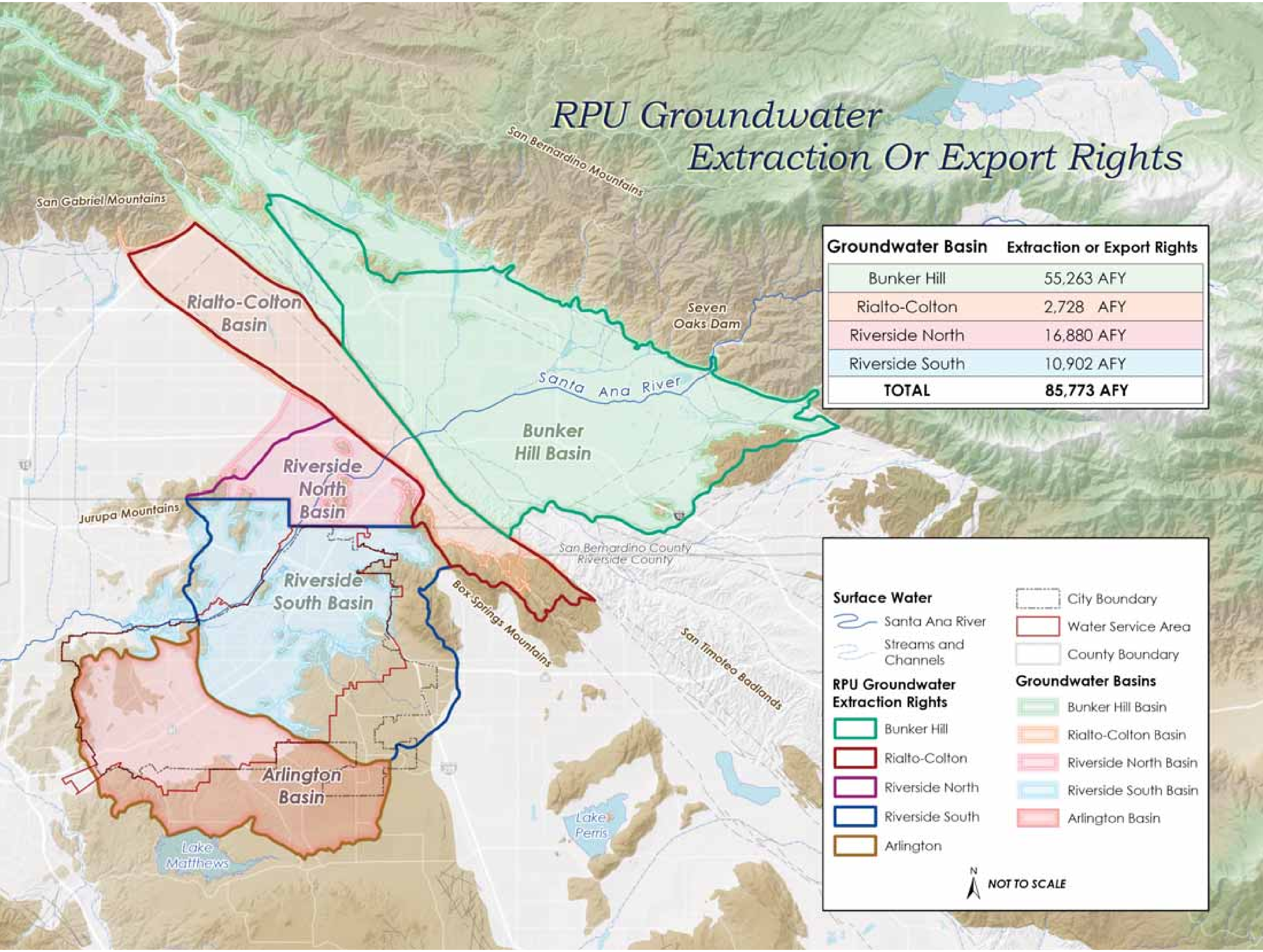
The City of Riverside Total Water Right and Base Period Production (in acre-feet) by Basin





The original division of water resources in the San Bernardino Basin Area.

Source: Physical Solution Western-San Bernardino Watermaster



Groundwater Basin	Extraction or Export Rights
Bunker Hill	55,263 AFY
Rialto-Colton	2,728 AFY
Riverside North	16,880 AFY
Riverside South	10,902 AFY
TOTAL	**85,773 AFY**

Seven Oaks Dam

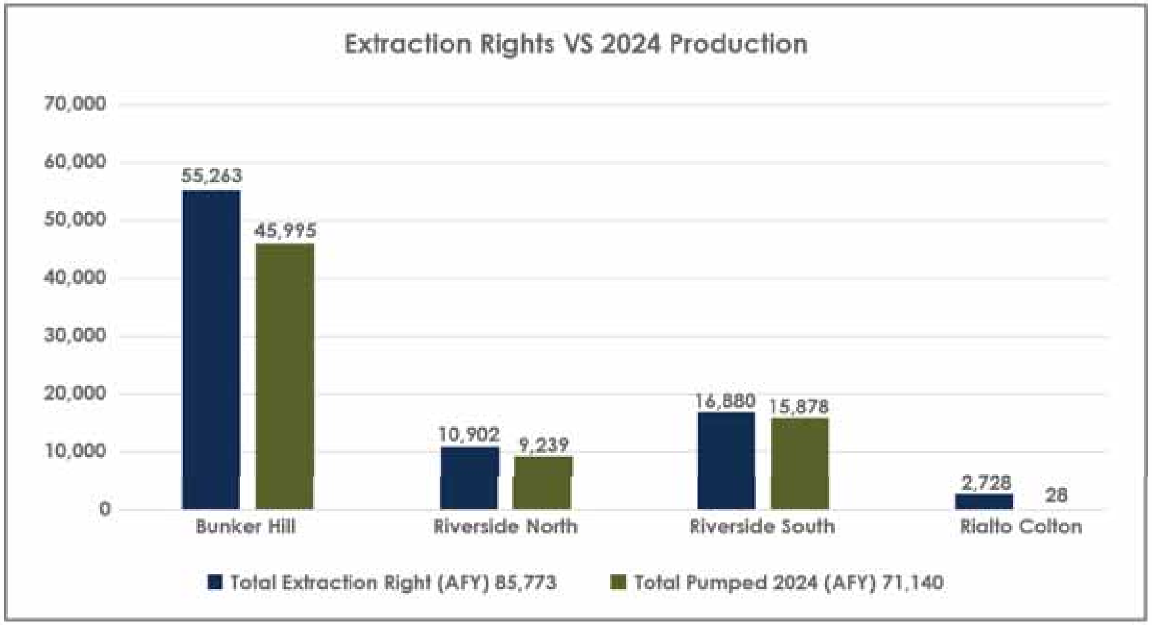
03 GROUNDWATER PRODUCTION

3 GROUNDWATER PRODUCTION

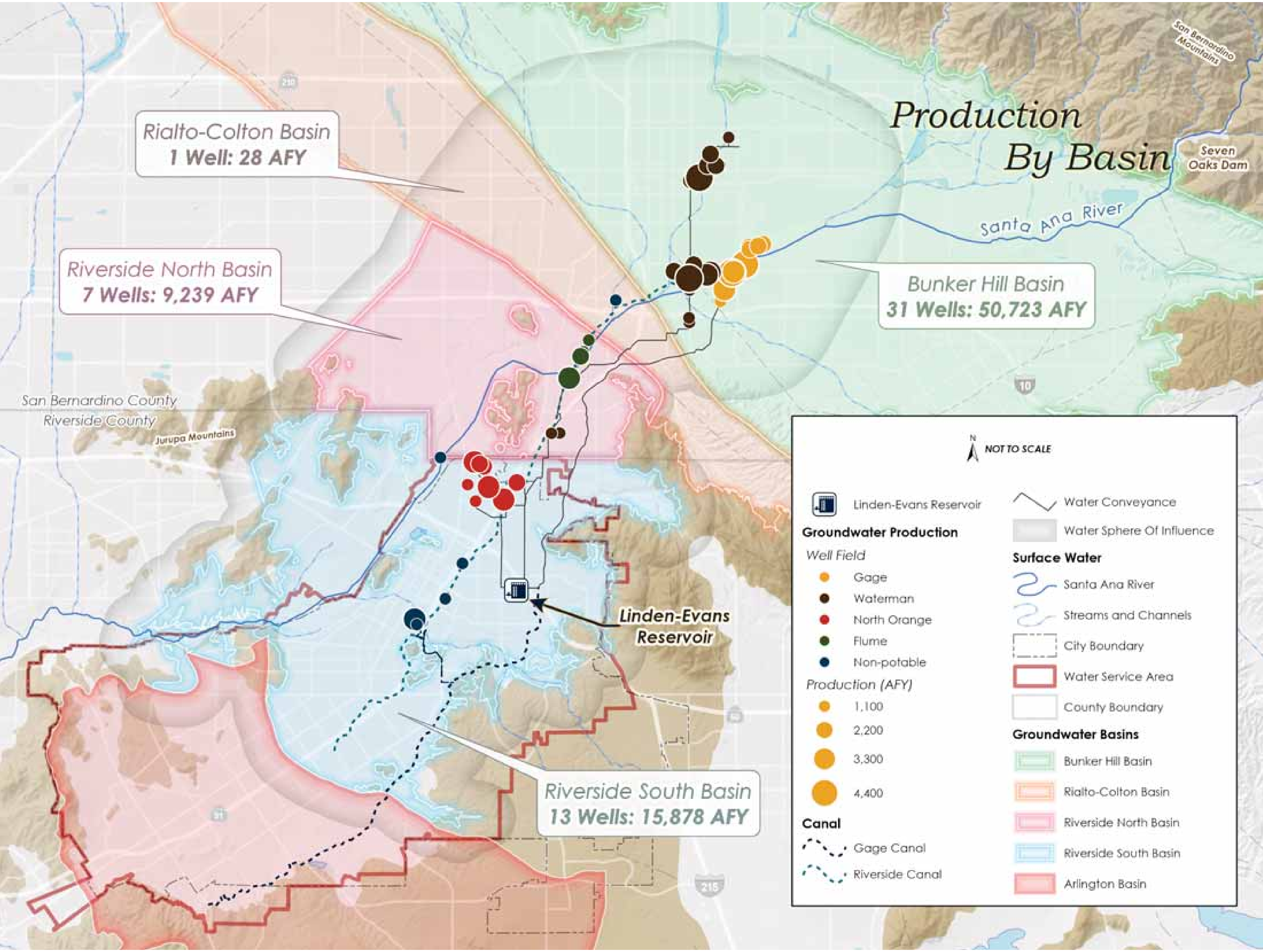
RPU has over 52 active wells located in five well fields that produce groundwater from the Bunker Hill, Rialto-Colton Basin, Riverside North, and Riverside South groundwater basins. The majority of groundwater is produced from the Waterman and Gage well field located in the Bunker Hill Basin.

Groundwater extracted from the groundwater basins is conveyed via pipeline to RPU's potable or non-potable distribution system based on the well location and demand. Raw groundwater from all of RPU's wells receives some form of treatment prior to entering the potable distribution system. In 2024, RPU operated 45 active potable water wells and 7 active non-potable water wells, for a total of 52 active wells. In addition, a portion of the treated potable water produced along the Gage pipeline is used for irrigation purposes by Gage Canal Company (GCC) customers located within Riverside's "Greenbelt".

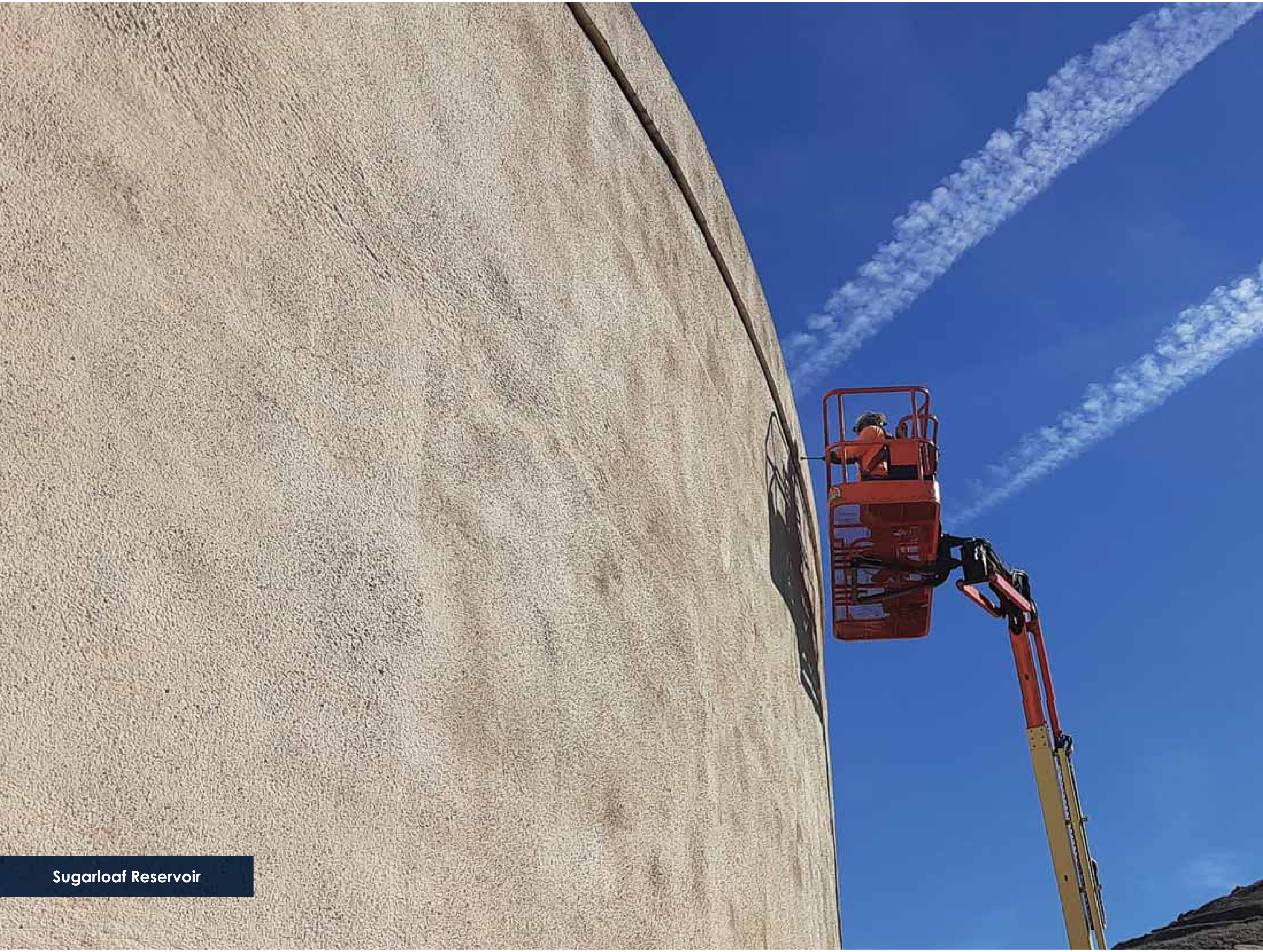
Since 2009, 100% of RPU's water supplies have originated from the groundwater basins, Flume, Gage, North Orange, Rialto-Colton, and Waterman well fields. RPU's wells are generally located in the section of the basin, with the greatest thickness of water-bearing layers, in which 71,140 AF were pumped in 2024 under the City's water right and the rest 4,727 AF were wheeled to WMWD under their water right. Approximately 75,868 acre-feet, which equal to 24.65 billion gallons, of water were extracted from aquifers in 2024 to supply water to the RPU service area and wheeled water to WMWD. The Western-San Bernardino Watermaster prepares an annual report presenting groundwater production data, while the Santa Ana River Watermaster prepares an annual report on the surface water flows along the Santa Ana River. These annual Watermaster reports are issued and submitted to the court annually to comply with the 1969 Judgment, which set surface water and groundwater rights for the region.



Groundwater Production by Basin in 2024



Production
By Basin
Rialto-Colton Basin
1 Well: 28 AFY
Riverside North Basin
7 Wells: 9,239 AFY
Bunker Hill Basin
31 Wells: 50,723 AFY
Riverside South Basin
13 Wells: 15,878 AFY
Linden-Evans Reservoir
Santa Ana River
San Bernardino Mountains
Seven Oaks Dam
San Bernardino County
Riverside County
Jurupa Mountains
NOT TO SCALE
Linden-Evans Reservoir
Groundwater Production
Well Field
Gage
Waterman
North Orange
Flume
Non-potable
Production (AFY)
1,100
2,200
3,300
4,400
Canal
Gage Canal
Riverside Canal
Water Conveyance
Water Sphere Of Influence
Surface Water
Santa Ana River
Streams and Channels
City Boundary
Water Service Area
County Boundary
Groundwater Basins
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
Riverside South Basin
Arlington Basin



Sugarloaf Reservoir

04 GROUNDWATER FACILITIES

4 GROUNDWATER FACILITIES

RPU has a vast network of conveyance facilities to deliver the groundwater produced from the basins to its customers through wells, treatment facilities, pipelines, reservoirs, and canals. RPU relies on these facilities and maintains them to ensure a reliable water supply throughout every season of the year.

Since 2009, all the City's water demand has been supplied from local groundwater sources in the Bunker Hill and Riverside basins.

RPU's potable water is conveyed via the Waterman, Gage, and North Orange distribution main pipelines to RPU customers. RPU's non-potable water is delivered by the Riverside and the Gage Canal to the WMWD and GCC respectively. Reports are prepared annually presenting groundwater production data and water quality.

Groundwater Well Production and Pipes

POTABLE WATER

WATERMAN + FLUME

- 22 Production Wells
- Producing 36,498 acre-feet in 2024
- Maximum monthly demand 4,124 acre-feet in 2024
- 19.69 miles of pipeline
- 72 inches max pipe diameter

GAGE

- 15 Production Wells
- Producing 18,108 acre-feet in 2024
- Maximum monthly demand 1,720 acre-feet in 2024
- 14.84 miles of pipeline
- 60 inches max pipe diameter

NORTH ORANGE

- 8 Production Wells
- Producing 12,165 acre-feet in 2024
- Maximum monthly demand 1,450 acre-feet in 2024
- 9.19 miles of pipeline
- 60 inches max pipe diameter

NON-POTABLE WATER

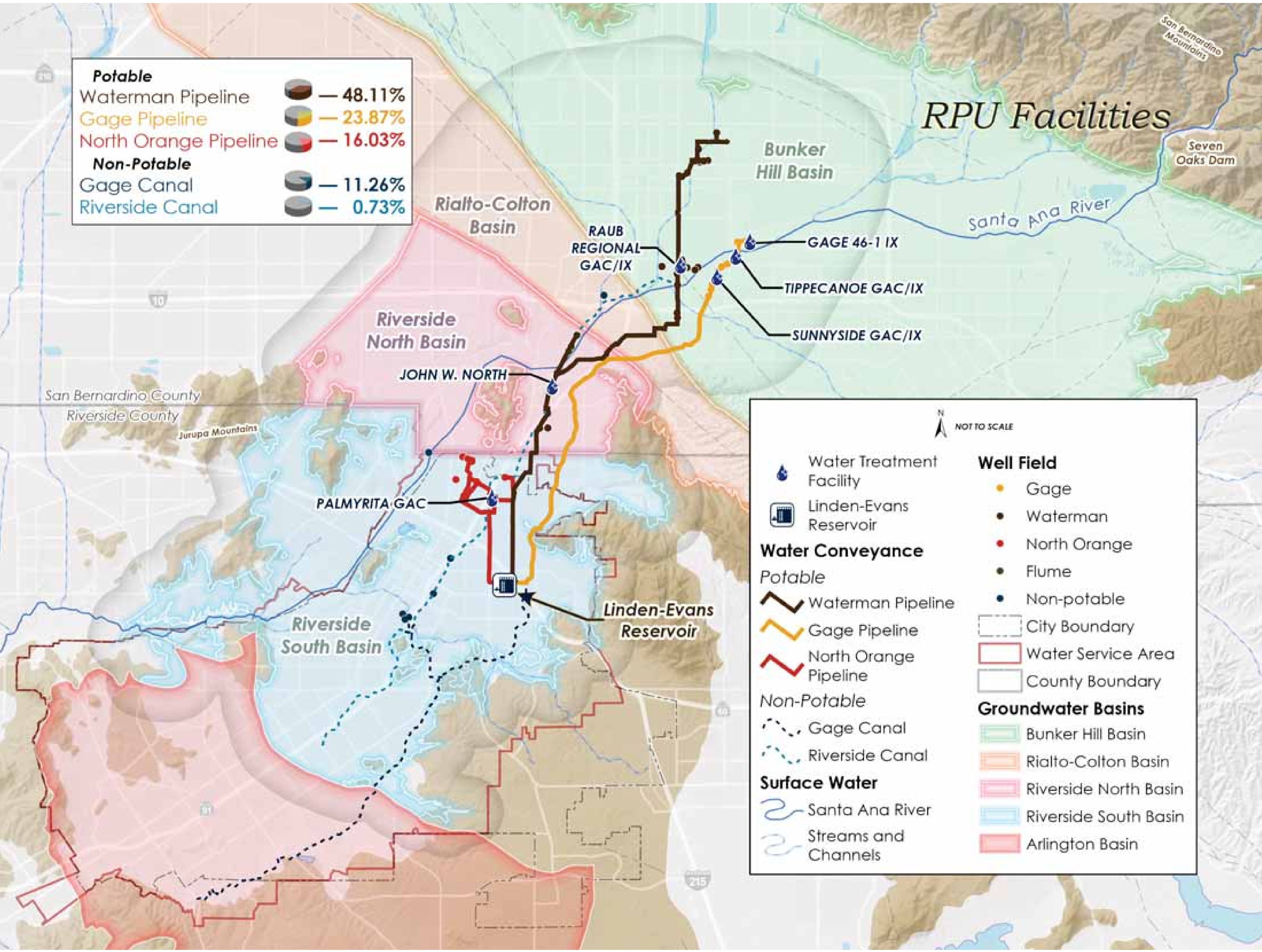
RIVERSIDE CANAL

- 3 Production Wells
- Producing 552 acre-feet in 2024
- Maximum monthly demand 118 acre-feet in 2024
- 13.9 miles

GAGE CANAL

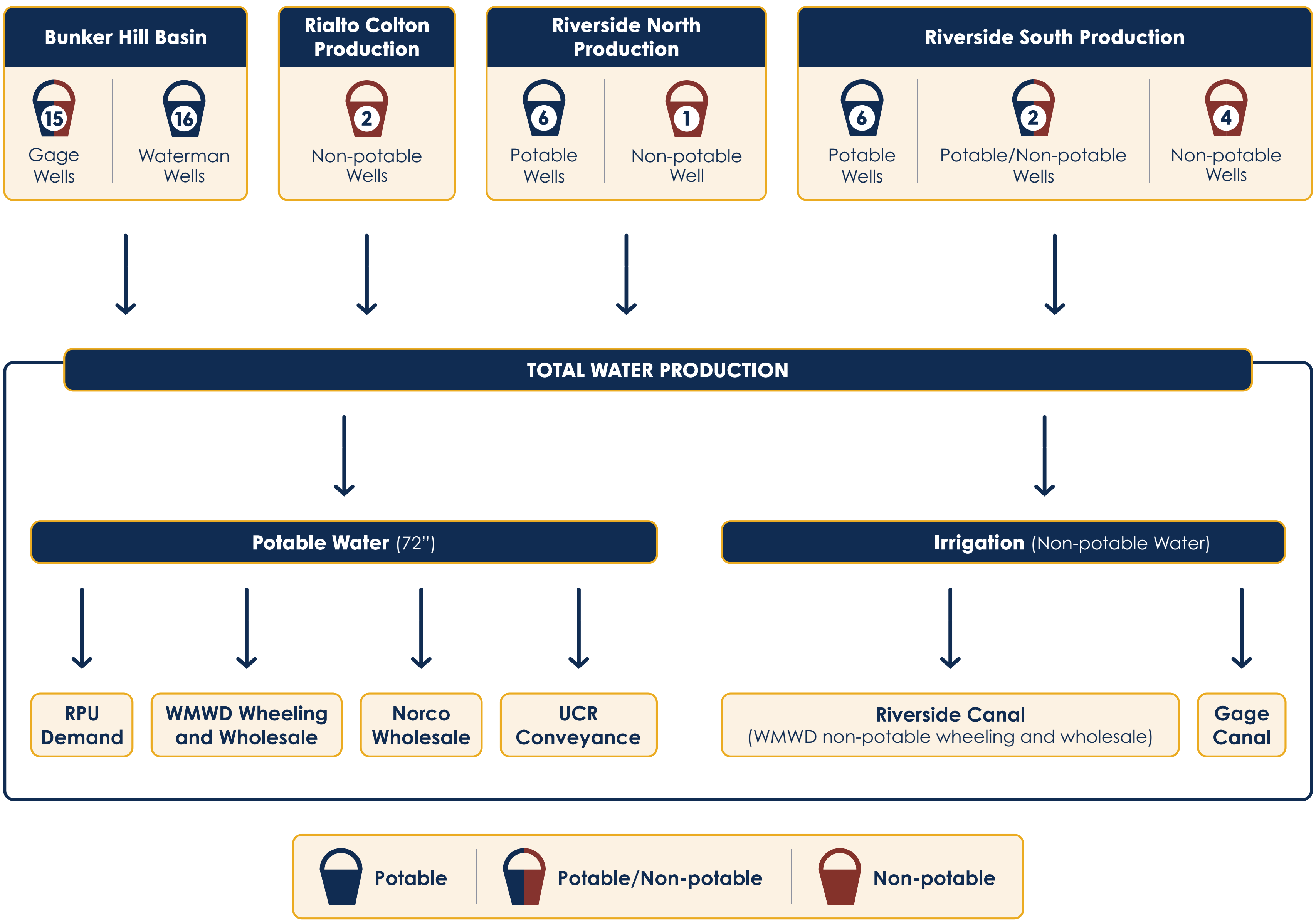
- 3 Production Wells
- Producing 8,545 acre-feet in 2024
- Maximum monthly demand 1,065 acre-feet in 2024
- 15.6 miles

Total Potable Water = 66,772 AF
Total Non-Potable Water = 9,096 AF
This includes overlaying use (Jurupa)



RPU Facilities
Potable
Waterman Pipeline — 48.11%
Gage Pipeline — 23.87%
North Orange Pipeline — 16.03%
Non-Potable
Gage Canal — 11.26%
Riverside Canal — 0.73%
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
Riverside South Basin
Santa Ana River
San Bernardino Mountains
Seven Oaks Dam
San Bernardino County
Riverside County
Jurupa Mountains
RAUB REGIONAL GAC/IX
GAGE 46-1 IX
TIPPECANOE GAC/IX
SUNNYSIDE GAC/IX
JOHN W. NORTH
PALMYRITA GAC
Linden-Evans Reservoir
NOT TO SCALE
Water Treatment Facility
Linden-Evans Reservoir
Water Conveyance
Potable
Waterman Pipeline
Gage Pipeline
North Orange Pipeline
Non-Potable
Gage Canal
Riverside Canal
Surface Water
Santa Ana River
Streams and Channels
Well Field
Gage
Waterman
North Orange
Flume
Non-potable
City Boundary
Water Service Area
County Boundary
Groundwater Basins
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
Riverside South Basin
Arlington Basin

RPU Water Production



Gage Well 92-3

Enhanced Recharge Pool

05 GROUNDWATER LEVELS

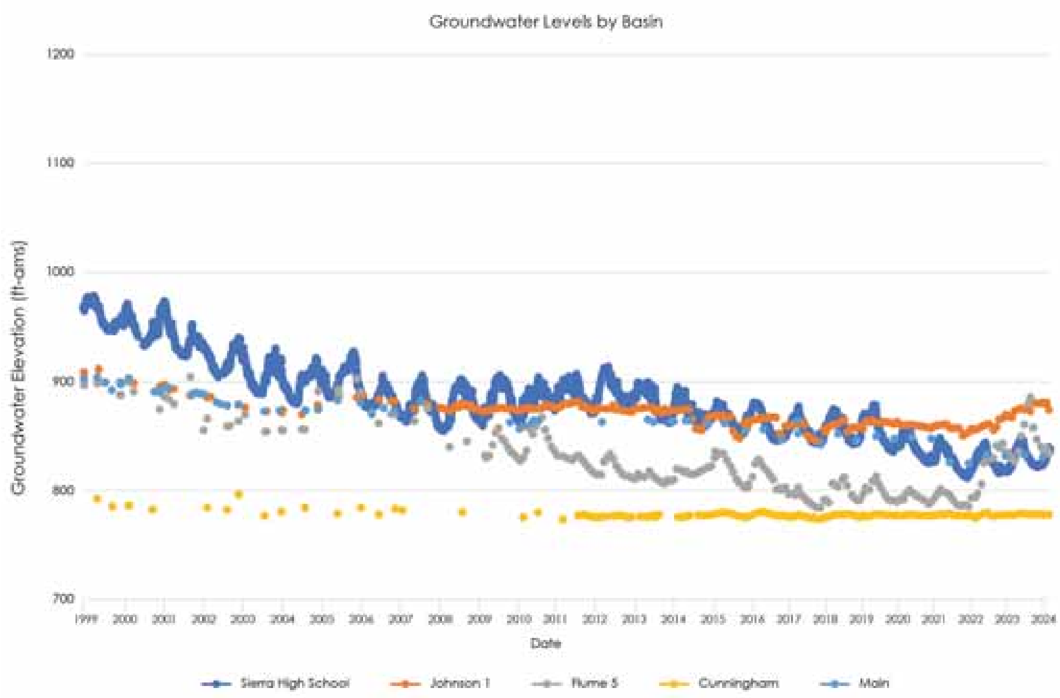
5 GROUNDWATER LEVELS

Overall groundwater conditions—specifically water levels—are unique to each basin. Tracking water levels throughout a basin can be used to understand how water levels respond to varying conditions (i.e., drought, groundwater pumping, recharge). RPU routinely measures water levels from their wells and uses this data to evaluate both short- and long-term trends. By collecting and evaluating this data, and understanding the factors driving changing conditions, RPU can act as environmental stewards, collaborate effectively with other local water agencies, and strategically plan future investments to ensure a reliable groundwater supply.

In 2024, RPU obtained over 100 water level measurements to determine the depth-to-water, flow direction, and gradient of groundwater in each basin. Groundwater elevations are calculated by subtracting the water level measurement from the surface elevation at each well. This information is then compared to historical data to identify trends in recharge and groundwater usage. Groundwater elevations are also contoured to identify pumping depressions, flow directions, areas of higher gradient, or areas that may be lower at depths to groundwater than anticipated. Over the last 20 years, average groundwater elevations have dropped over 100 feet in the Bunker Hill Basin with some areas having 200 feet in groundwater elevation change.

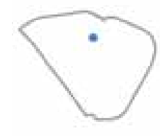
This section displays a series of maps showing the groundwater levels in 2023 and 2024 and the change in groundwater levels from 2023 to 2024. To illustrate the change in groundwater levels over the last 10 years, corresponding to the most recent drought, groundwater elevation contours were generated for 2014 and 2024 and the change in water levels.

Groundwater Levels by Basin



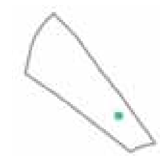
The figure above shows a time series of groundwater levels from representative wells located in Riverside's sphere of influence, overlying the groundwater basins from 1999 to the end of 2024. Each dot represents a groundwater level measurement and is plotted over time to identify trends. The chart shows how groundwater basins respond to hydrologic conditions and groundwater pumping. The groundwater levels in the respective basins represent a long-term decline in groundwater levels. Sierra High School, located in the Bunker Hill Basin, shows groundwater level declines of about 4.7 ft/yr. Johnson 1, located in the Rialto-Colton Basin, shows groundwater level declines of about 1.0 ft/yr. Flume 5, located in the Riverside North Basin, shows groundwater level declines of about 2.1 ft/yr. Cunningham, located in the Riverside South Basin, have been relatively stable with groundwater level declines of about 0.3 ft/yr over a 25-year time period.

Rate of Groundwater Level Decline from 1999 to 2024 within RPU's Sphere of Influence



BUNKER HILL

Decline of about 4.7 ft/yr



RIALTO-COLTON

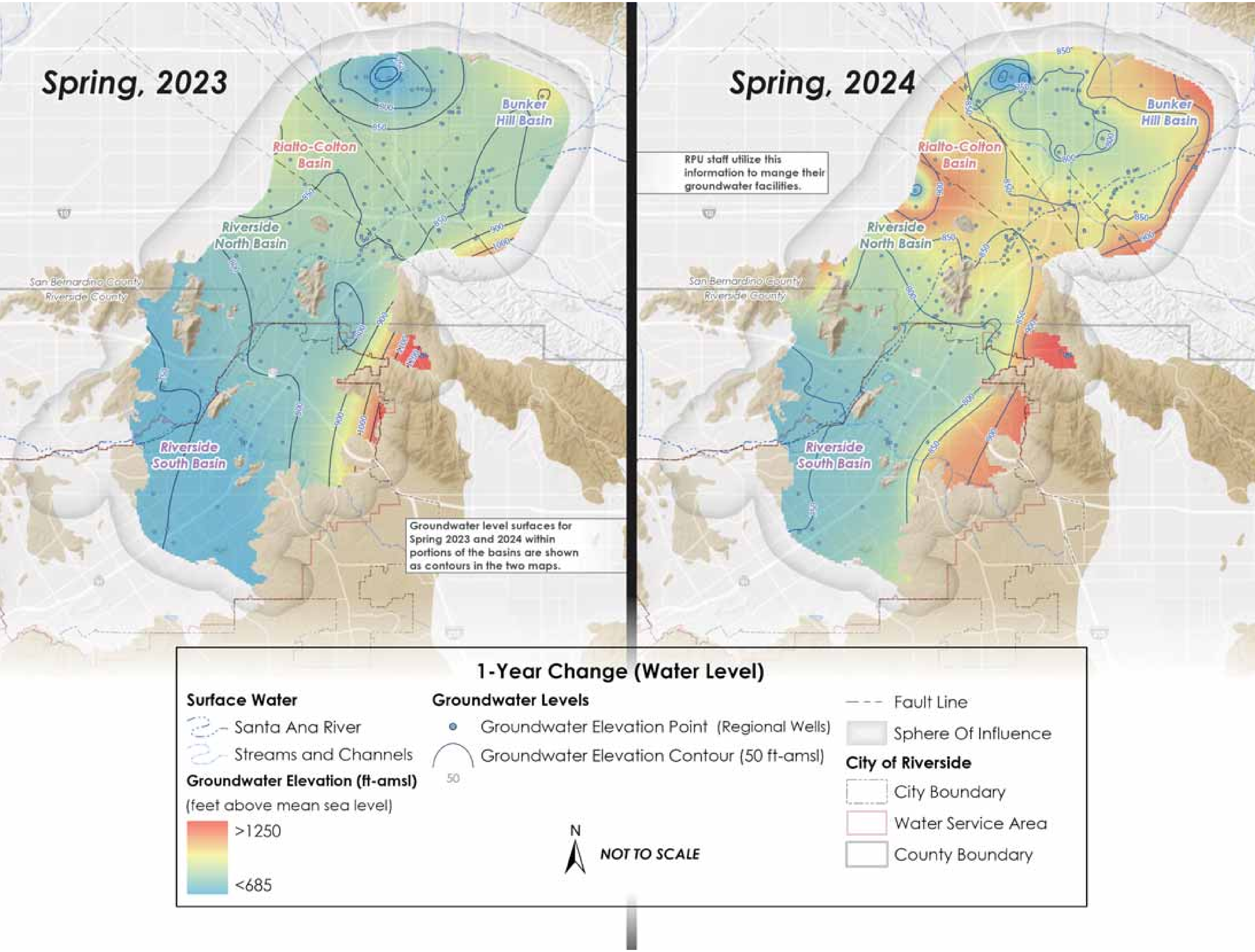
Decline of about 1.0 ft/yr

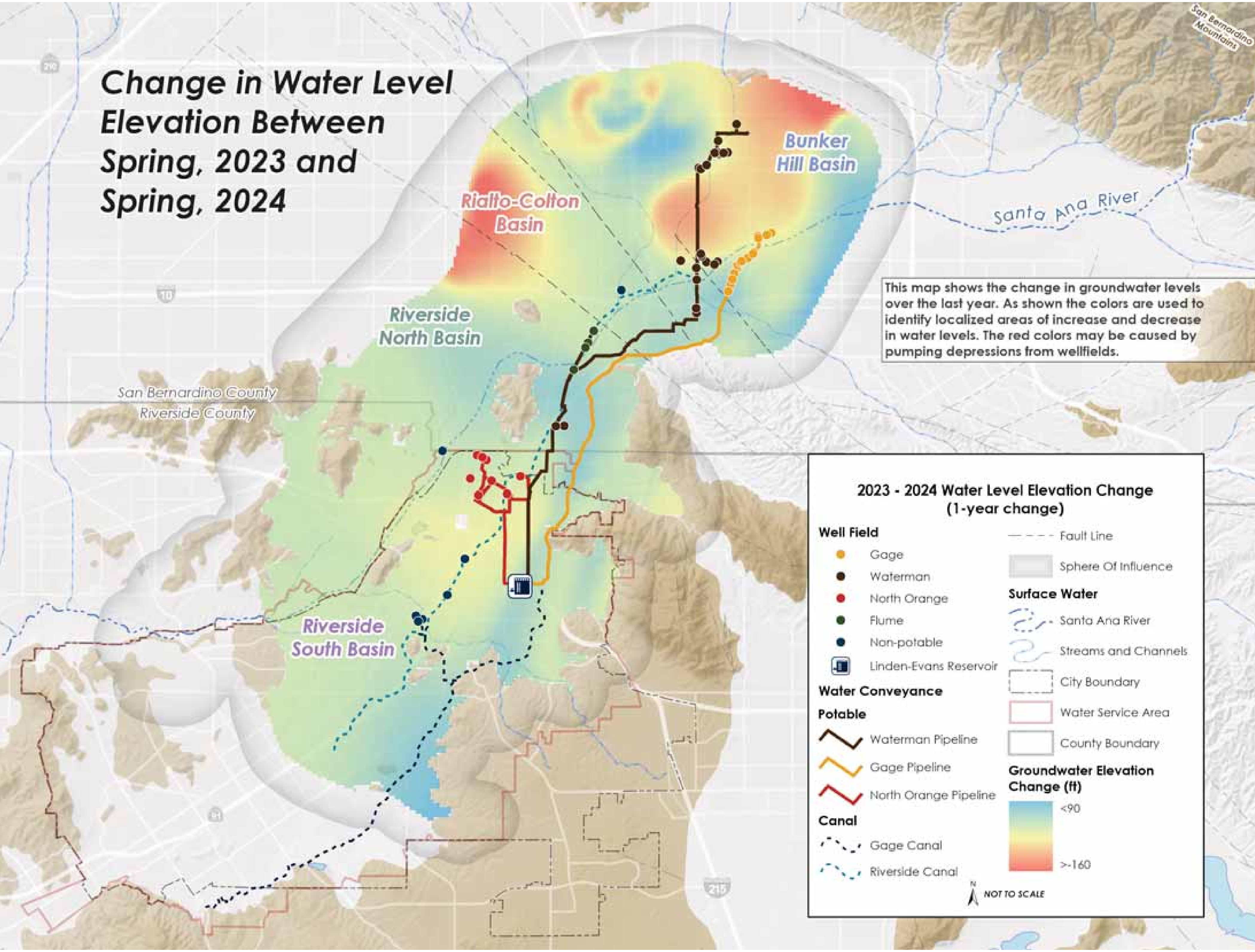
RIVERSIDE NORTH

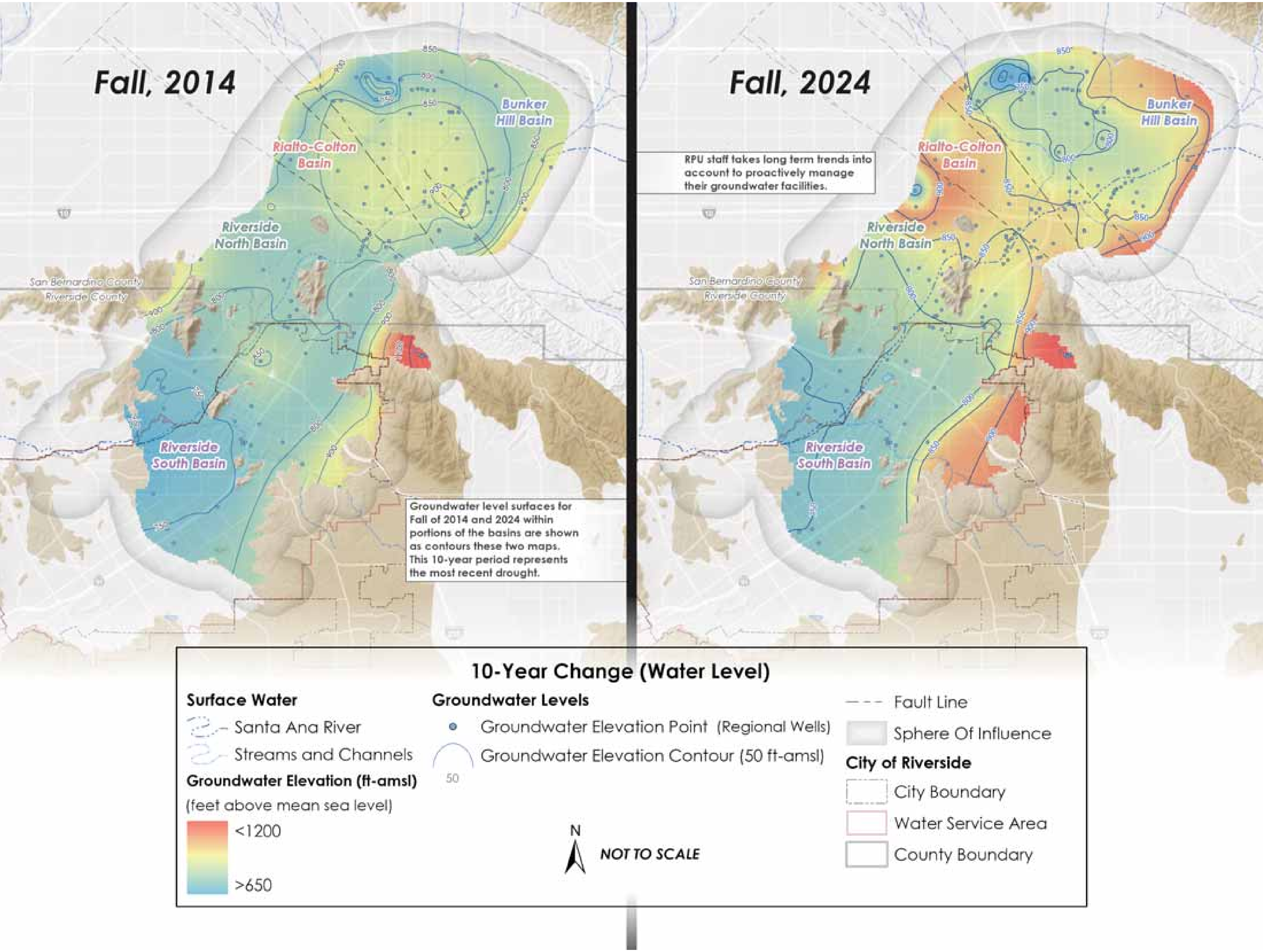
Decline of about 2.1 ft/yr

RIVERSIDE SOUTH

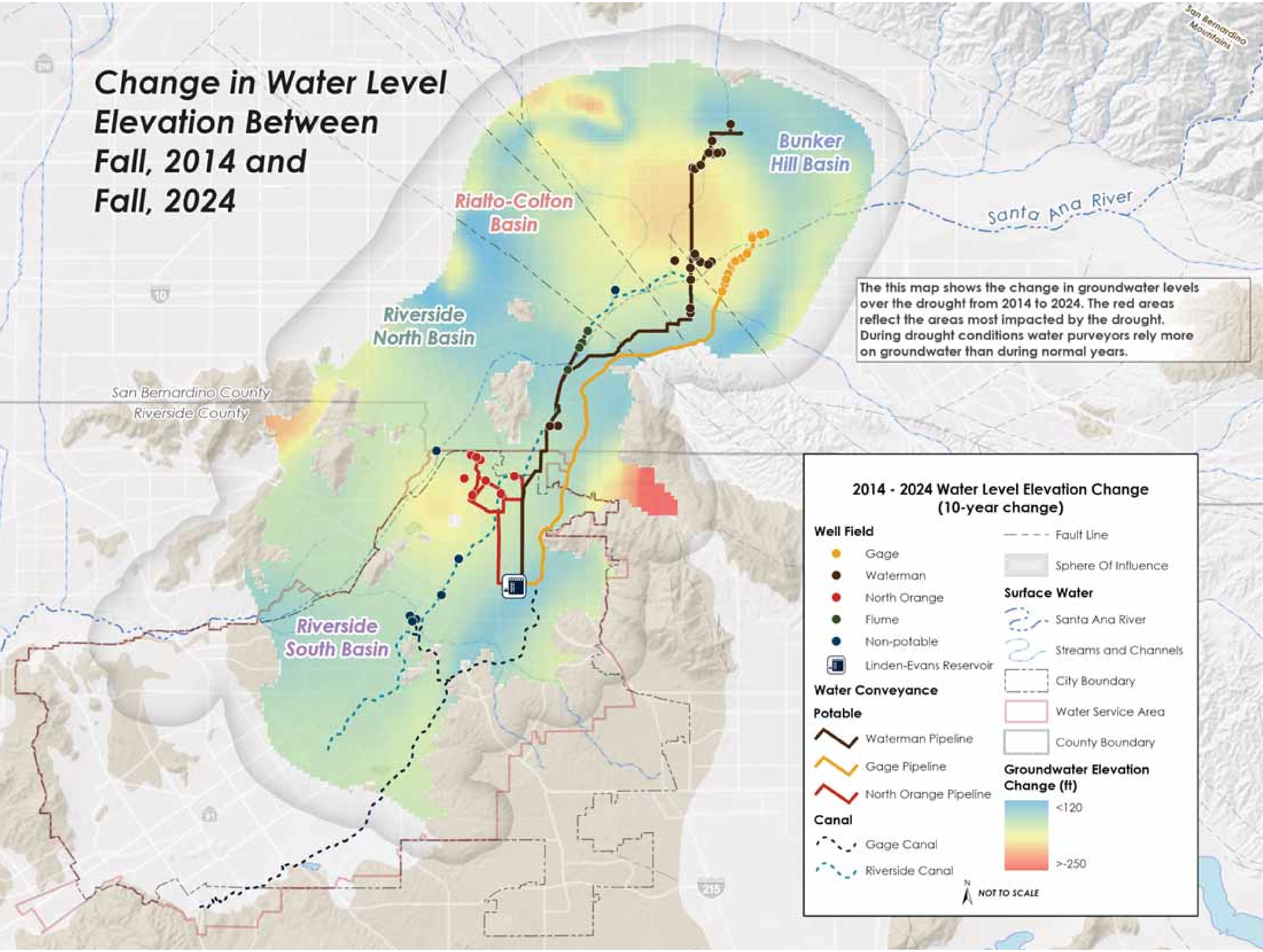
Decline of about 0.3 ft/yr


Spring, 2023
Spring, 2024
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
Riverside South Basin
San Bernardino County
Riverside County
RPU staff utilize this information to mange their groundwater facilities.
Groundwater level surfaces for Spring 2023 and 2024 within portions of the basins are shown as contours in the two maps.
1-Year Change (Water Level)
Surface Water
Santa Ana River
Streams and Channels
Groundwater Elevation (ft-amsl)
(feet above mean sea level)
>1250
<685
Groundwater Levels
Groundwater Elevation Point (Regional Wells)
Groundwater Elevation Contour (50 ft-amsl)
50
N
NOT TO SCALE
Fault Line
Sphere Of Influence
City of Riverside
City Boundary
Water Service Area
County Boundary


Change in Water Level Elevation Between Spring, 2023 and Spring, 2024
San Bernardino Mountains
Bunker Hill Basin
Rialto-Colton Basin
Santa Ana River
Riverside North Basin
Riverside South Basin
San Bernardino County
Riverside County
This map shows the change in groundwater levels over the last year. As shown the colors are used to identify localized areas of increase and decrease in water levels. The red colors may be caused by pumping depressions from wellfields.
2023 - 2024 Water Level Elevation Change (1-year change)
Well Field
Gage
Waterman
North Orange
Flume
Non-potable
Linden-Evans Reservoir
Water Conveyance
Potable
Waterman Pipeline
Gage Pipeline
North Orange Pipeline
Canal
Gage Canal
Riverside Canal
Fault Line
Sphere Of Influence
Surface Water
Santa Ana River
Streams and Channels
City Boundary
Water Service Area
County Boundary
Groundwater Elevation Change (ft)
<90
>-160
N
NOT TO SCALE
210
10
91
215



Fall, 2014
Fall, 2024
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
Riverside South Basin
San Bernardino County
Riverside County
RPU staff takes long term trends into account to proactively manage their groundwater facilities.
Groundwater level surfaces for Fall of 2014 and 2024 within portions of the basins are shown as contours these two maps. This 10-year period represents the most recent drought.
10-Year Change (Water Level)
Surface Water
Santa Ana River
Streams and Channels
Groundwater Elevation (ft-amsl)
(feet above mean sea level)
<1200
>650
Groundwater Levels
Groundwater Elevation Point (Regional Wells)
Groundwater Elevation Contour (50 ft-amsl)
50
N
NOT TO SCALE
Fault Line
Sphere Of Influence
City of Riverside
City Boundary
Water Service Area
County Boundary



Change in Water Level Elevation Between Fall, 2014 and Fall, 2024
San Bernardino Mountains
Bunker Hill Basin
Rialto-Colton Basin
Santa Ana River
Riverside North Basin
Riverside South Basin
San Bernardino County
Riverside County
The this map shows the change in groundwater levels over the drought from 2014 to 2024. The red areas reflect the areas most impacted by the drought. During drought conditions water purveyors rely more on groundwater than during normal years.
2014 - 2024 Water Level Elevation Change (10-year change)
Well Field
Gage
Waterman
North Orange
Flume
Non-potable
Linden-Evans Reservoir
Water Conveyance
Potable
Waterman Pipeline
Gage Pipeline
North Orange Pipeline
Canal
Gage Canal
Riverside Canal
Fault Line
Sphere Of Influence
Surface Water
Santa Ana River
Streams and Channels
City Boundary
Water Service Area
County Boundary
Groundwater Elevation Change (ft)
<120
>-250
NOT TO SCALE

Enhanced Recharge Project

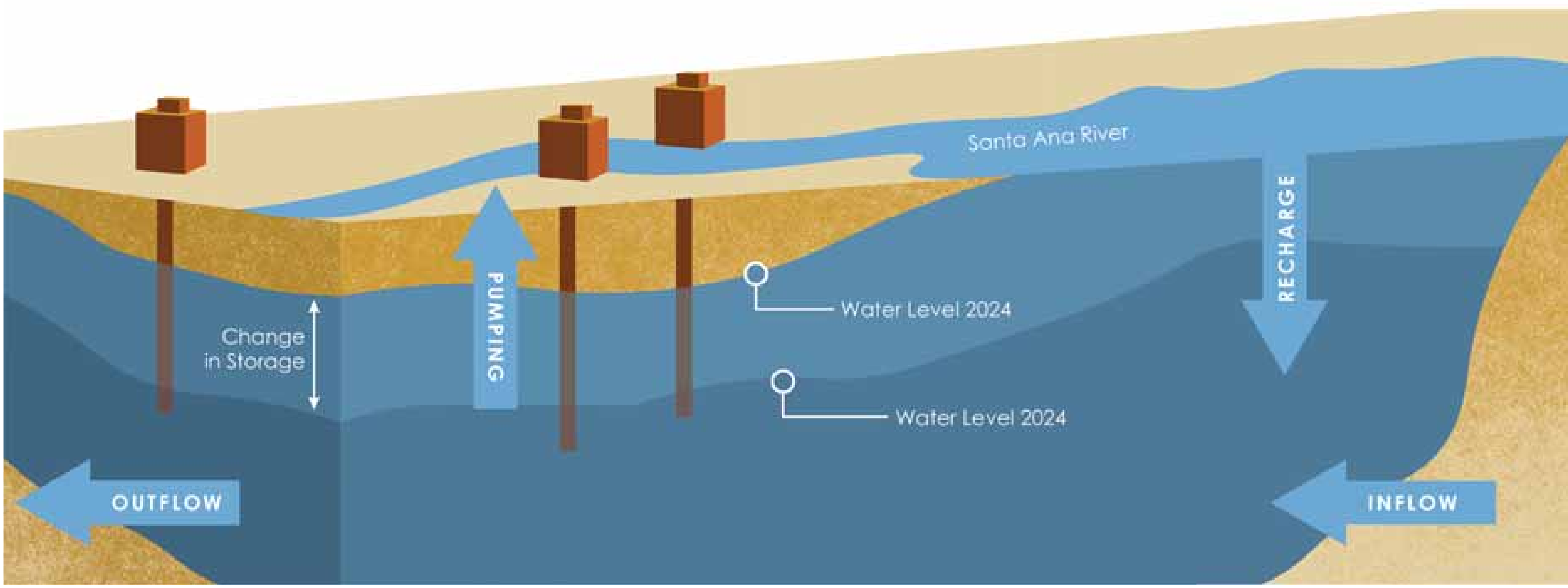
06 GROUNDWATER IN STORAGE

6 GROUNDWATER IN STORAGE

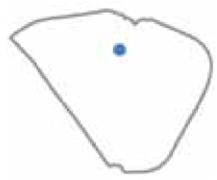
RPU tracks the quantity of groundwater in storage in each basin area as another tool to monitor groundwater conditions. Changes in storage can be used to better understand groundwater production and demands from each of RPU's wellfields distributed across the groundwater basins, and to make future decisions on where to replace and locate groundwater wells.

The change in storage over a time period is calculated by multiplying the change in groundwater level, by the specific yield of the aquifer materials over which the water-level change occurred, and by the area where the change occurred. The graphic below is a 3D representation of what a groundwater basin such as the Bunker Hill Basin may look like when comparing the change in storage that occurred over the 10-year period corresponding to drought conditions. Water levels decreased possibly due to a combination of items such as urbanization, cultural conditions, changes in pumping patterns from other agencies, lower amounts of recharge, and less rainfall in general.

The volume of groundwater for each basin is summarized in the graphic below. The preceding pages show the spatial distribution of the volume of groundwater in each basin.



Summary of Groundwater in Storage by Basin within RPU's Sphere of Influence *(Acre-Feet)*



BUNKER HILL

Fall 2014 Total Volume: 1,988,000

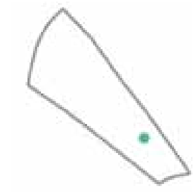
Spring 2023 Total Volume: 1,982,000

Spring 2024 Total Volume: 1,946,000

Fall 2024 Total Volume: 1,938,000

Spring 2023-2024 Volume Change: -36,000

Fall 2014 to 2024 Volume Change: -50,000



RIALTO-COLTON

Fall 2014 Total Volume: 467,000

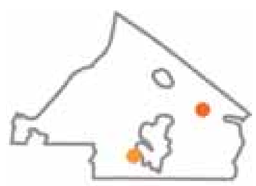
Spring 2023 Total Volume: 470,000

Spring 2024 Total Volume: 446,000

Fall 2024 Total Volume: 466,000

Spring 2023-2024 Volume Change: -24,000

Fall 2014 to 2024 Volume Change: -1,000



RIVERSIDE NORTH

Fall 2014 Total Volume: 441,000

Spring 2023 Total Volume: 444,000

Spring 2024 Total Volume: 438,000

Fall 2024 Total Volume: 438,000

Spring 2023-2024 Volume Change: -6,000

Fall 2014 to 2024 Volume Change: -3,000

RIVERSIDE SOUTH

Fall 2014 Total Volume: 333,000

Spring 2023 Total Volume: 352,000

Spring 2024 Total Volume: 355,000

Fall 2024 Total Volume: 366,00

Spring 2023-2024 Volume Change: 3,000

Fall 2014 to 2024 Volume Change: 33,000

TOTAL VOLUME

Fall 2014 Total Volume: 3,228,000

Spring 2023 Total Volume: 3,249,000

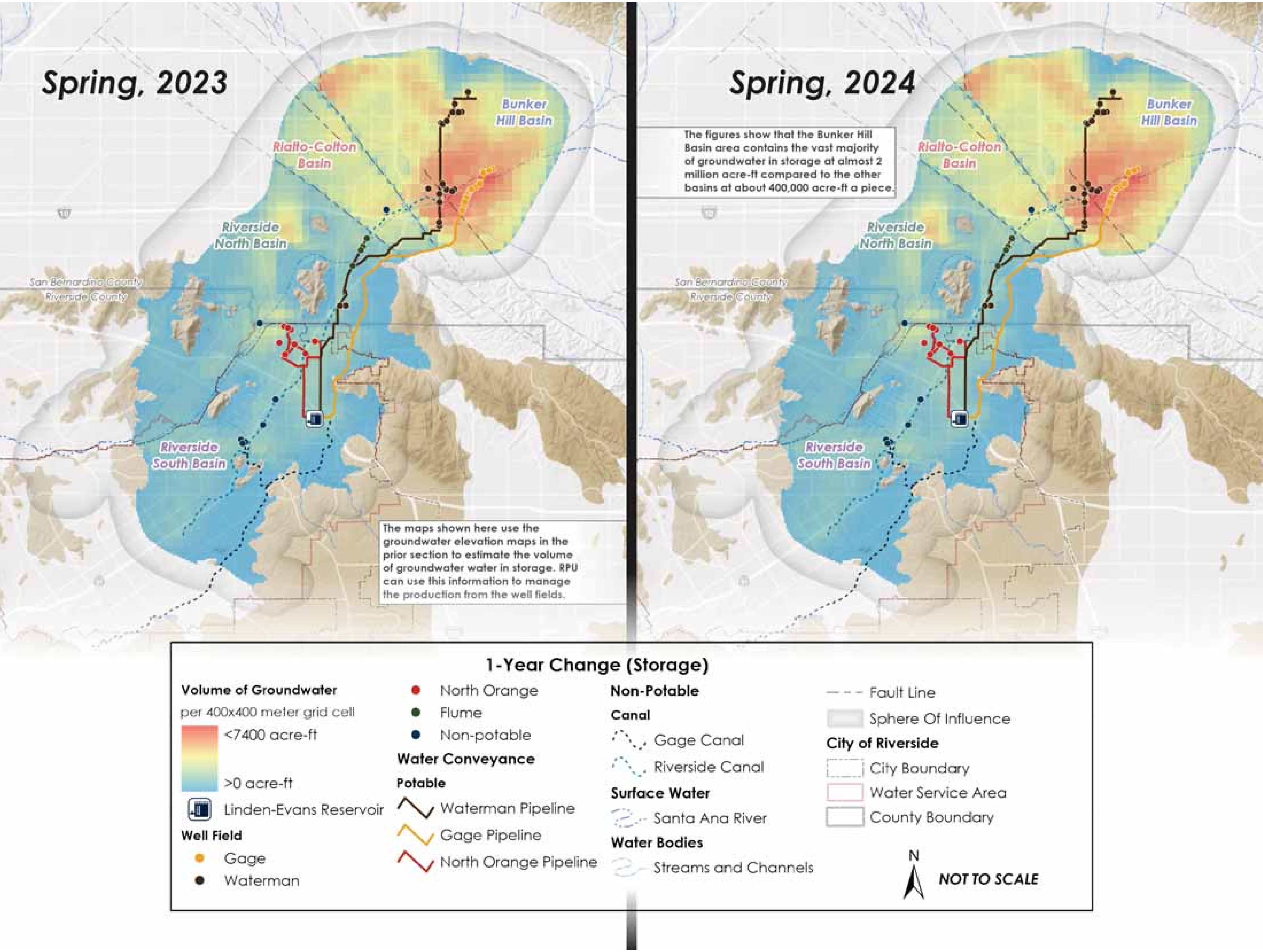
Spring 2024 Total Volume: 3,186,000

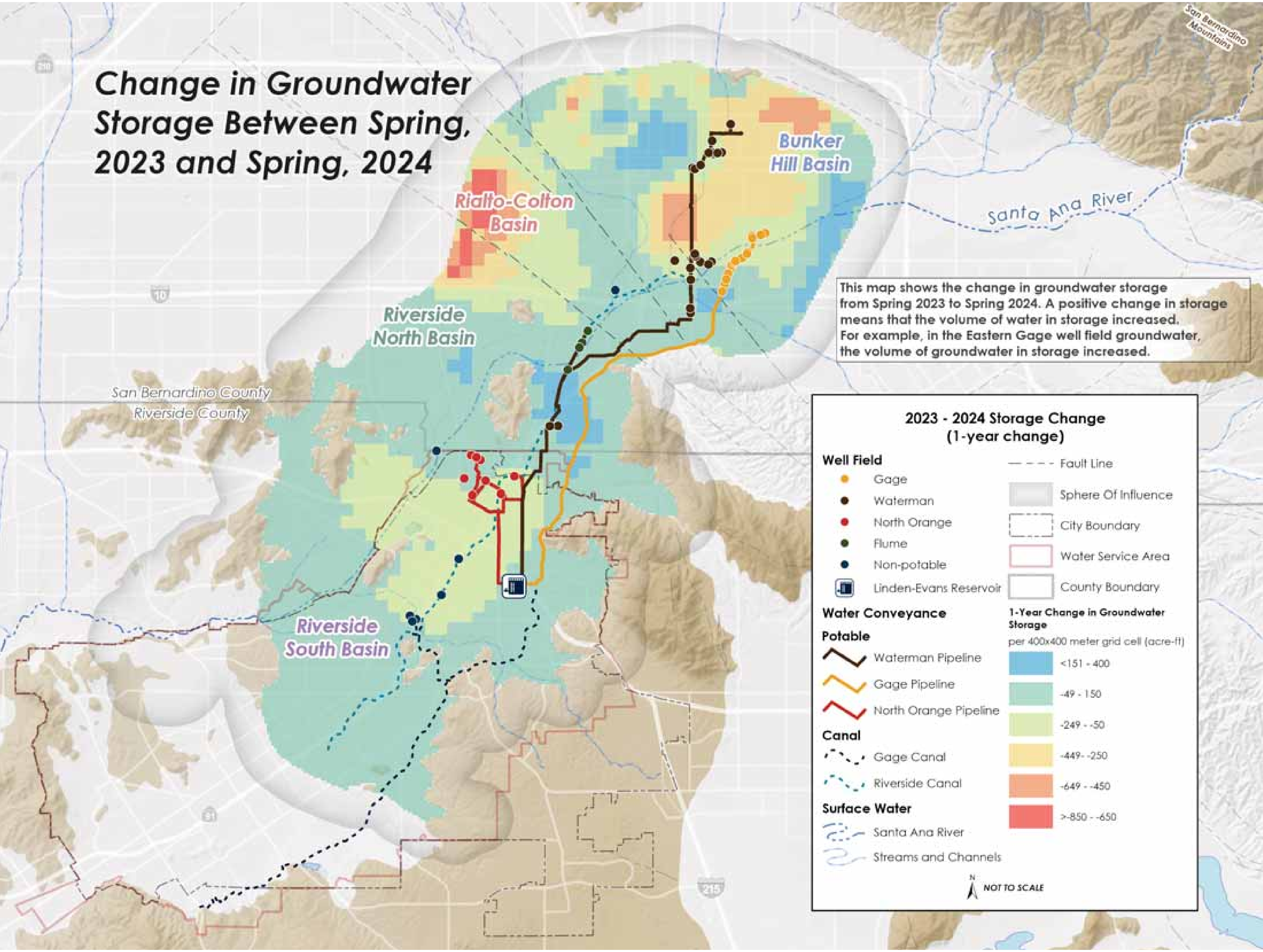
Fall 2024 Total Volume: 3,208,000

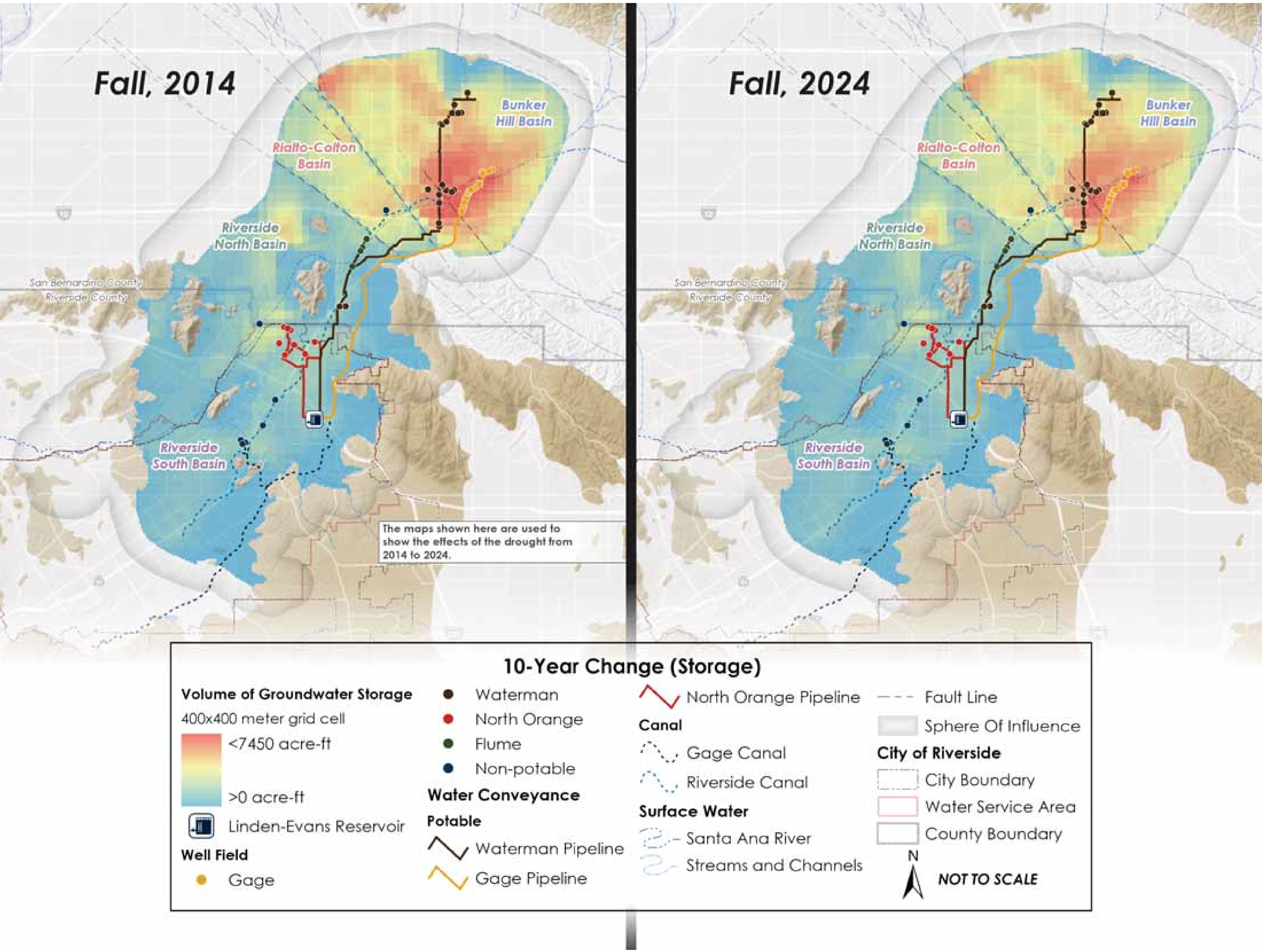
Spring 2023-2024 Volume Change: -63,000

Fall 2014 to 2024 Volume Change: -20,000

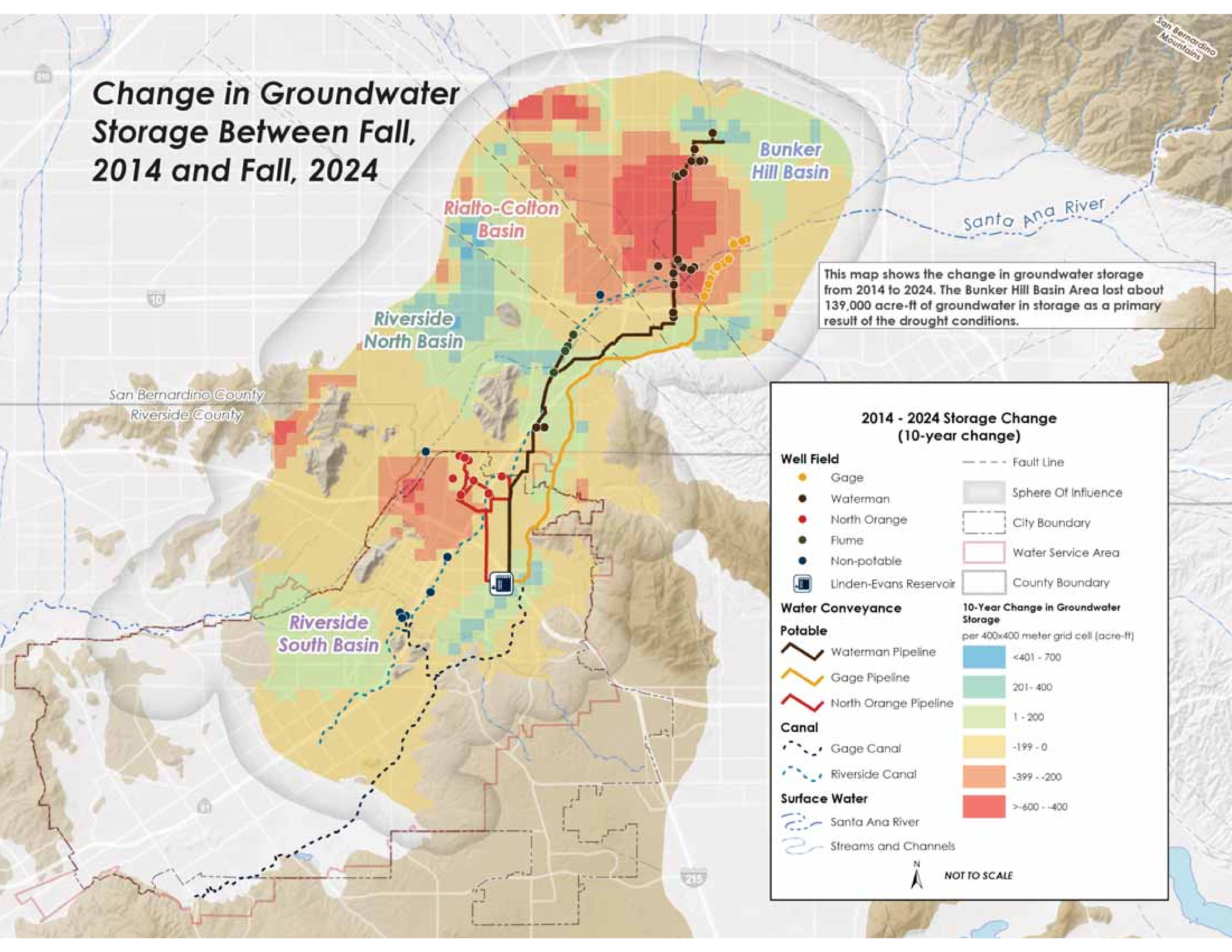
Note: The groundwater basin boundaries used in the storage calculations represent only a portion of each basin in the vicinity of RPU's well fields.


Spring, 2023
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
San Bernardino County
Riverside County
Riverside South Basin
The maps shown here use the groundwater elevation maps in the prior section to estimate the volume of groundwater water in storage. RPU can use this information to manage the production from the well fields.
Spring, 2024
The figures show that the Bunker Hill Basin area contains the vast majority of groundwater in storage at almost 2 million acre-ft compared to the other basins at about 400,000 acre-ft a piece.
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
San Bernardino County
Riverside County
Riverside South Basin
1-Year Change (Storage)
Volume of Groundwater
per 400x400 meter grid cell
<7400 acre-ft
>0 acre-ft
Linden-Evans Reservoir
Well Field
Gage
Waterman
North Orange
Flume
Non-potable
Water Conveyance
Potable
Waterman Pipeline
Gage Pipeline
North Orange Pipeline
Non-Potable
Canal
Gage Canal
Riverside Canal
Surface Water
Santa Ana River
Water Bodies
Streams and Channels
Fault Line
Sphere Of Influence
City of Riverside
City Boundary
Water Service Area
County Boundary
N
NOT TO SCALE


Change in Groundwater Storage Between Spring, 2023 and Spring, 2024
San Bernardino Mountains
Bunker Hill Basin
Rialto-Colton Basin
Santa Ana River
Riverside North Basin
San Bernardino County
Riverside County
Riverside South Basin
This map shows the change in groundwater storage from Spring 2023 to Spring 2024. A positive change in storage means that the volume of water in storage increased. For example, in the Eastern Gage well field groundwater, the volume of groundwater in storage increased.
2023 - 2024 Storage Change (1-year change)
Well Field
Gage
Waterman
North Orange
Flume
Non-potable
Linden-Evans Reservoir
Fault Line
Sphere Of Influence
City Boundary
Water Service Area
County Boundary
Water Conveyance
Potable
Waterman Pipeline
Gage Pipeline
North Orange Pipeline
Canal
Gage Canal
Riverside Canal
Surface Water
Santa Ana River
Streams and Channels
1-Year Change in Groundwater Storage
per 400x400 meter grid cell (acre-ft)
<151 - 400
-49 - 150
-249 - -50
-449- -250
-649 - -450
>-850 - -650
N
NOT TO SCALE
210
10
91
215



Fall, 2014
Fall, 2024
Bunker Hill Basin
Rialto-Colton Basin
Riverside North Basin
Riverside South Basin
San Bernardino County
Riverside County
The maps shown here are used to show the effects of the drought from 2014 to 2024.
10-Year Change (Storage)
Volume of Groundwater Storage
400x400 meter grid cell
<7450 acre-ft
>0 acre-ft
Linden-Evans Reservoir
Well Field
Gage
Waterman
North Orange
Flume
Non-potable
Water Conveyance
Potable
Waterman Pipeline
Gage Pipeline
North Orange Pipeline
Canal
Gage Canal
Riverside Canal
Surface Water
Santa Ana River
Streams and Channels
Fault Line
Sphere Of Influence
City of Riverside
City Boundary
Water Service Area
County Boundary
N
NOT TO SCALE


Change in Groundwater Storage Between Fall, 2014 and Fall, 2024
San Bernardino Mountains
Bunker Hill Basin
Santa Ana River
Rialto-Colton Basin
Riverside North Basin
San Bernardino County
Riverside County
Riverside South Basin
This map shows the change in groundwater storage from 2014 to 2024. The Bunker Hill Basin Area lost about 139,000 acre-ft of groundwater in storage as a primary result of the drought conditions.
2014 - 2024 Storage Change (10-year change)
Well Field
Gage
Waterman
North Orange
Flume
Non-potable
Linden-Evans Reservoir
Water Conveyance
Potable
Waterman Pipeline
Gage Pipeline
North Orange Pipeline
Canal
Gage Canal
Riverside Canal
Surface Water
Santa Ana River
Streams and Channels
Fault Line
Sphere Of Influence
City Boundary
Water Service Area
County Boundary
10-Year Change in Groundwater Storage
per 400x400 meter grid cell (acre-ft)
<401 - 700
201- 400
1 - 200
-199 - 0
-399 - -200
>-600 - -400
N
NOT TO SCALE

John W North Treatment Plant

07 GROUNDWATER QUALITY

7

GROUNDWATER QUALITY

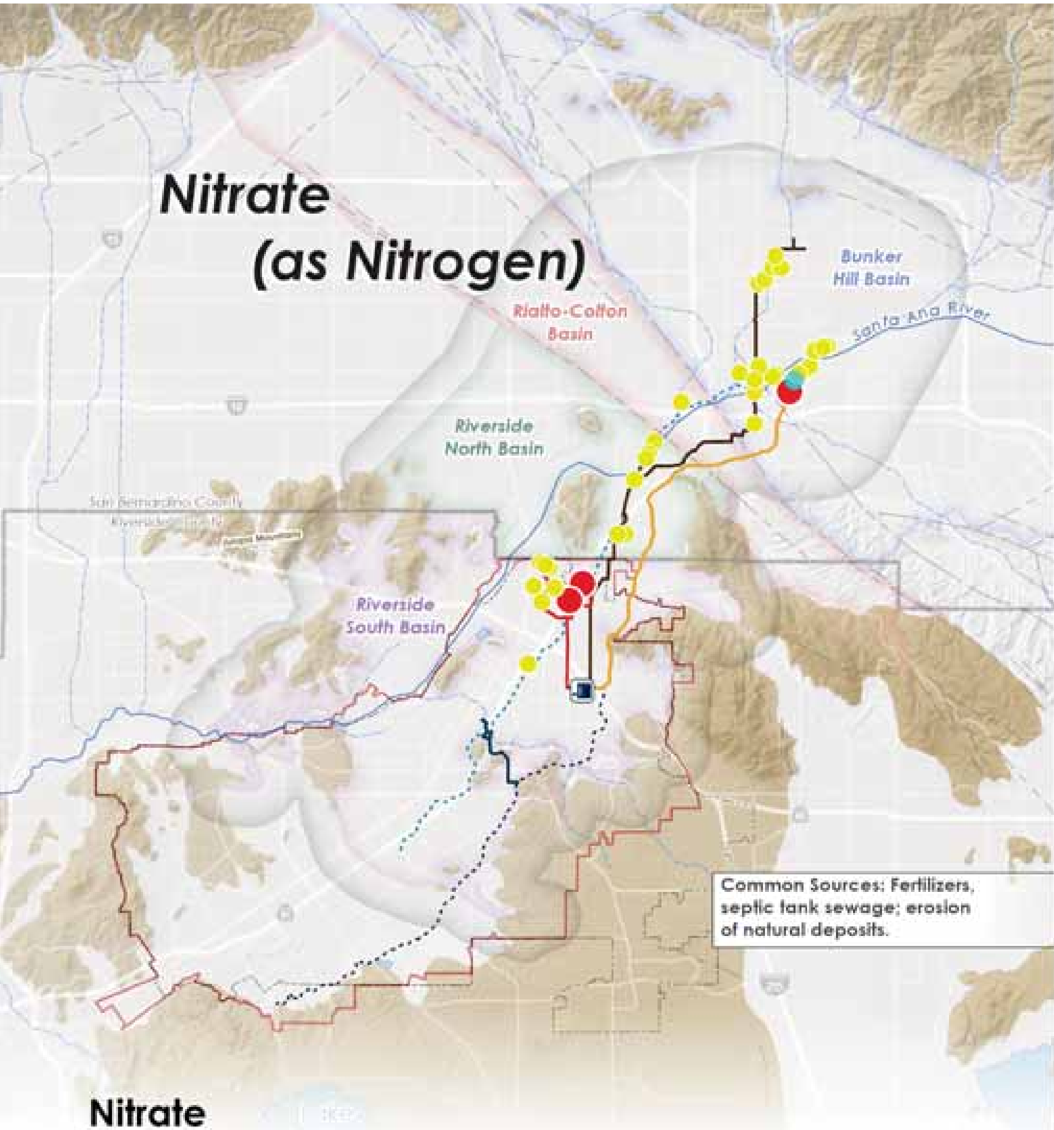
Most groundwater produced throughout the southern and inland California region requires treatment. RPU continuously monitors the water quality of its drinking water wells to ensure the water it serves meets both federal and state drinking water standards. This proactive approach allows RPU to quickly identify changes in groundwater quality conditions so we may pursue additional investigations, communicate with stakeholders, and take remedial action if necessary.

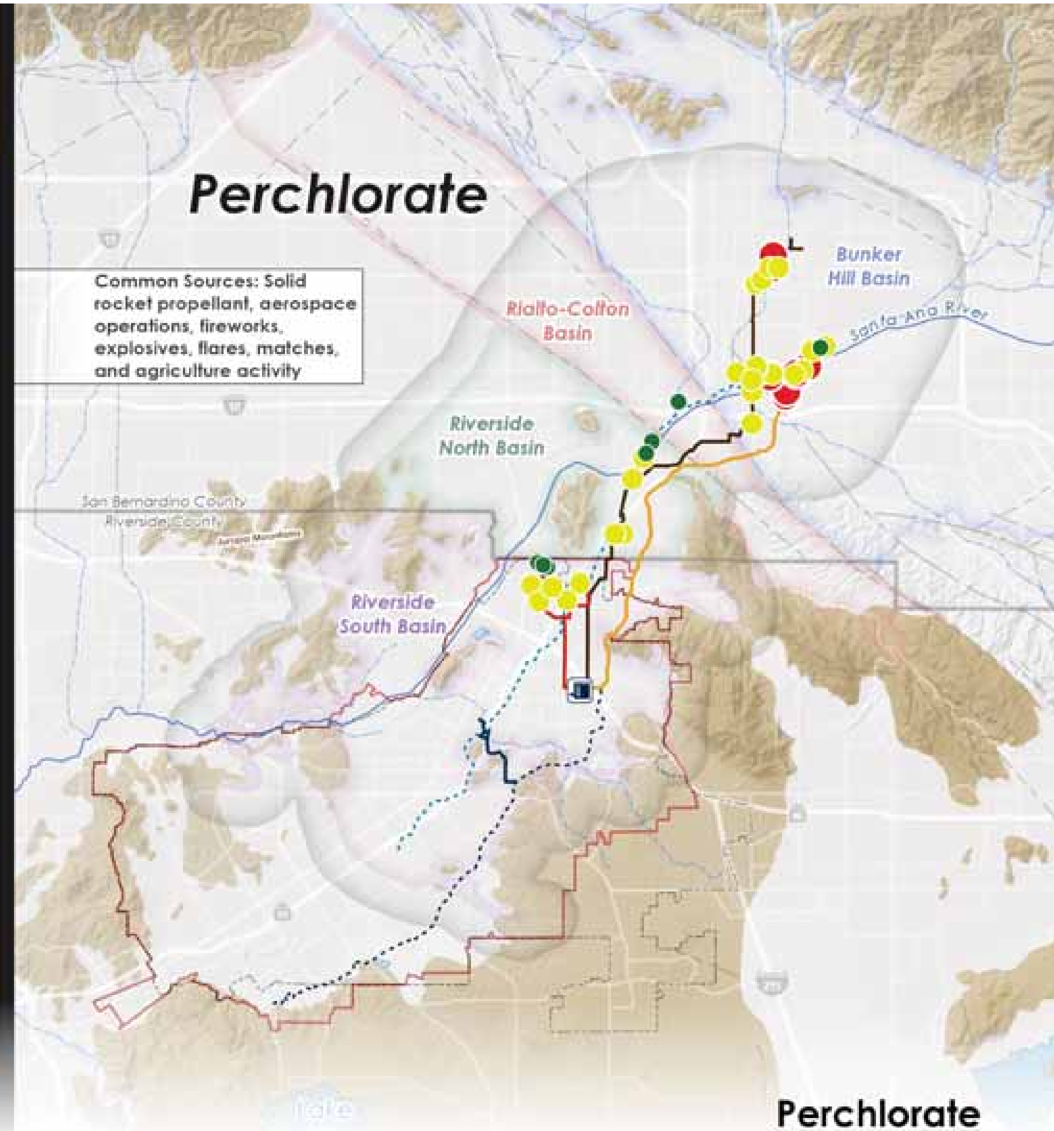
The Safe Drinking Water Act was originally passed by Congress in 1974 to protect public health by regulating public drinking water supplies. Since then, additional amendments and measures have been implemented by Federal and State Officials to ensure public water supply systems deliver safe and reliable drinking water for public consumption. Historical waste disposal practices and chemical application of now-banned chemicals that were once legally and regularly used, have created localized contaminant plumes that have impacted the region's groundwater basins and at times, the City's supply. The City of Riverside has actively litigated against known entities that have impacted Riverside's groundwater supplies and has successfully obtained funding for construction and maintenance of facilities used to remove the constituents of concern from its groundwater supply. RPU has developed mutually beneficial relationships with some of the known entities to work collaboratively to intentionally capture a plume with select wells to limit the spread of the plume and protect downstream wells, and to provide treatment at the capture wells to remove the constituents of concern. Extensive monitoring occurs in areas of known plumes to ensure plume containment is always maintained. In addition, RPU strategically locates and constructs new wells to extract water from deeper, cleaner zones within the groundwater basin. The following figures depict some of the constituents RPU closely tracks.

2024 RPU Groundwater Sampling

49 wells sampled 45 potable 4 non-potable	**150+** constituents	**36,004** water quality samples

Raub Water Treatment Plant





Nitrate
(parts per million)

California DLR = 0.4 ppm
(Detection Level Report)

California MCL = 10 ppm
(Maximum Contaminant Level)

RPU Wells Above MCL = 3

Highest Detection = 13 ppm

Legend

Well Contaminate Level
- < Detection Level Reporting
- > Detection Level Reporting & <= Maximum Contaminant Level
- > Maximum Contaminant Level
- Linden-Evans Reservoir

Water Conveyance
- Waterman Pipeline
- Gage Pipeline
- North Orange Pipeline
- Flume Pipeline
- Non-potable

Canal
- Gage Canal
- Riverside Canal

Surface Water
- Santa Ana River
- Streams and Channels
- Fault Line

Groundwater Basins
- Bunker Hill Basin
- Rialto-Colton Basin
- Riverside North Basin
- Riverside South Basin

City of Riverside
- City Boundary
- Water Service Area

N
NOT TO SCALE

Data shown in the figures above shows raw groundwater prior to treatment and delivery to RPU customers.

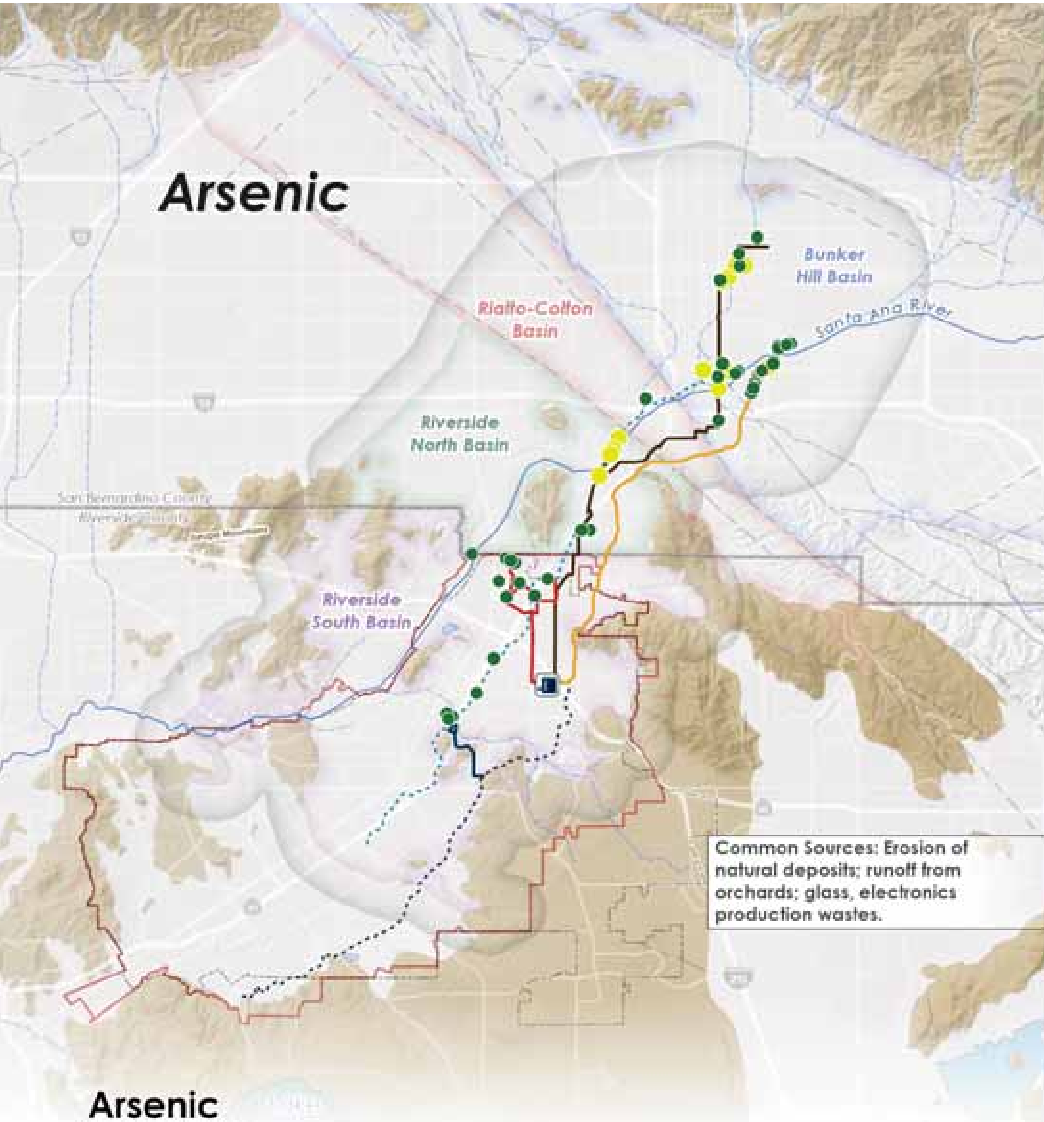
Perchlorate
(parts per billion)

California DLR = 1 ppb
(Detection Level Report)

California MCL = 6 ppb
(Maximum Contaminant Level)

RPU Wells Above MCL = 11

Highest Detection = 33 ppb



Arsenic
(parts per billion)

California DLR = 2 ppb
(Detection Level Report)

California MCL = 10 ppb
(Maximum Contaminant Level)

RPU Wells Above MCL = 0

Highest Detection = 6.9 ppb

Chromium
(parts per billion)

California DLR = 10 ppb
(Detection Level Report)

California MCL = 50 ppb
(Maximum Contaminant Level)

RPU Wells Above MCL = 0

Highest Detection = 6.7 ppb

Legend

Well Contaminate Level
- < Detection Level Reporting
- > Detection Level Reporting & <= Maximum Contaminant Level
- > Maximum Contaminant Level
- Linden-Evans Reservoir

Water Conveyance
- Waterman Pipeline
- Gage Pipeline
- North Orange Pipeline
- Flume Pipeline
- Non-potable

Canal
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- Riverside Canal

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Groundwater Basins
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- Riverside South Basin

City of Riverside
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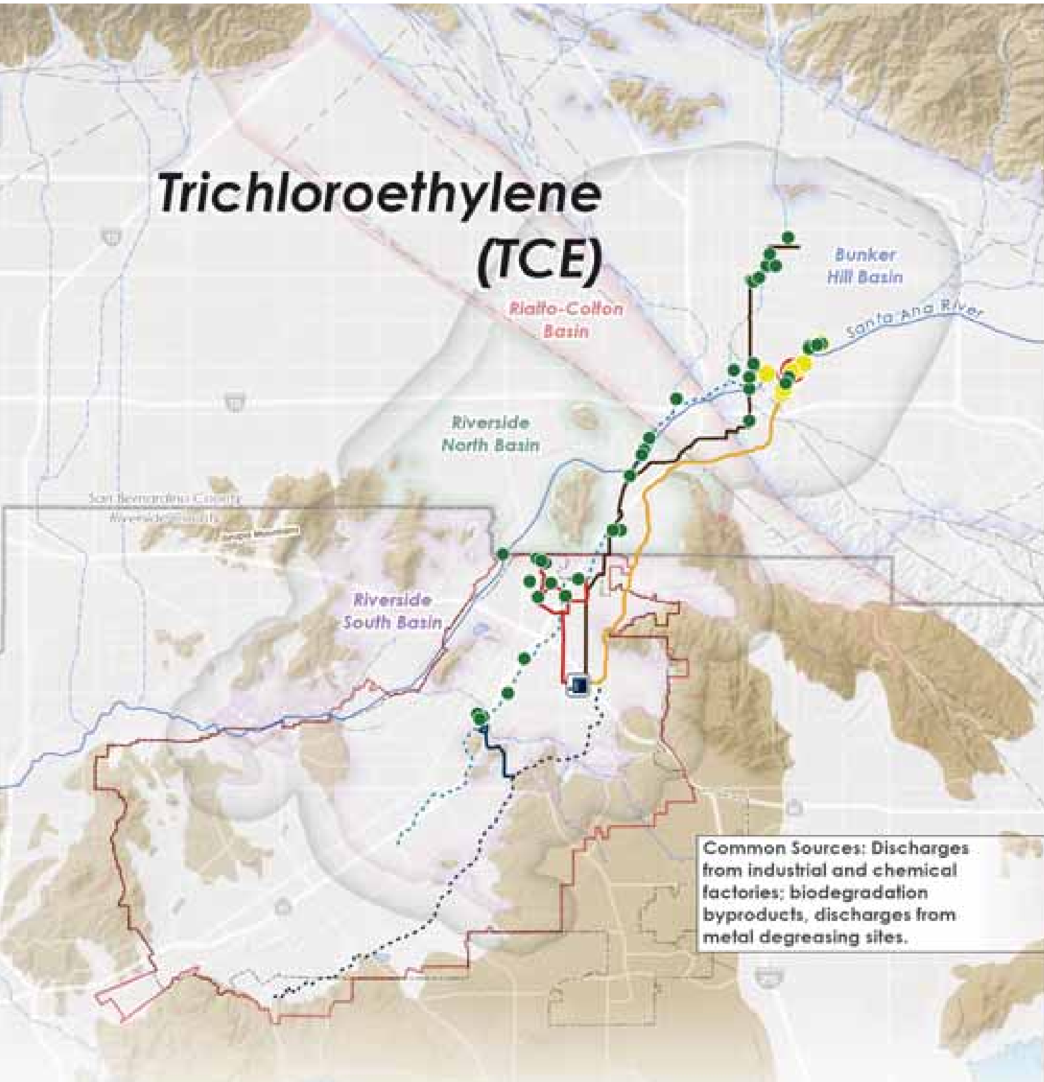
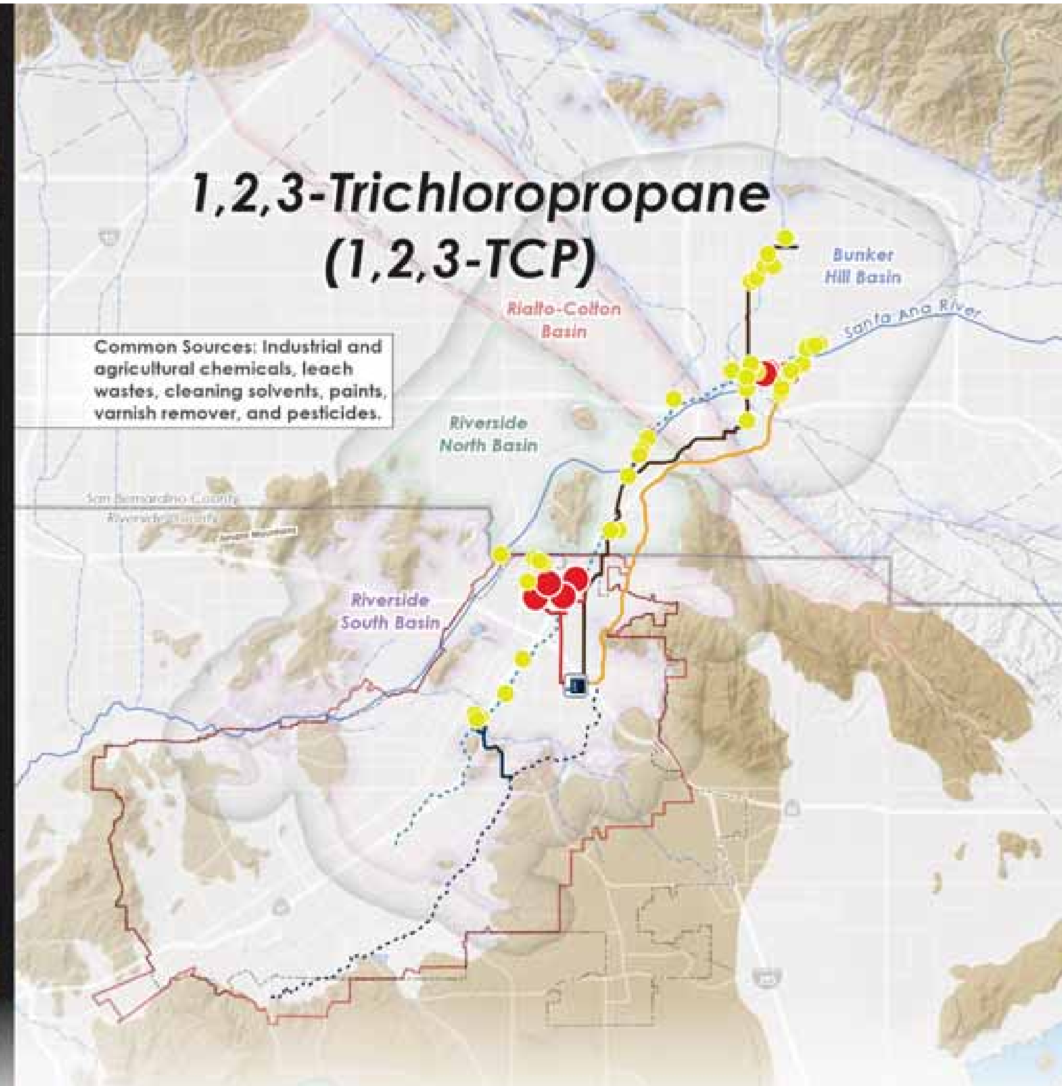
N
NOT TO SCALE

Data shown in the figures above shows raw groundwater prior to treatment and delivery to RPU customers.





Trichloroethylene (TCE)

(parts per billion)

California DLR = 0.5 ppb
(Detection Level Report)

California MCL = 5 ppb
(Maximum Contaminant Level)

RPU Wells Above MCL = 2

Highest Detection = 8.9 ppb

1,2,3-Trichloropropane (1,2,3-TCP)

(parts per trillion)

California DLR = 5 ppt
(Detection Level Report)

California MCL = 5 ppt
(Maximum Contaminant Level)

RPU Wells Above MCL = 6

Highest Detection = 41 ppt

Legend

Well Contaminate Level
- < Detection Level Reporting
- > Detection Level Reporting & <= Maximum Contaminant Level
- > Maximum Contaminant Level
- Linden-Evans Reservoir

Water Conveyance
- Waterman Pipeline
- Gage Pipeline
- North Orange Pipeline
- Flume Pipeline
- Non-potable

Canal
- Gage Canal
- Riverside Canal

Surface Water
- Santa Ana River
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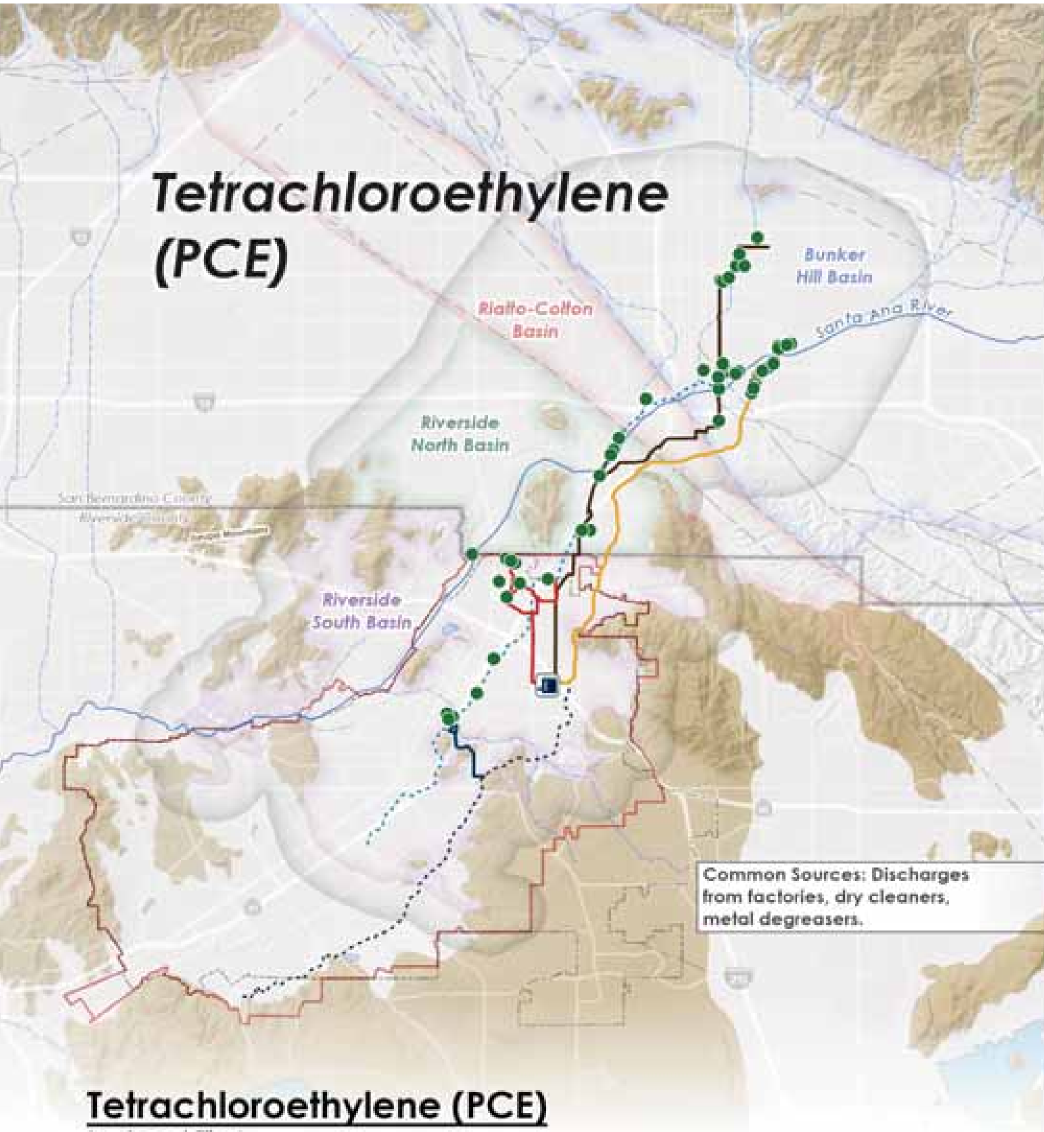
- Fault Line

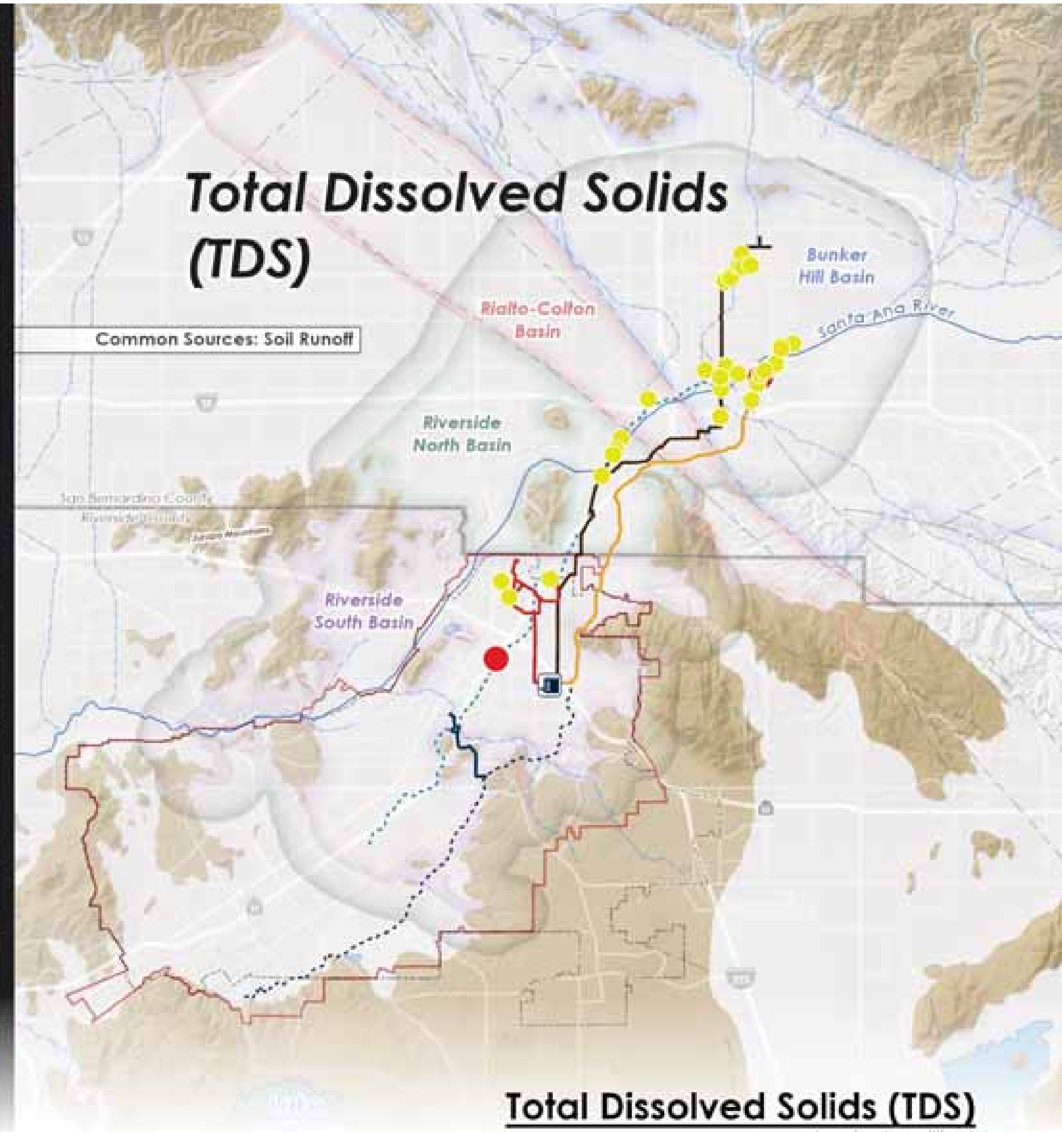
Groundwater Basins
- Bunker Hill Basin
- Rialto-Colton Basin
- Riverside North Basin
- Riverside South Basin

City of Riverside
- City Boundary
- Water Service Area

N *NOT TO SCALE*

Data shown in the figures above shows raw groundwater prior to treatment and delivery to RPU customers.





Tetrachloroethylene (PCE)

(parts per billion)

California DLR = 0.5 ppb
(Detection Level Report)

California MCL = 5 ppb
(Maximum Contaminant Level)

RPU Wells Above MCL = 0

Highest Detection < 0.5 ppb

Legend

Well Contaminate Level
- < Detection Level Reporting
- > Detection Level Reporting & <= Maximum Contaminant Level
- > Maximum Contaminant Level
- Linden-Evans Reservoir

Water Conveyance
- Waterman Pipeline
- Gage Pipeline
- North Orange Pipeline
- Flume Pipeline
- Non-potable

Canal
- Gage Canal
- Riverside Canal

Surface Water
- Santa Ana River
- Streams and Channels
- Fault Line

Groundwater Basins
- Bunker Hill Basin
- Rialto-Colton Basin
- Riverside North Basin
- Riverside South Basin

City of Riverside
- City Boundary
- Water Service Area

N
NOT TO SCALE

Data shown in the figures above shows raw groundwater prior to treatment and delivery to RPU customers.

Total Dissolved Solids (TDS)

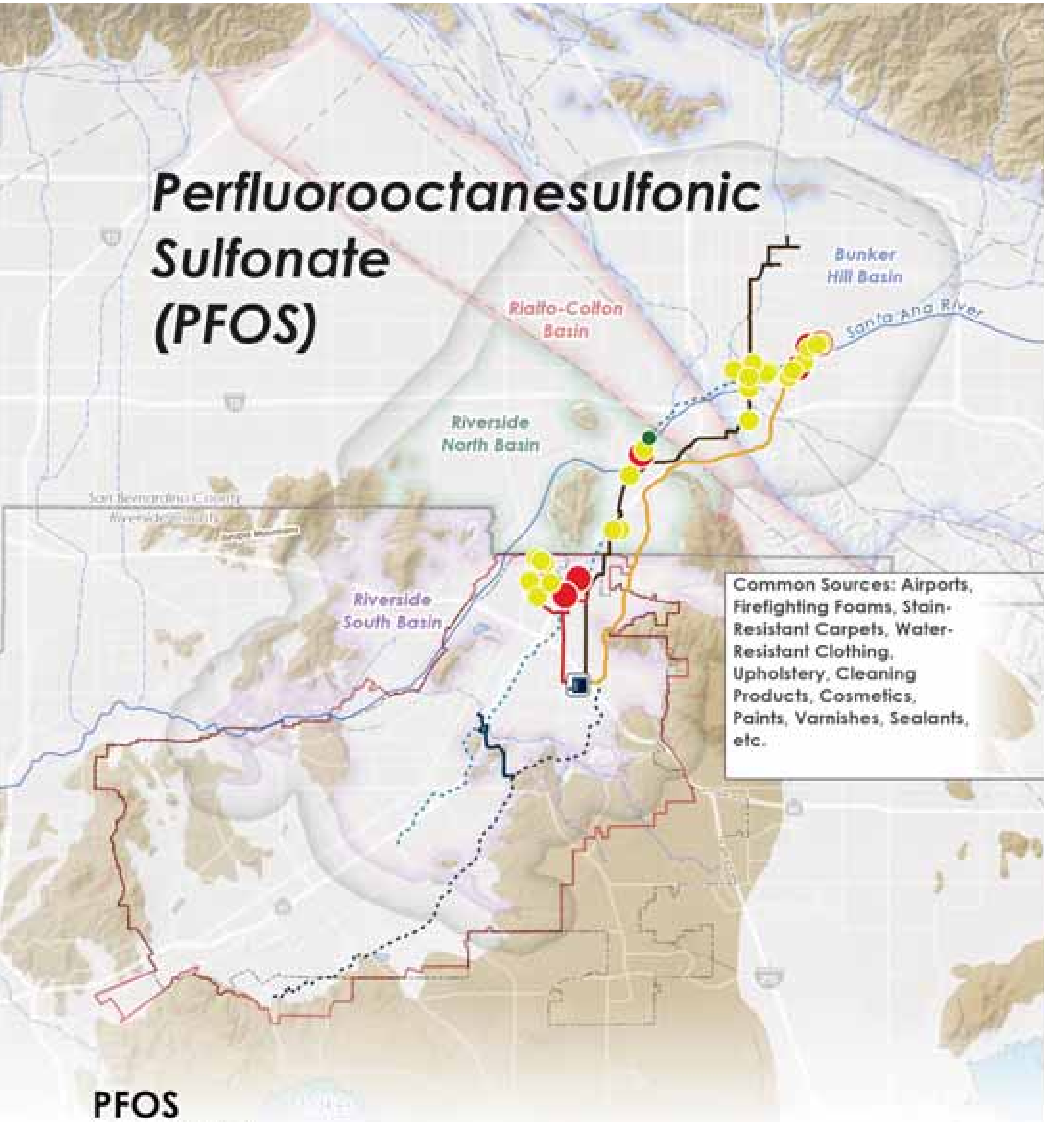
(parts per million)

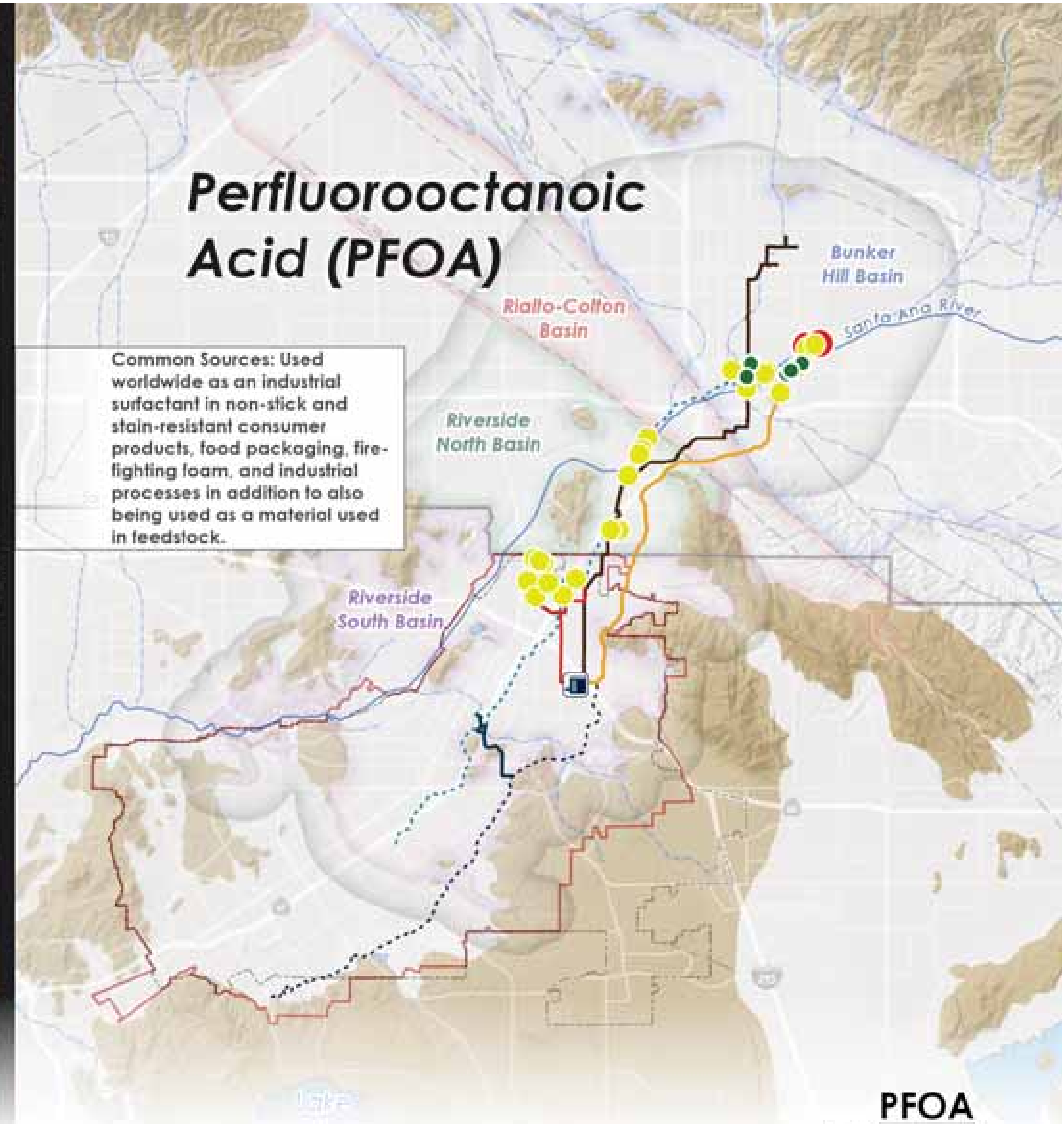
California U-SMCL = 1,000 ppm
(Upper Secondary Maximum Contaminant Level)

California SMCL = 500 ppm
(Recommended Secondary Maximum Contaminant Level)

RPU Wells Above U-SMCL = 0
RPU Wells Above SMCL = 2

Highest Detection = 550 ppm





PFOS

(parts per trillion)

California NL = 6.5 ppt
(Notification Level)

USA Federal MCL = 4 ppt
(Maximum Contaminant Level)

RPU Wells Above MCL = 32

Highest Detection = 26 ppt

PFOA

(parts per trillion)

California NL = 5.1 ppt
(Notification Level)

USA Federal MCL = 4 ppt
(Maximum Contaminant Level)

RPU Wells Above MCL = 27

Highest Detection = 23 ppt

Legend

Well Contaminate Level
- < Notification Level
- > Notification Level & <= 15ppt Contaminant Level
- > 15ppt Max Contaminant Level
- Linden-Evans Reservoir

Water Conveyance
- Waterman Pipeline
- Gage Pipeline
- North Orange Pipeline
- Flume Pipeline
- Non-potable

Canal
- Gage Canal
- Riverside Canal

Surface Water
- Santa Ana River
- Streams and Channels
- Fault Line

Groundwater Basins
- Bunker Hill Basin
- Rialto-Colton Basin
- Riverside North Basin
- Riverside South Basin

City of Riverside
- City Boundary
- Water Service Area

N

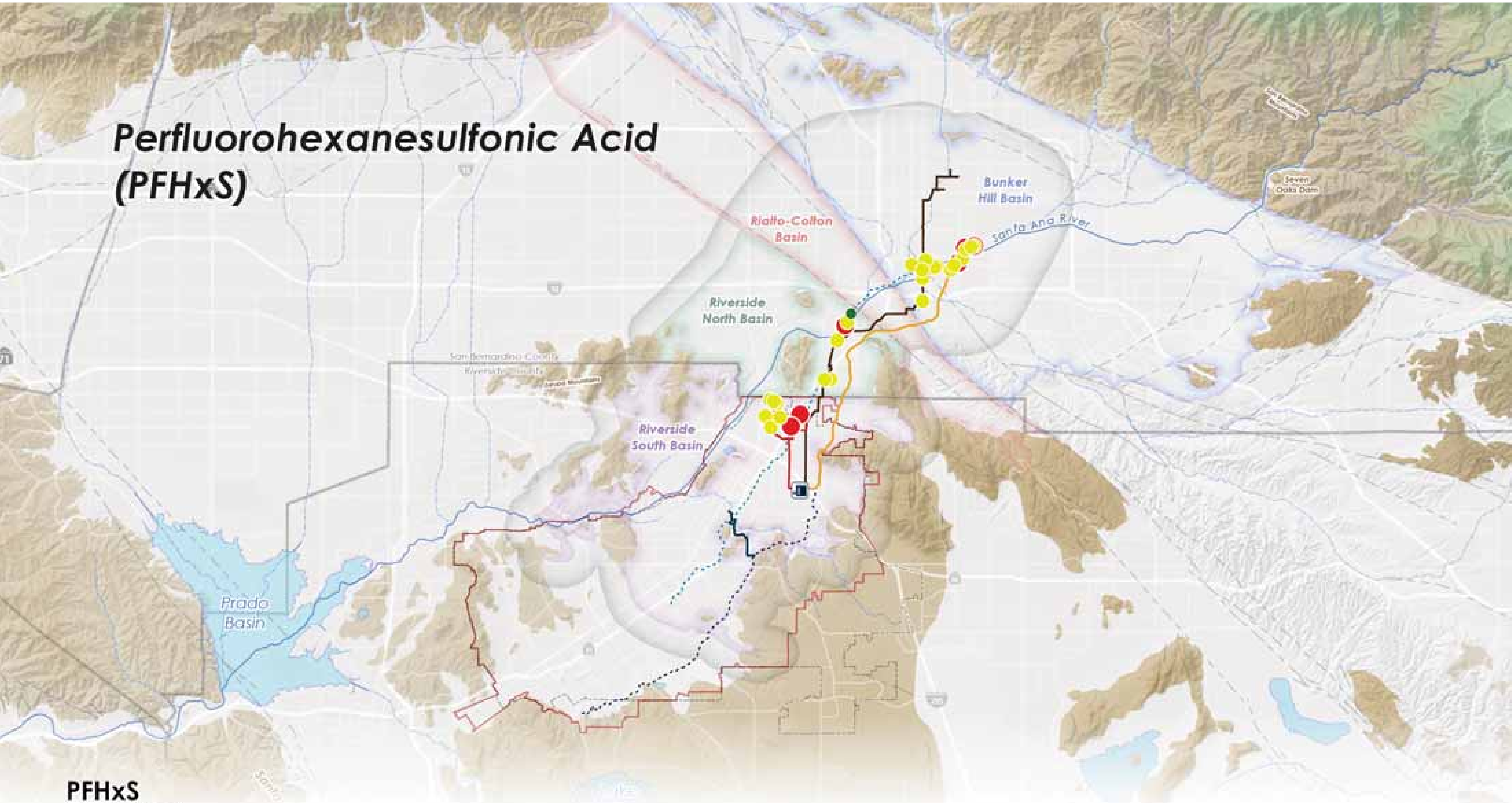
NOT TO SCALE

PFOS and PFOA Data shown in the figures above are for raw well data prior to treatment and delivery. The State and Federal regulations are met at the compliance point below Linden-Evans Reservoir. EPA compliance required by 2029.

Technical Fact Sheet - PFOS - US EPA

Technical Fact Sheet - PFOA - US EPA

Perfluorohexanesulfonic Acid (PFHxS)



PFHxS
(parts per trillion)

California NL = 3 ppt
(Notification Level)

USA Federal MCL = 10 ppt
(Maximum Contaminant Level)

RPU Wells Above MCL = 9

Highest Detection = 83 ppt

Legend

Well Contaminate Level
- < Notification Level
- > Notification Level & <= 10ppt Contaminant Level
- > 10ppt Max Contaminant Level
- Linden-Evans Reservoir

N
NOT TO SCALE

PFHxS Data shown in the figures above are for raw well data prior to treatment and delivery. The State and Federal regulations are met at the compliance point below Linden-Evans Reservoir.

Water Conveyance
- Waterman Pipeline
- Gage Pipeline
- North Orange Pipeline
- Flume Pipeline
- Non-potable

Canal
- Gage Canal
- Riverside Canal

Surface Water
- Santa Ana River
- Streams and Channels
- Fault Line

Groundwater Basins
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- Riverside North Basin
- Riverside South Basin

City of Riverside
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Common Sources: Water and Stain Protective Coatings used for carpets, textiles, paper, packaging, electronics, etc. In addition, used in cleaning and polishing products, water-proofing agents, aqueous film-forming foam (AFFF), etc.

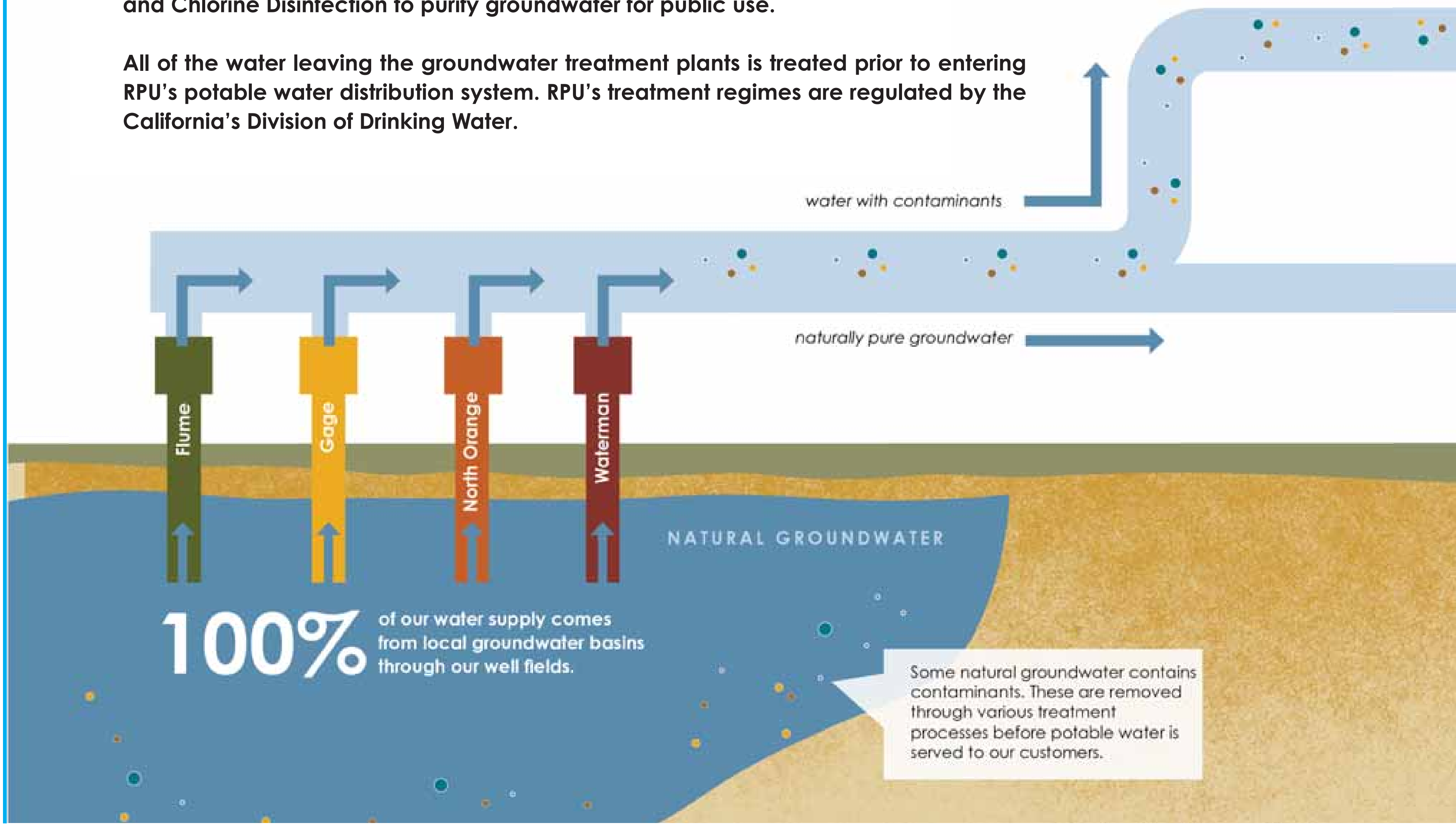
Palmyrita Treatment Plant

08 GROUNDWATER TREATMENT

8 GROUNDWATER TREATMENT

To ensure the City's drinking water is of highest quality, RPU operates 6 treatment facilities and 7 Disinfection facilities to produce safe, clean water. RPU's treatment plants use a combination of Ion Exchange, Granular Activated Carbon, Microfiltration Membranes and Chlorine Disinfection to purify groundwater for public use.

All of the water leaving the groundwater treatment plants is treated prior to entering RPU's potable water distribution system. RPU's treatment regimes are regulated by the California's Division of Drinking Water.



RPU routinely monitors each groundwater well for contaminants and provides targeted treatment.

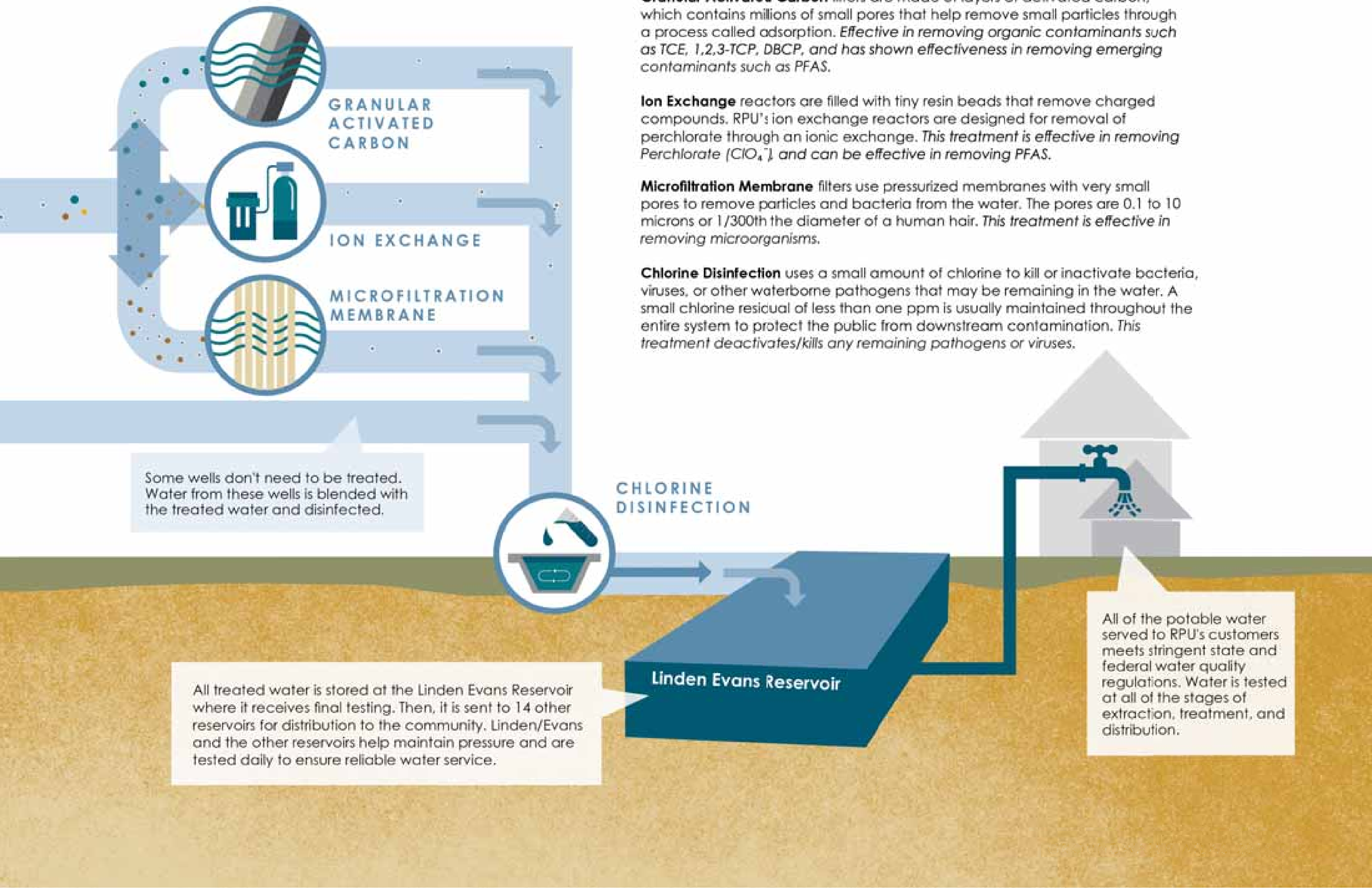
GROUNDWATER TREATMENT

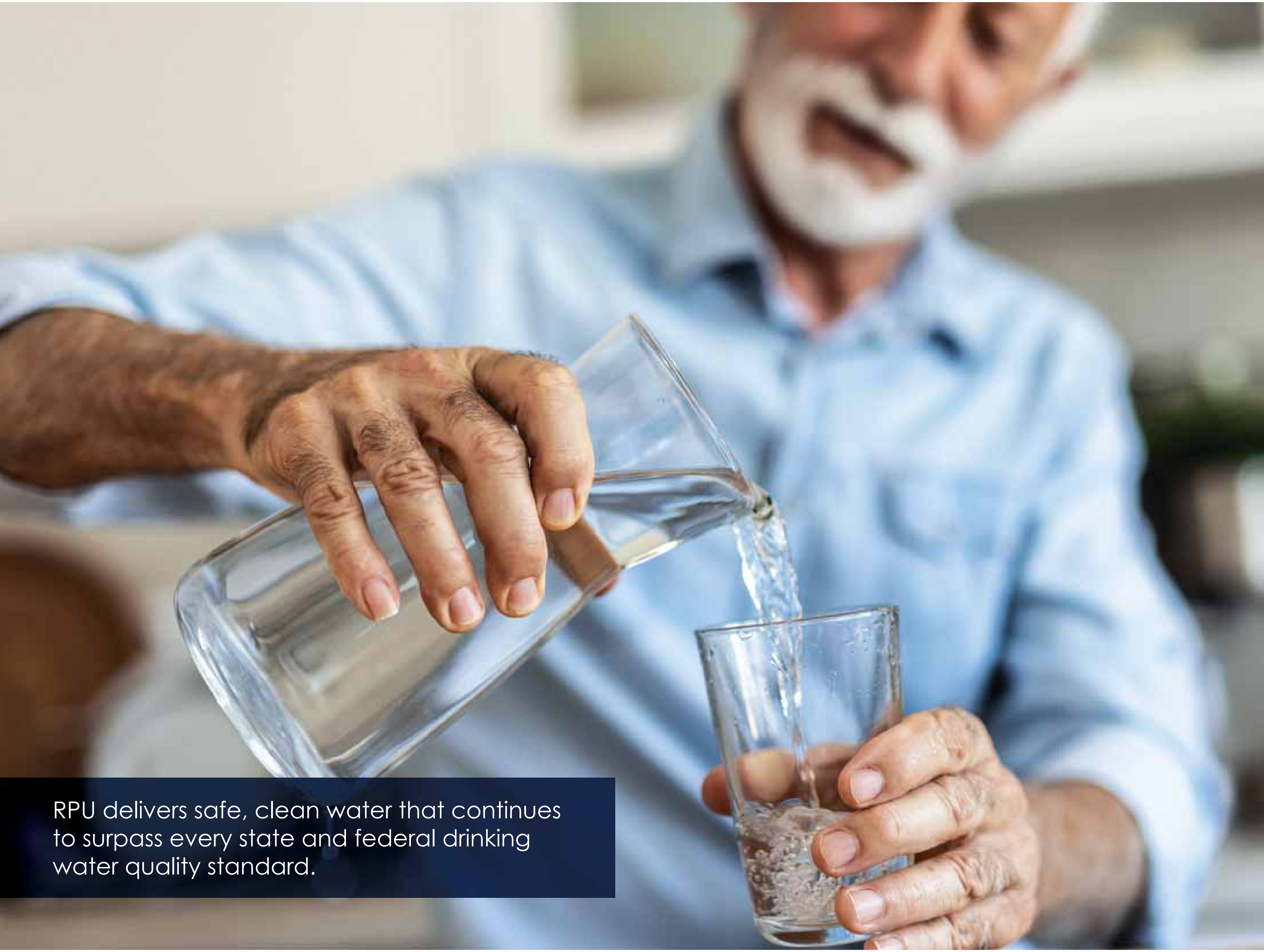
Granular Activated Carbon filters are made of layers of activated carbon, which contains millions of small pores that help remove small particles through a process called adsorption. *Effective in removing organic contaminants such as TCE, 1,2,3-TCP, DBCP, and has shown effectiveness in removing emerging contaminants such as PFAS.*

Ion Exchange reactors are filled with tiny resin beads that remove charged compounds. RPU's ion exchange reactors are designed for removal of perchlorate through an ionic exchange. *This treatment is effective in removing Perchlorate (ClO_4^-), and can be effective in removing PFAS.*

Microfiltration Membrane filters use pressurized membranes with very small pores to remove particles and bacteria from the water. The pores are 0.1 to 10 microns or 1/300th the diameter of a human hair. *This treatment is effective in removing microorganisms.*

Chlorine Disinfection uses a small amount of chlorine to kill or inactivate bacteria, viruses, or other waterborne pathogens that may be remaining in the water. A small chlorine residual of less than one ppm is usually maintained throughout the entire system to protect the public from downstream contamination. *This treatment deactivates/kills any remaining pathogens or viruses.*





RPU delivers safe, clean water that continues to surpass every state and federal drinking water quality standard.

ACKNOWLEDGMENTS

Riverside Public Utilities Board of Directors:

Rebeccah A. Goldware (Board Chair), Ward 2

Brian D. Siana (Board Vice-Chair), City Wide/Ward 2

Warren Avery, Ward 3

Gary Montgomery, Ward 4

Tom Evans, Ward 5

Mikael Becker, Ward 7

Peter Wohlgemuth, Citywide/Ward 1

Riverside Public Utilities Executives:

David Garcia, General Manager

Daniel Honeyfield, Assistant General Manager Energy Delivery

Robin Glenney, Assistant General Manager Water

Dr. Scott Lesch, Assistant General Manager Power Resources

Brian Seinturier, Assistant General Manager Finance and Administration

Tracy Sato, Assistant General Manager Strategic Initiatives and Customer Engagement

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WATER | ENERGY | LIFE

CITY OF RIVERSIDE

PUBLIC UTILITIES

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