Regional Wells Study

American Rescue Plan Act (ARPA) Funded

Ada County

Boise, Idaho
March 12, 2024

Prepared for Ada County

Regional Wells Study

Ada County
Boise, Idaho

March 12, 2024

Prepared by

HDR Engineering, Inc.
412 East Parkcenter Boulevard, Suite 100
Boise, ID 83706-6659

REGISTERED PROFESSIONAL GEOLOGIST
ALYSSA VEATCH
No. 1817
3-12-2024
STATE OF IDAHO

Prepared by:

Alyssa Veatch, P.G.

Jason Thompson, P.E.

Table of Contents

Figures

Plots

Tables

Appendices

Acronyms

Acronym	Definition
μg/L	micrograms per liter
ADC	Area of Drilling Concern
ARPA	American Rescue Plan Act
cfs	cubic feet per second
CGWA	critical groundwater area
EDMS	Environmental Data Management System
GIS	geographic information system
GWMA	Groundwater Management Area
GWMD	Groundwater Management District
IDEQ	Idaho Department of Environmental Quality
IDWR	Idaho Department of Water Resources
MCL	maximum contaminant limit
mg/L	milligrams per liter
pCi/L	picouries per liter
PERC	perchloroethylene
Reclamation	U.S. Bureau of Reclamation
TVAC	Treasure Valley Advisory Committee
TVAS	Treasure Valley Aquifer System
USGS	U.S. Geological Survey

1 Introduction

A number of homeowners in the southwest area of Ada County in Boise, Idaho, have recently reported that their domestic wells have gone dry or experienced a decline in production. Using American Rescue Plan Act (ARPA) funding, Ada County requested that HDR Engineering, Inc. (HDR) conduct a study to better understand hydrogeological conditions in this area and identify the number of wells that have reportedly gone dry and the number of wells that may be affected in the future if current water level trends continue. Ada County established a study area, generally bounded by Cloverdale Road to the west, Franklin Road to the north, Cole Road to the east, and Lake Hazel Road to the south (**Figure 1** and **Figure 2**). The study area is approximately 8,500 acres.

This study has several objectives:

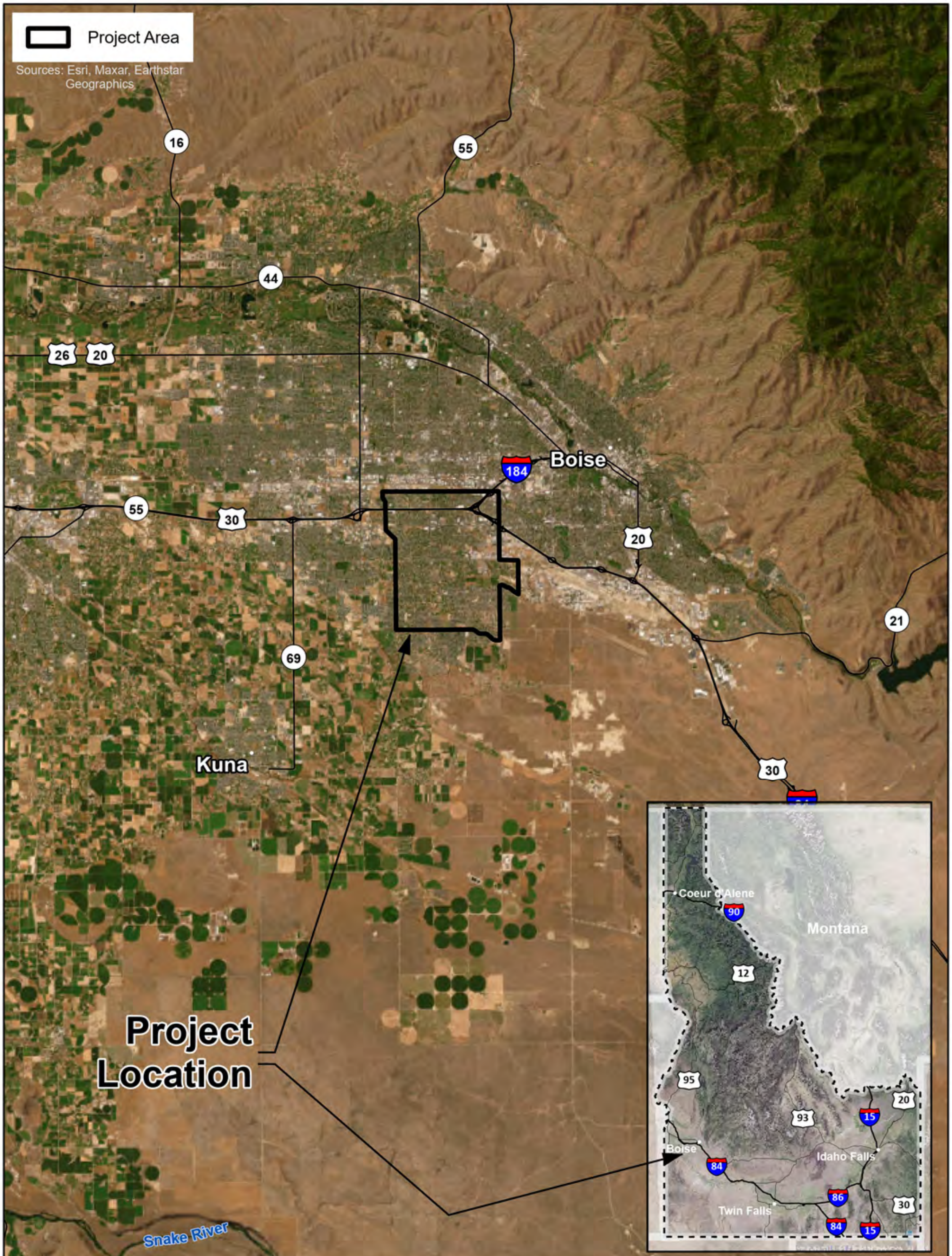
1) Quantify the number of wells that have gone dry or are currently at risk of failure due to water level declines;
2) Predict the number of wells that are at risk of failure in the future if water level trends persist;
3) Evaluate options for mitigating water level declines to ensure adequate residential water supply by connecting to the local municipal water purveyor, Veolia, or by deepening or replacing domestic wells;
4) Consider if the quality of the groundwater in existing wells can be improved by connecting to Veolia or by drilling deeper wells;
5) Help Ada County understand if creating a Groundwater Management District in this area would be of benefit to homeowners and the local water supply; and, finally,
6) Evaluate how applicable the Treasure Valley Groundwater-Flow Model may be to groundwater conditions within the study area.

2 Hydrogeological Evaluation

There are a number of components to the hydrogeological evaluation of the study area, including:

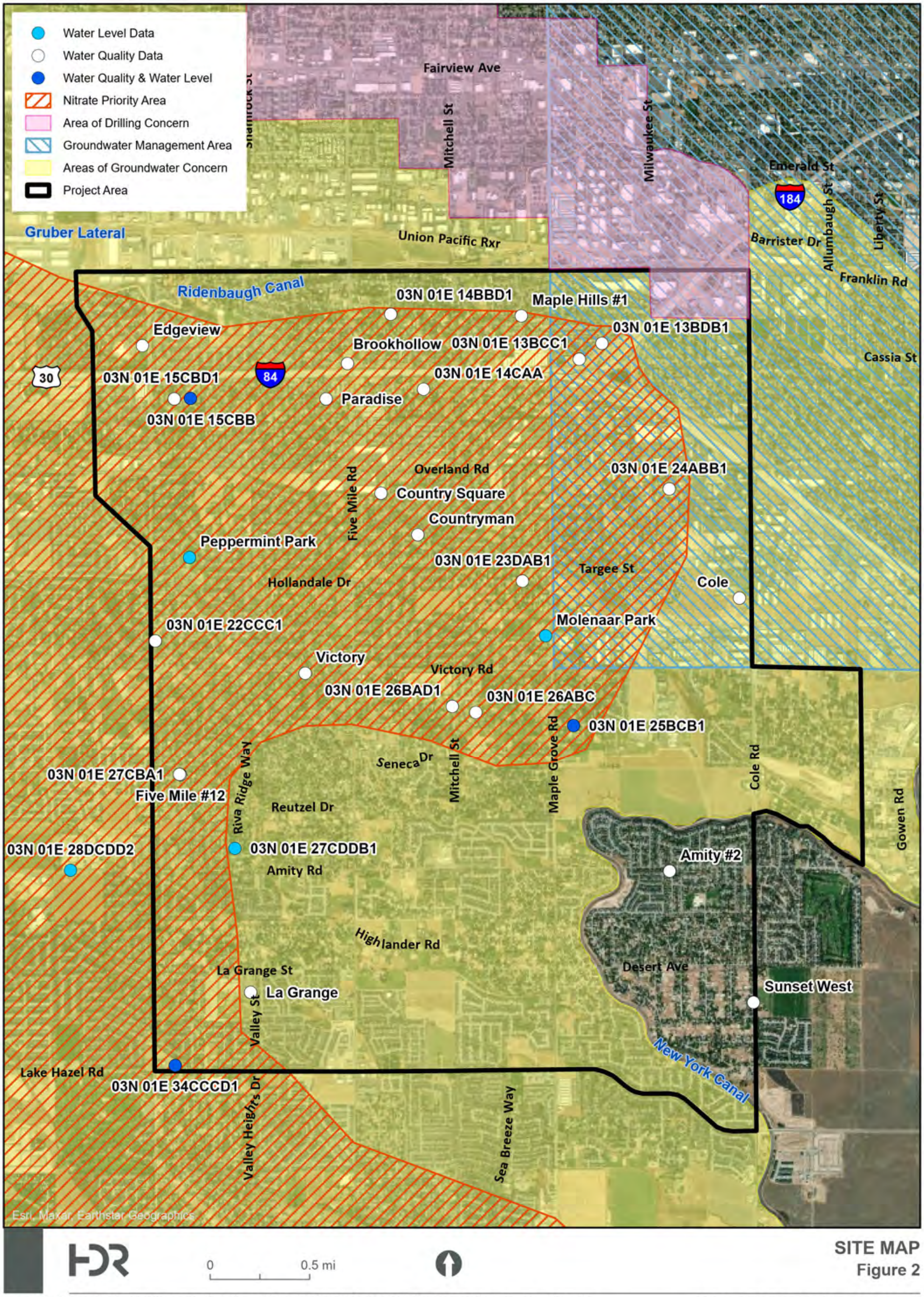
- Review historic literature pertaining to hydrogeology of the study area.
- Examine the amount of change in irrigated lands, review well data, and review water level data over a period of several years for insight into recent and long-term groundwater level trends in the study area.
- Review New York Canal diversion and measurements of static water level data over a period of several years for aquifer level trends, recharge, and discharge characteristics within the study area.
- Analyze historical trends of drain flows into the Boise River in the study area.

The following subsections review each of these components in detail.



VICINITY MAP

Figure 1



SITE MAP
Figure 2

2.1 Historical Literature Review

The first step of conducting a hydrogeological evaluation was to summarize current and historical data related to shallow groundwater in the southwest Boise area, with an emphasis on the study area.

HDR's study team reviewed previous groundwater studies for the area completed by the Idaho Department of Water Resources (IDWR), the U.S. Geological Survey (USGS), U.S. Bureau of Reclamation (Reclamation), and the Idaho Department of Environmental Quality (IDEQ). The most pertinent studies are those focused on the shallow aquifer system, describing the influence of local recharge, the susceptibility of the shallow aquifer to water level declines during drought conditions, and the influence of residential development on groundwater quantity and quality.

2.1.1 Previous Studies

The following subsections summarize the findings from the review of previous studies. Additional studies or references may be listed separately if data is used in other sections (see Section 5 on uranium concentration in groundwater).

2.1.1.1 2020 USGS PRESENTATION

A USGS PowerPoint presentation from September 2020 (slides posted online; USGS 2020) shows seepage measurements for the New York Canal. January 2004 seepage maps indicated that the section of the New York Canal in and just downstream of the study area was a losing reach, losing up to 18 cubic feet per second (cfs). Seepage measurements for the same section from March 1997 were also losing, ranging from 18 to 53 cfs. April 1998 seepage measurements for this section were losing at 18 to 35 cfs.

2.1.1.2 2012 PROPOSED TREASURE VALLEY COMPREHENSIVE AQUIFER MANAGEMENT PLAN

The Treasure Valley Advisory Committee (TVAC) developed a proposed aquifer management plan in 2012 in order to provide a framework for long-term management of the Treasure Valley Aquifer. The proposed plan (TVAC 2012) stated that 65 percent of drinking water in the valley is from the Treasure Valley Aquifer System, which is composed of shallow, intermediate, and deep aquifers. Shallow groundwater is generally directly linked with surface water, is unconfined and controlled by topography, and provides water for rural domestic and irrigation uses. Intermediate aquifers are generally used for domestic, irrigation, and municipal purposes and it is not clear how much these are connected with surface water. Deep aquifers are generally only used for municipal and industrial purposes, are generally not connected to surface water, and some are artesian. The proposed plan indicates that groundwater generally flows from east to west and discharges to the Snake River.

In the early to mid-1900s, water levels in the shallow aquifer system were shown to have risen due to irrigation until the water levels reached equilibrium with drains and the Boise River, while the intermediate and deep aquifers remained stable.

The proposed plan states that 95 percent of water use in the valley is domestic, commercial, municipal, and industrial, and is sourced primarily from groundwater (94 percent) with a much smaller amount from surface water (6 percent). For irrigation, 97 percent of water use is from surface water, and only 3 percent is pulled from groundwater. Per capita daily groundwater use for domestic wells is 160 gallons.

2.1.1.3 2002 GROUNDWATER RECHARGE AND FLOW IN THE REGIONAL TREASURE VALLEY AQUIFER SYSTEM, GEOCHEMISTRY AND ISOTOPE STUDY

Hutchings and Petrich completed this regional study (2002a) focused on determining sources and ages of the various groundwater units in the Treasure Valley. The study generally found that residence times for water in the aquifer system tend to increase with depth and distance along the regional east to west flow path. Two main aquifer units are in the valley, the shallow alluvial aquifer and the deeper aquifer hosted in the Idaho Group sediments.

The study used tritium to analyze groundwater age. Tritium is a good marker of “modern” waters because “modern” waters show concentrations of tritium above 10 picocuries per liter (pCi/L) due to atmospheric nuclear testing in the 1950s and 1960s, indicating that a substantial portion of the water entered the subsurface in the last 50 years. Present day precipitation contains little tritium as most has precipitated. The presence of carbon-14 was also used to identify paleo waters and determine residence time by determining the decay of carbon-14 to carbon-12 in the water.

The study found that groundwater samples from five shallow wells adjacent to the New York Canal indicate that downward movement of surface water from canal seepage and flood irrigation is limited to approximately a 200-foot-depth since the 1950s. It also found that deep, regional aquifers in the valley had groundwater that likely entered the system prior to the 1950s due to the lack of tritium in groundwater (from atmospheric nuclear testing). In addition, the levels of total dissolved solids (TDS) and specific conductivity in the deep system indicate that the water did not enter the system through the carbonate rich treasure valley soils.

Based on carbon-14 dating, they found that the youngest waters in the valley are only a few thousand years old and are found along the northeast boundary of the basin along the foothills, while the oldest waters were between 20,000 and 40,000 years old and typically found in the western areas of the basin near the Snake River. Deep groundwater is thought to have recharged around 10,000 and 20,000 years ago, and the most likely source of groundwater for the deep aquifers is from paleo-river channels, fractured granite aquifers from the Idaho Batholith, and tributary sedimentary aquifers. Shallow aquifer recharge is thought to be dominated from canal seepage and percolation from irrigation water. Additional recharge to the shallow aquifer is likely from precipitation, underflow from the Idaho batholith and tributary aquifers, and from mountain recharge. The extent of the connection between the surface water recharging the deep aquifer or the shallow aquifer recharge to the deep aquifer is unknown.

2.1.1.4 2002 INFLUENCE OF CANAL SEEPAGE ON AQUIFER RECHARGE NEAR THE NEW YORK CANAL

Hutchings and Petrich completed this study (2002b) to better define the interactions of surface and groundwater around the New York Canal. Groundwater mounding is present beneath the canal system in the valley and is generally attributed to canal seepage. Seepage rates from the canal were previously estimated at between 12 and 20 percent of the canal flow. A reference to a previous study in 1999 (Carlson and Petrich 1999) stated that seepage rates from the New York Canal were proportional to canal flow and that these rates were generally influenced and controlled by the geology and depth to groundwater below the canal.

This Hutchings and Petrich study indicates that no work was previously done in the valley examining the extent of surface and groundwater interactions due to canal seepage, although several geochemical studies examined the age of waters in the valley and suggest that canal seepage and irrigation water are important for shallow groundwater recharge, but not generally for aquifers deeper than about 200 feet.

In order to better define the interactions between surface and groundwater around the New York Canal, environmental tracers were used, such as tritium, nitrate, and carbon dioxide. Groundwater samples collected near the New York Canal were tested for the presence of tritium to examine recharge and residence times. Concentrations of constituents such as nitrate and carbon dioxide were used to show the effect of flood irrigation on shallow groundwater recharge, as areas underlying irrigated lands showed elevated levels of both constituents; areas that did not underly irrigated land did not show elevated levels. The study shows what appears to be a groundwater divide beneath the canal, which minimizes mixing of these two groundwaters. The study also shows that the shallow aquifers and deep aquifers in the valley do not substantially mix (shallow groundwater does not recharge the deep aquifer) due to the lack of nitrate and tritium in deep aquifer samples (below the "blue clay" layers that separate the two aquifer systems). Tritium levels in the shallow aquifer system also show that groundwater had recharged within the last 50 years.

2.1.1.5 2001 DOMESTIC, COMMERCIAL, MUNICIPAL, AND INDUSTRIAL WATER DEMAND ASSESSMENT AND FORECAST IN ADA AND CANYON COUNTIES

This IDWR study (2001) shows that there was a 44 percent increase in population in Ada and Canyon counties between 1988 and 2000. Baseline water demand for the counties in 1997 and 1998 was estimated at 103,000 acre-feet per year, and by 2025, it was estimated that it would rise to 179,000 acre-feet per year, a 74 percent increase.

2.1.1.6 1999 STREAMFLOW GAINS AND LOSSES IN THE LOWER BOISE RIVER BASIN, IDAHO, 1996-97

This report looked at streamflow gains and losses in the lower Boise River Basin. As part of the analysis, seepage runs were made on irrigation canals and creek reaches during June and July 1996, which showed that irrigations canals both gained and lost water, while seepage runs in September showed that most reaches lost water. No correlation could be made between seepage and environment as there was no substantial difference noted. Seepage runs completed on three reaches of the lower Boise River in November 1996 showed net gains in the upper two reaches, and net loss in the downstream reach near the confluence with the Snake River.

In March 1997, due to high water in the Boise River, water was diverted to the New York Canal (which provides more than 60 percent of irrigation water to the area), allowing for a seepage run on the canal while no irrigation diversions or return flows were occurring. Losses were dominant in the seepage runs, although some gains were present. The total losses from the runs in March 1997 were -54 and -143 cubic feet per second. In general, losses increased downstream. Near the study area, losses from the runs were -43 and -60 cubic feet per second.

Additionally, 16 wells near the New York Canal were measured on a weekly basis between February and mid-June, which showed decreasing water levels until mid-April, after which they increased through June (this is consistent with other reports stating water levels in the shallow aquifer are tied to irrigation). Paired wells monitored near the canal indicated that there is downward movement of water, likely from recharge to the groundwater system due to canal loss.

2.1.1.7 1993 GROUNDWATER CONDITIONS IN THE AREA NORTHEAST OF KUNA, WEST-CENTRAL ADA COUNTY, IDAHO

This IDWR study examined an area just to the southwest of the study area. Findings from the study indicate that irrigation is the main cause of recharge to the shallow aquifer, while main natural outflow or discharge is from underflow leaving the area to the west, with artificial discharge coming from wells. Water level measurements from March 1993 show that shallow groundwater is moving from the east/southeast to the west/northwest and the water table slope ranges from 10 to 30 feet per mile, with a gentle gradient likely due to recharge from irrigation.

Water levels in the area are highest in the late summer and lowest in early spring, with fluctuations ranging between 3 and 16 feet. Water level declines in the study area over 23 years exceeded 14 feet and appeared to be the result of reduced recharge from surface water during a recent drought at the time. The study indicated that many of the wells in the study area that were deepened or re-drilled were originally drilled too shallow to withstand the worst period of drought. Over 600 domestic wells were drilled in the area between 1967 to early 1993.

2.2 Urban Area Change, Wells, and Water Levels

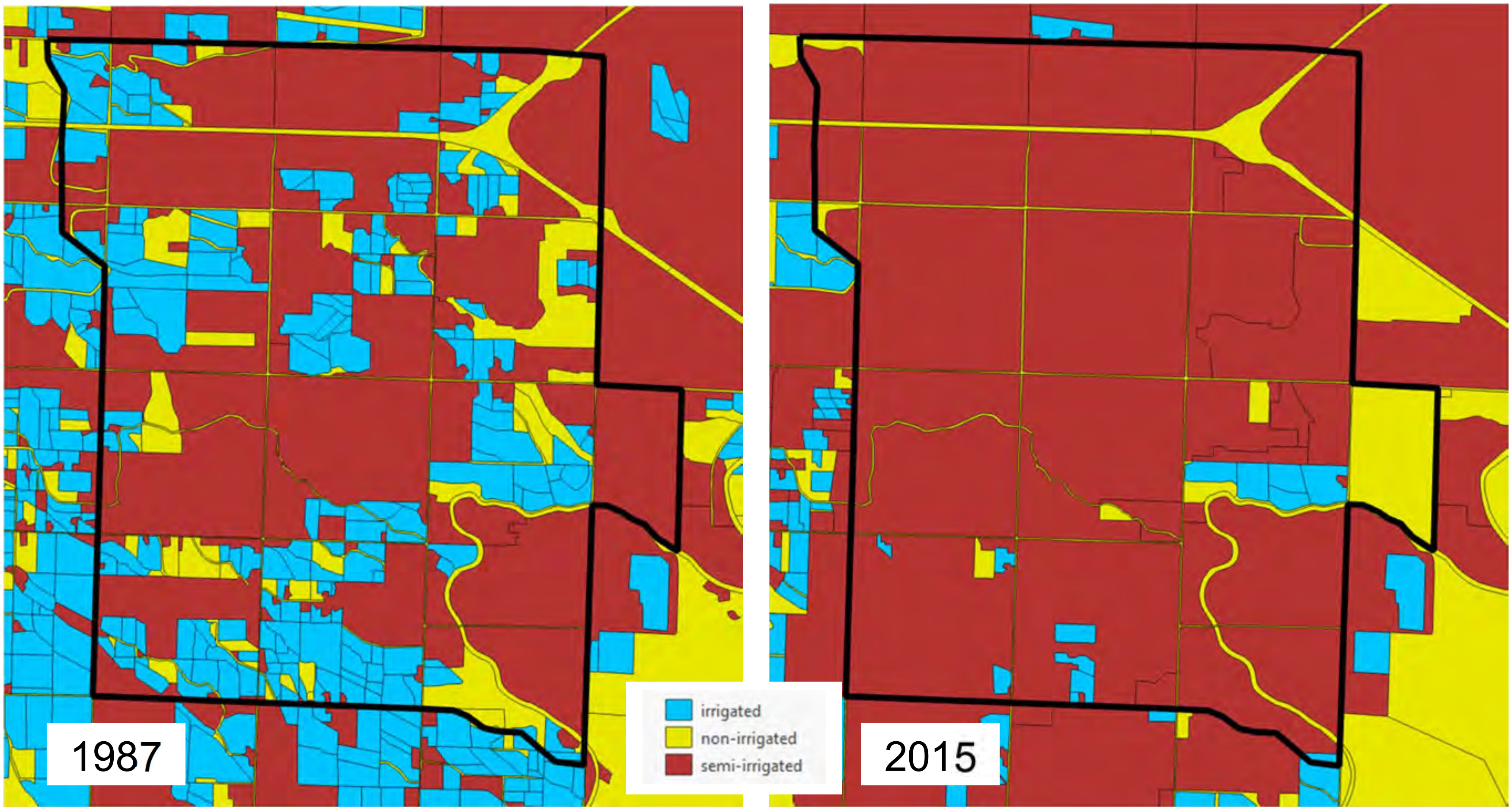
The study team evaluated available groundwater-level monitoring and water-quality monitoring data from wells in and near the study area, collected by the USGS, IDWR, Boise Parks Department, and other governmental and private entities. These data provide insight into recent and long-term groundwater level trends in the study area, seasonal water-level changes, historical groundwater responses to residential development, changes in irrigation practices, increases in municipal groundwater pumping, and other aquifer stresses; any differences in water-level and water quality between shallow and deep aquifer zones; and any changes in groundwater quality over time.

2.2.1 Urban Area Change

The study team examined the change in irrigated lands between 1987 and 2015 in order to quantify the change in irrigation within the study area. As much of the shallow groundwater recharge in the Treasure Valley is from irrigation and seepage, the increase in urban area within the study area boundary may correlate to decreases in shallow groundwater levels. As more urban development occurs, less irrigation is occurring within the study area. **Table 1** shows the change in irrigated land between 1987 and 2015 and **Plot 1** shows images of the irrigated land types for 1987 and 2015. HDR used data available from IDWR through ArcGIS which shows each irrigated area type (IDWR 2020) and clipped the acreages to the study area boundaries to determine the acreage for each year.

Table 1. Change in Irrigated Land Between 1987 and 2015

Irrigation Status	1987 (Acres)	2015 (Acres)
Irrigated	2,085	204
Non-irrigated	1,218	737
Semi-irrigated	5,084	7,446
Total	8,387	8,387

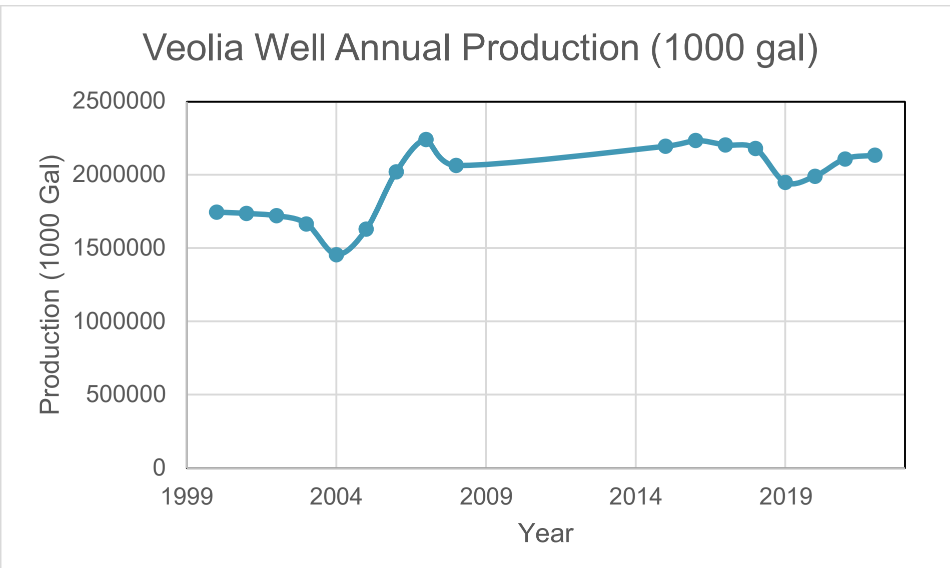


Plot 1. Irrigated Land Comparison Between 1987 and 2015

As shown in **Table 1** and **Plot 1**, irrigated land within the Treasure Valley has changed greatly over the 28-year time period examined, with the total irrigated acres declining from 2,085 acres to just 204 acres. However, semi-irrigated land has increased since 1987, likely due to residential properties increasing throughout the study area. Based on the data, increasing urban growth is moving away from full irrigation to more semi-irrigated lands (primarily home lawn irrigation).

2.2.2 Groundwater Pumping

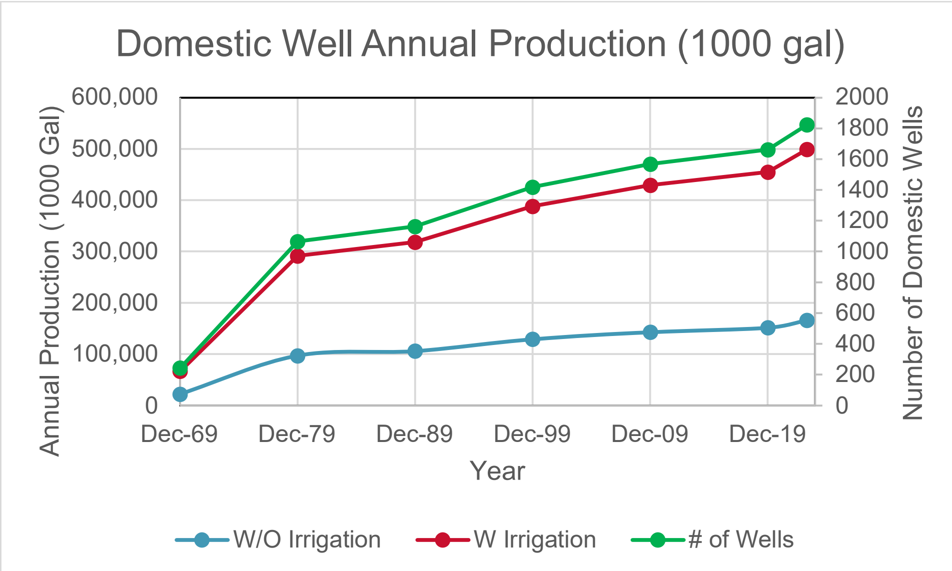
Veolia published annual well production data, including for 12 Veolia wells identified within the study area, in their annual reports from 2000 through 2022. As shown in **Plot 2**, annual groundwater production increased in Veolia wells within the study area after 2005. Pumping amounts dropped after 2018 and have been steadily increasing since 2019. It is reasonable to assume that pumping rates in municipal and supply wells throughout the study area will continue to increase over time as more municipal and supply wells are drilled and groundwater needs increase. It is also important to note that Veolia wells are generally pulling water from deeper intervals than domestic wells in the area (generally closer to 500 to 600 feet below ground surface [bgs] compared to domestic wells that are under 200 feet deep).



Plot 2. Annual Veolia Well Production

Estimated annual production from domestic wells in the study area is shown in **Plot 3**. Annual domestic well production is based on the number of domestic wells identified from IDWR's website by installation date. This plot includes annual production with and without irrigation, assuming 750 gallons per day (gpd) per home with irrigation and 250 gpd per home without irrigation. These values are typical for water use in the Treasure Valley.

Wells marked as abandoned or whose installation dates are "unknown" are not included in the number of domestic wells in **Plot 3**. Generally, these excluded wells were manually entered into GIS, based on the Ada County well maps in portions of the study area, and/or do not have well logs or date information in the IDWR GIS points. Additionally, there are many wells IDWR identifies as replacement or modified wells, based on either IDWR or well log classification, or HDR classification (based on multiple wells at the same property). These are included in the domestic well annual production with no additional correction to the domestic well count per year, as there are assumed to be many wells in the study area that are not identified on IDWR's website (may have been installed prior to IDWR reporting requirements) and many that were not included as they are marked as "unknown" for the installation date.



Plot 3. Annual Domestic Well Production

2.2.3 Wells

The study team downloaded well data within the study area from IDWR (IDWR 2023a) (**Figure 3** through **Figure 6**). A total of 2,487 wells were identified through IDWR data, Environmental Data Management System (EDMS), Ada County-provided points, and other sources. Each well log (if available) was examined for intended use, depth, static water level, construction (screen or no screen), year of construction, and exact location such as address or parcel information. Each well point for which there was an address or an identified sub/lot/block was mapped to that specific location and deemed as having an identified location. Location identification could only be done as accurately as the parcel or address itself, so some minor error in location is likely without field verification.

Of the 2,049 domestic wells identified, 939 have identified locations (identified addresses). The remaining domestic wells do not have a driller's log or the log does not contain specific location information such as address or subdivision information. Many older logs only identify a well location by section quarter-quarter (i.e., 40-acre tract). Of the 31 irrigation wells, 19 have identified locations. Most of the locations of monitoring, municipal, and commercial wells have been identified.

For construction type, 1,469 wells are labeled as new, while 397 wells are labeled as either replacement or modified wells. Very few well logs are for abandonments (less than 100). Almost 400 wells are labeled as unknown because their well logs do not have a construction type listed, or there is no well log to tie to the well point.

Table 2 shows all wells in the study area and categorizes them by well use. **Table 3** shows construction type based on well logs, as well as an adjusted construction type count. The adjusted construction type count was determined based on identifying properties where multiple wells were drilled (with some marked as "new" on well logs), but the wells were progressively drilled deeper.

Table 2. Well Use Breakdown in Study Area

Well Use	Count
Domestic	2,048
Irrigation	31
Municipal	32
Commercial	3
Monitoring	89
Other	32
Unknown	251
Total	**2,486**

Table 3. Construction Type from Well Logs or Points

Construction Type	Count
New	1,469
Replacement	243
Modified (deepened/modified)	154
Abandoned	95
Unknown	380
Total	**2,486**

Wells marked as unknown either do not have a well log, the log does not have any information indicating a well's intended use, or the log provides no construction type information.

Table 4 lists an adjusted construction type count based on properties with two or more domestic wells (with addresses identified from well logs) constructed at increasing depths. **Table 5** lists identified replacement or modified wells per decade. Actual numbers of replacement wells (and any wells) may be different, and are likely higher than indicated here, because there are many well points without identified addresses (and an unknown number of wells may not be included in IDWR's well database). There are several properties within the study area that added multiple replacement or modified wells over time. Several of the wells in the adjusted counts shown in **Table 4** and **Table 5** were initially marked as new on the well log, but are corrected here to replacement if there were multiple identified wells on a single property, with depth increasing in more recent years of installation.

The numbers displayed in **Table 2** through **Table 5** are estimates based on well log or well point information; actual numbers may differ. Wells without identified addresses/locations and wells that may exist in the study area but do have well logs or points are not accounted for in this study. The numbers in **Table 2** through **Table 5** would likely change should there be additional well surveys in the study area. The numbers of all well types are likely to be higher than shown here.

Based on the adjusted construction counts shown in **Table 4,** at least 472 of the 2,048 domestic wells have gone dry. This estimate is based on the number of domestic wells that are marked as replacement, deepened, or modified (442 wells) as well as 30 wells that Ada County identified (see map in Appendix A) as dry that are not tied to well logs (those that are tied to well logs were counted and are included in the corrected construction count). It is expected that the actual number of wells that have gone dry in the study area is higher.

Table 4. Adjusted Domestic Well Construction Type Count

Domestic Well Construction Type (corrected)	Count[2]	Percentage of Identified Domestic Wells
New	1349 (137)	66%
Deepened or Modified	150 (7)	7%
Replaced	292 (8)	14%
Abandoned	79	4%
Unknown	178	9%
Total	**2,048**	

[1]Corrections were made based on visual review of well logs and of wells that had an address matched to them (i.e., properties that had multiple domestic wells with an identified address)

[2]number in parentheses are the number of wells that were later deepened, modified, or replaced

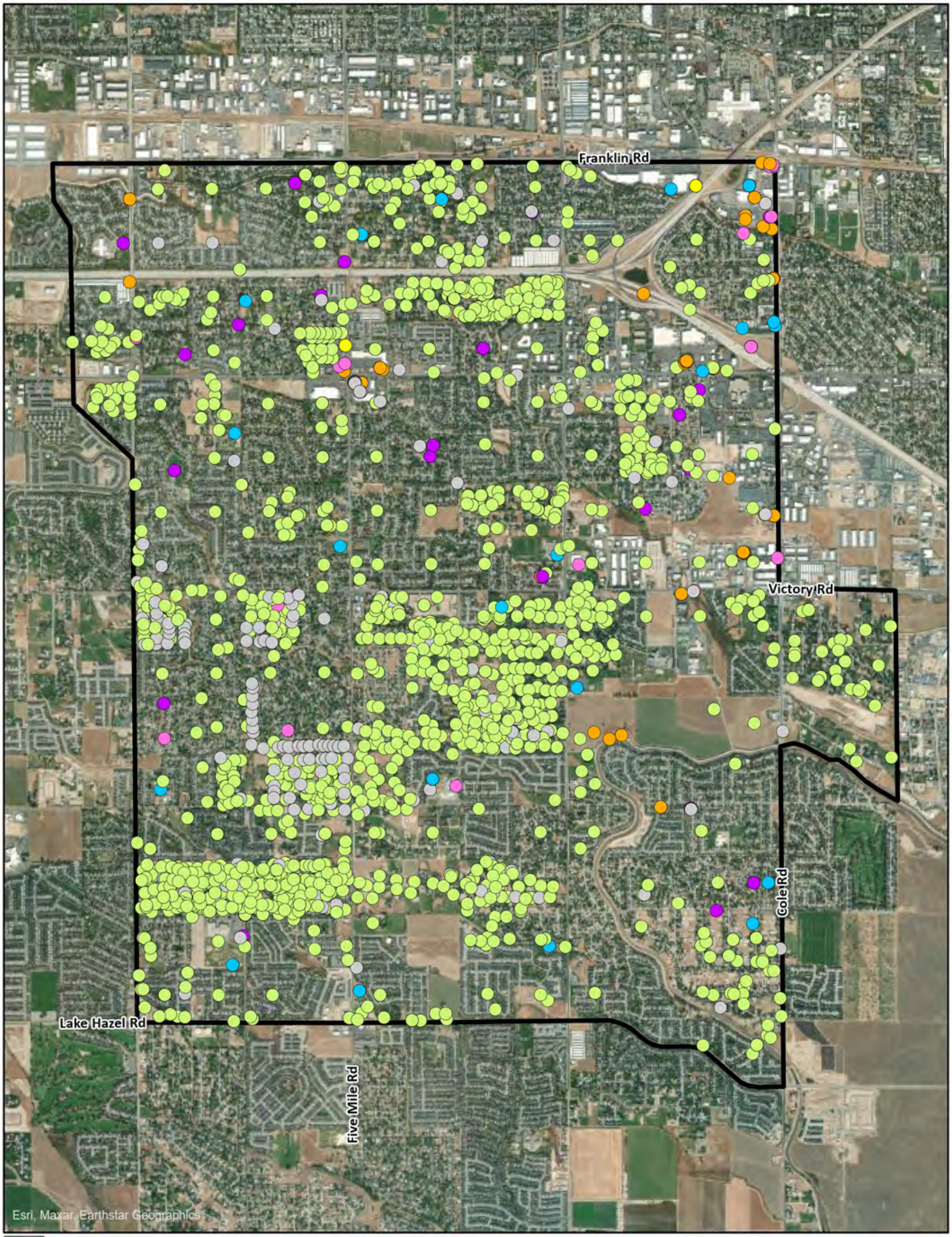
Table 5. Number of Replacement or Modified Domestic Wells by Decade

Decade	Replacement Domestic Wells (corrected number)	Modified or Deepened Wells (corrected number)
Prior to 1969	2	3
1970-1979	14	39
1980-1989	8	17
1990-1999	63	62
2000-2009	56	10
2010-2019	50	4
2020-2023[1]	99	15
Total[2]	**292**	**150**

[1]Through June 2023

[2]Total count of domestic replacement or modified/deepened wells is from the corrected count in **Table 4**

The study team examined drilled well depths over several years and generated maps showing wells depths over the course of three time periods: 1970 to 1979 (**Figure 7**), 1990 to 1999 (**Figure 8**), and 2000 to 2009 (**Figure 9**). In general, more wells were drilled to a depth of 75 to 100 feet between 1970 and 1979 than in the other two decades examined. The wells drilled from 1990 to 1999 and 2000 to 2009 were drilled to depths greater than 100 feet (though fewer wells were drilled in the latter two decades than from 1970 to 1979). In general, it appears as though domestic wells have been drilled deeper over time.



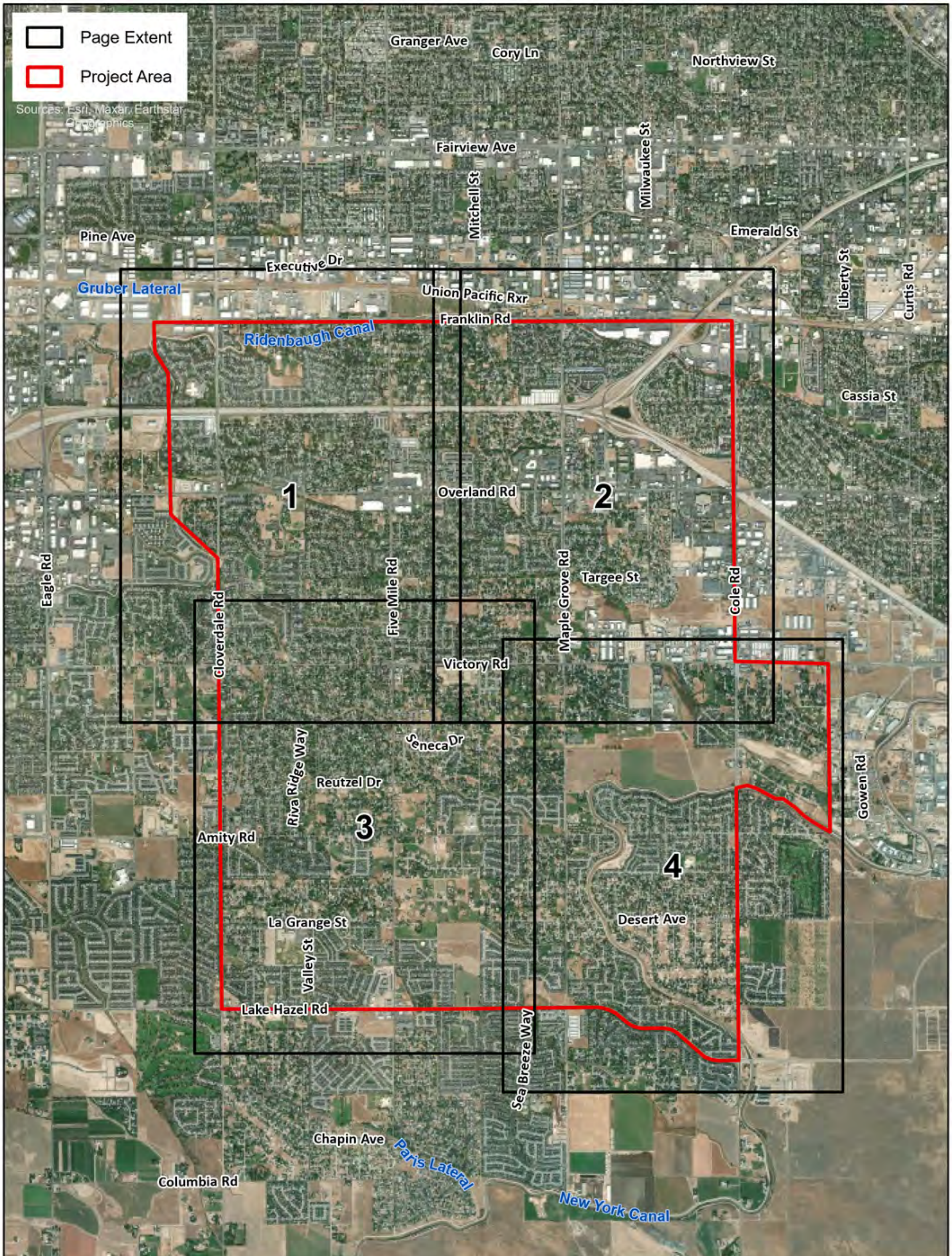
Project Area (1)
Commercial (3)
Domestic (2048)
Irrigation (31)
Monitoring (89)
Municipal (32)
Other (32)
Unknown (250)
*Use based on well log
WELLS WITHIN PROJECT AREA: 2487

0 0.5 mi

HDR

DATA OVERVIEW
WELL USE
Figure 3

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 10/3/2023

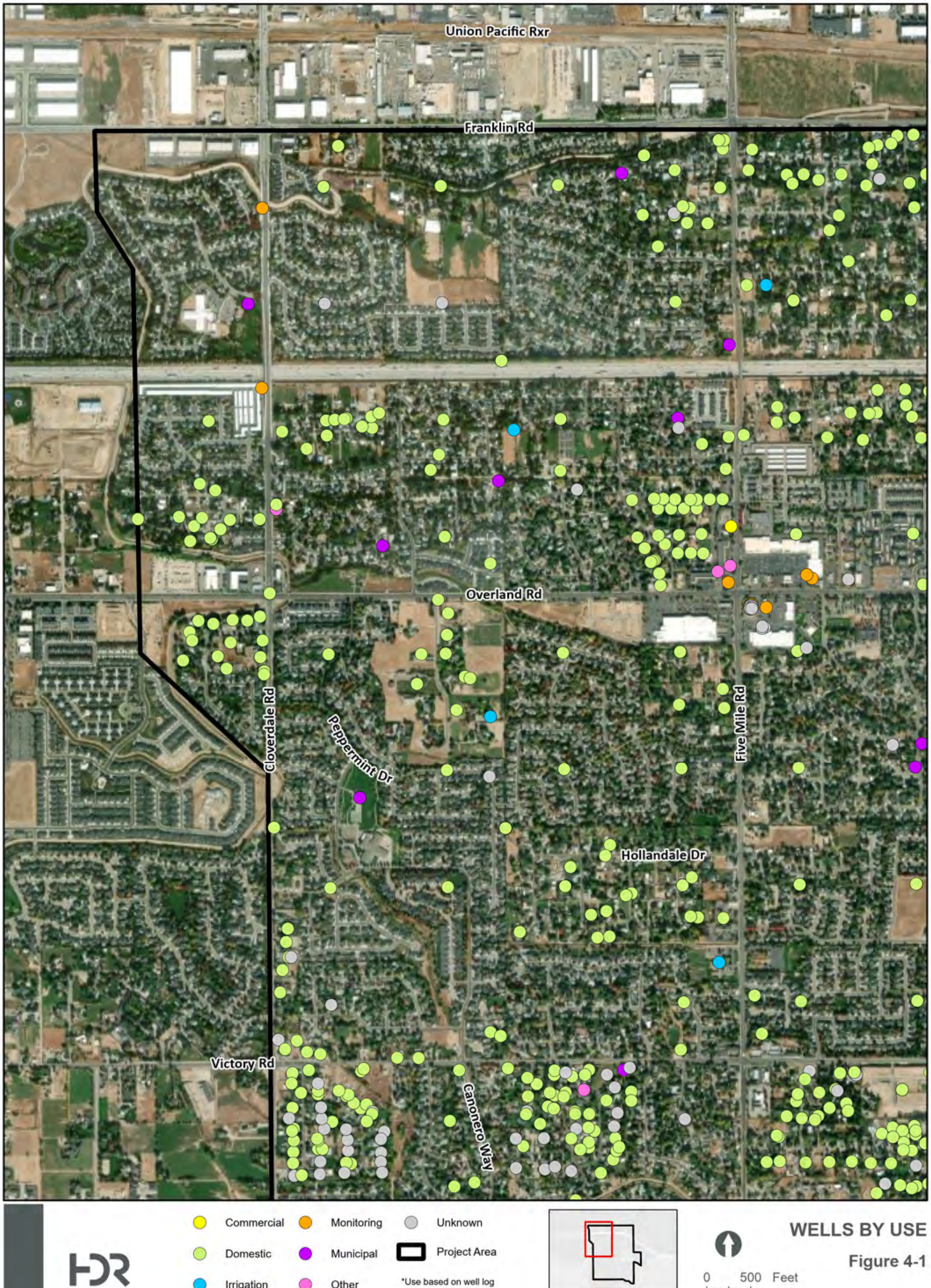


0 0.5 mi

WELLS BY USE

Figure 4

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 10/3/2023

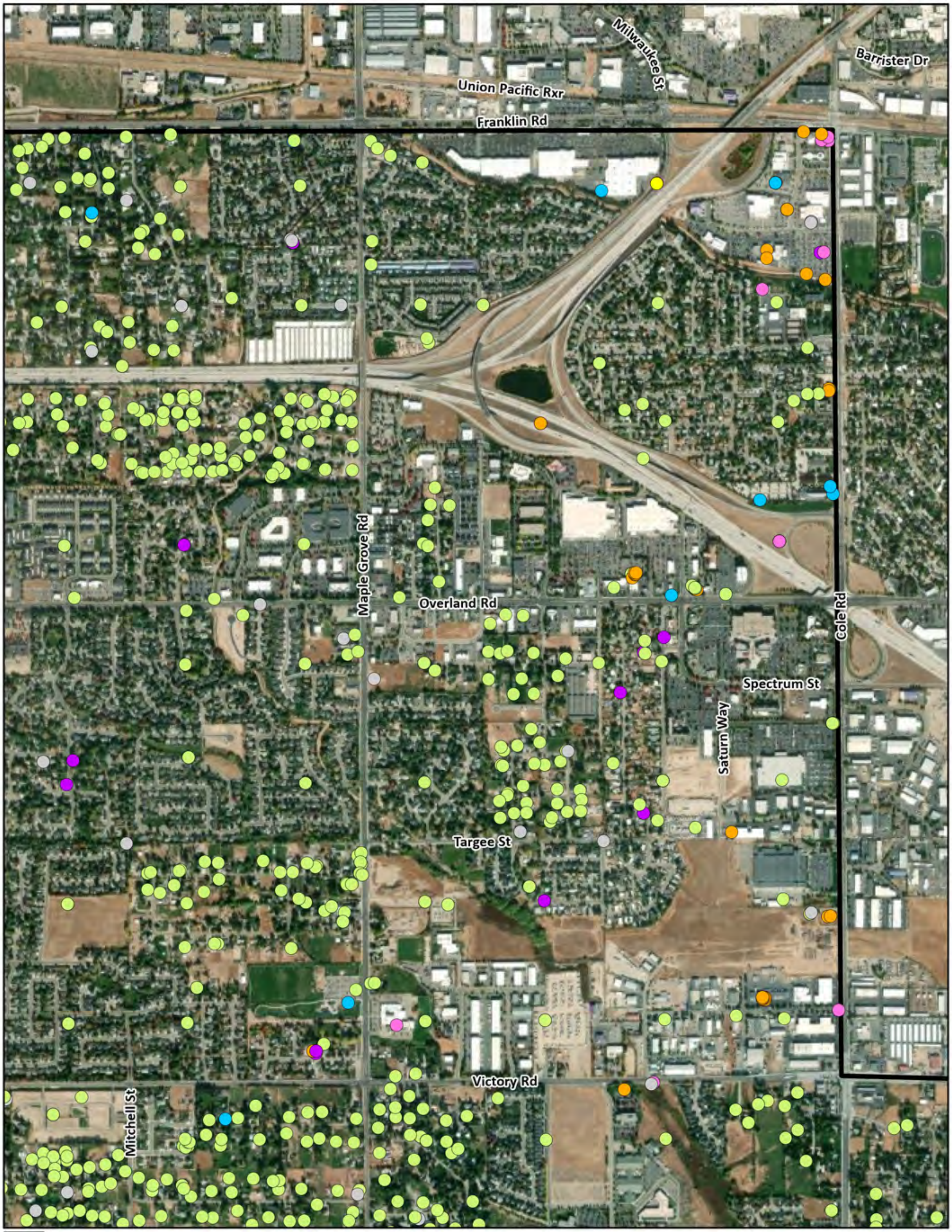


HDR

WELLS BY USE

Figure 4-1

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 10/3/2023

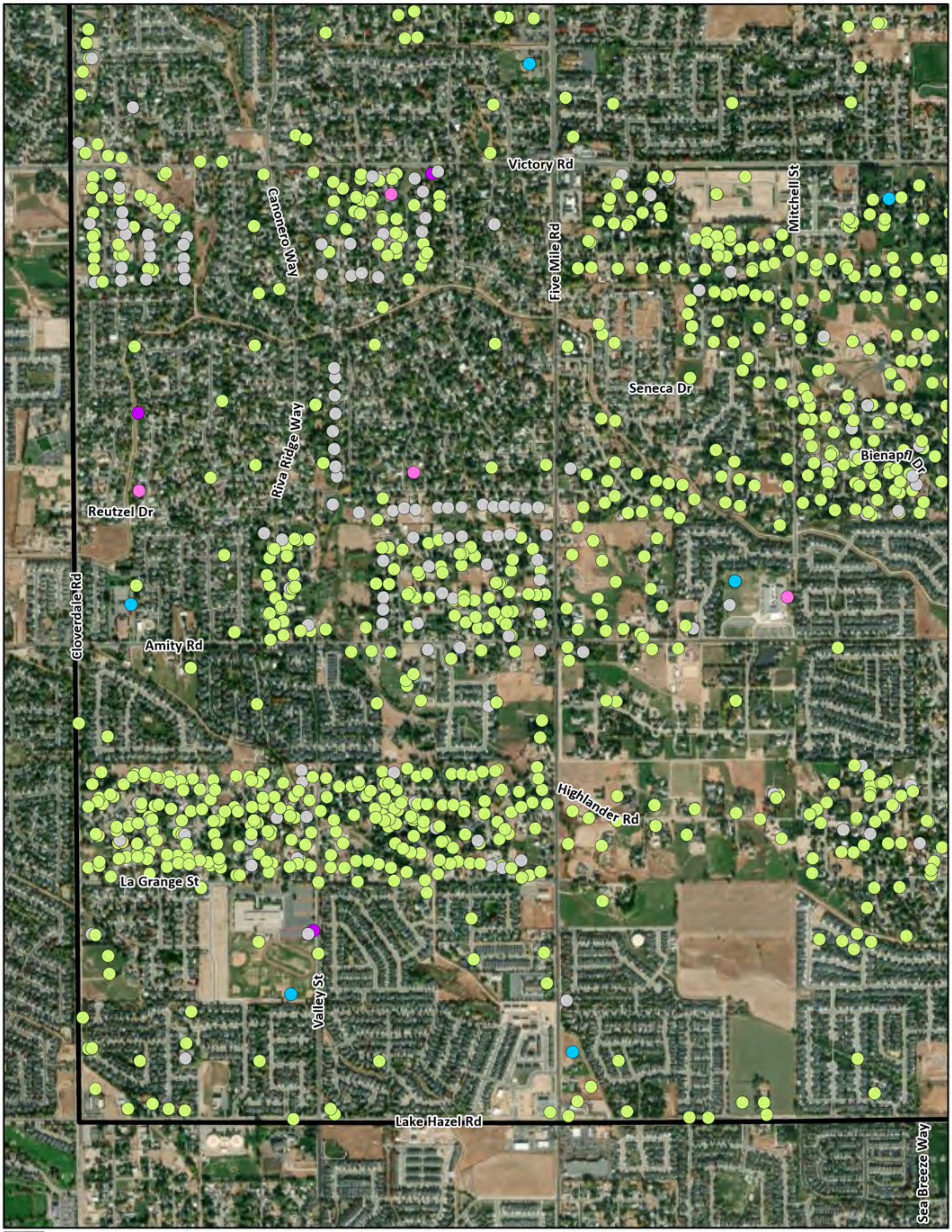


Commercial
Domestic
Irrigation
Monitoring
Municipal
Other
Unknown
Project Area
*Use based on well log

0 500 Feet

WELLS BY USE

Figure 4-2

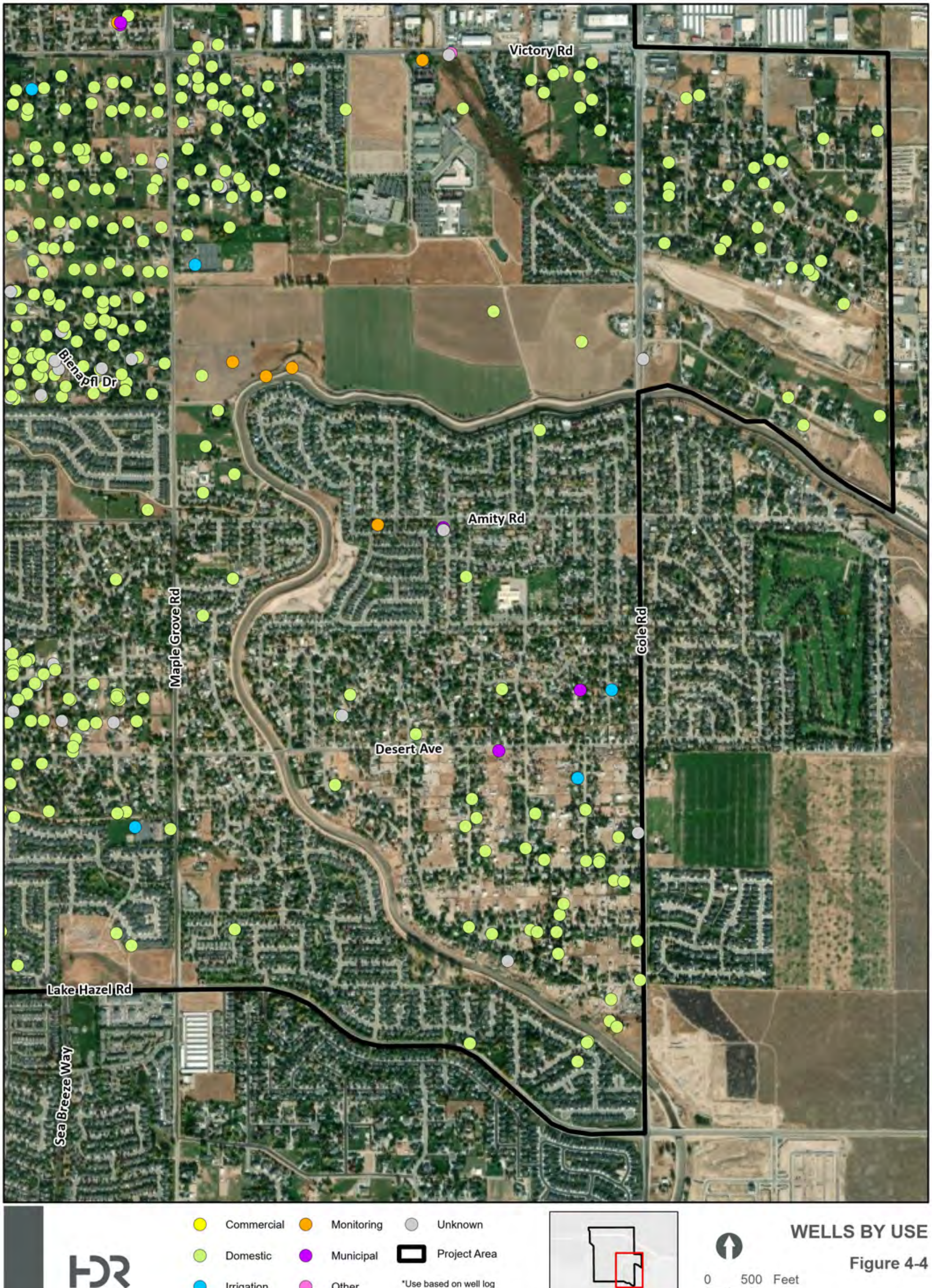


Commercial
Domestic
Irrigation
Monitoring
Municipal
Other
Unknown
Project Area
*Use based on well log

0 500 Feet

WELLS BY USE

Figure 4-3

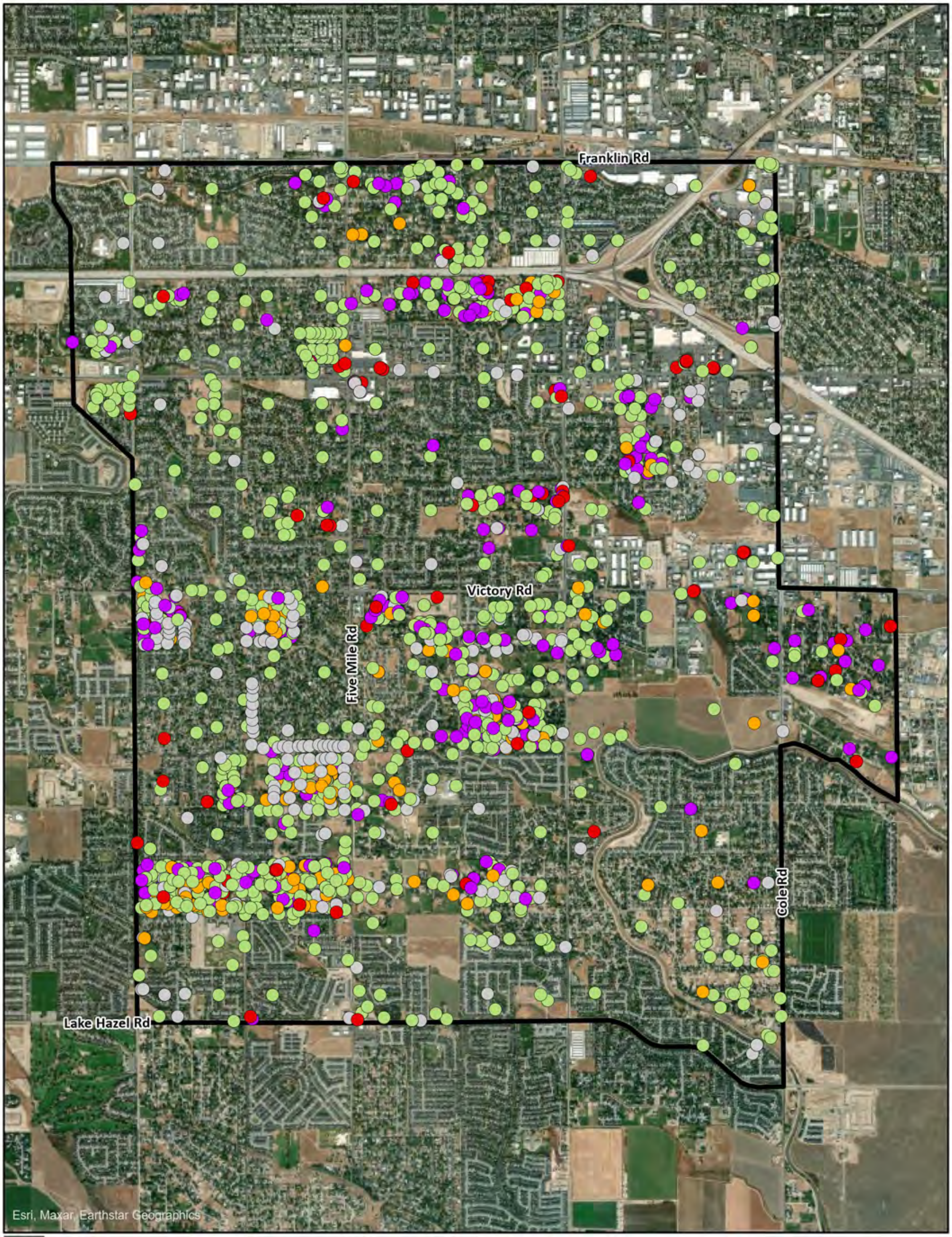


HDR

WELLS BY USE

Figure 4-4

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 10/3/2023



New (1469)
Abandoned (93)
Replacement (243)
Status Unknown (380)
Modified (154)
Project Area (1)

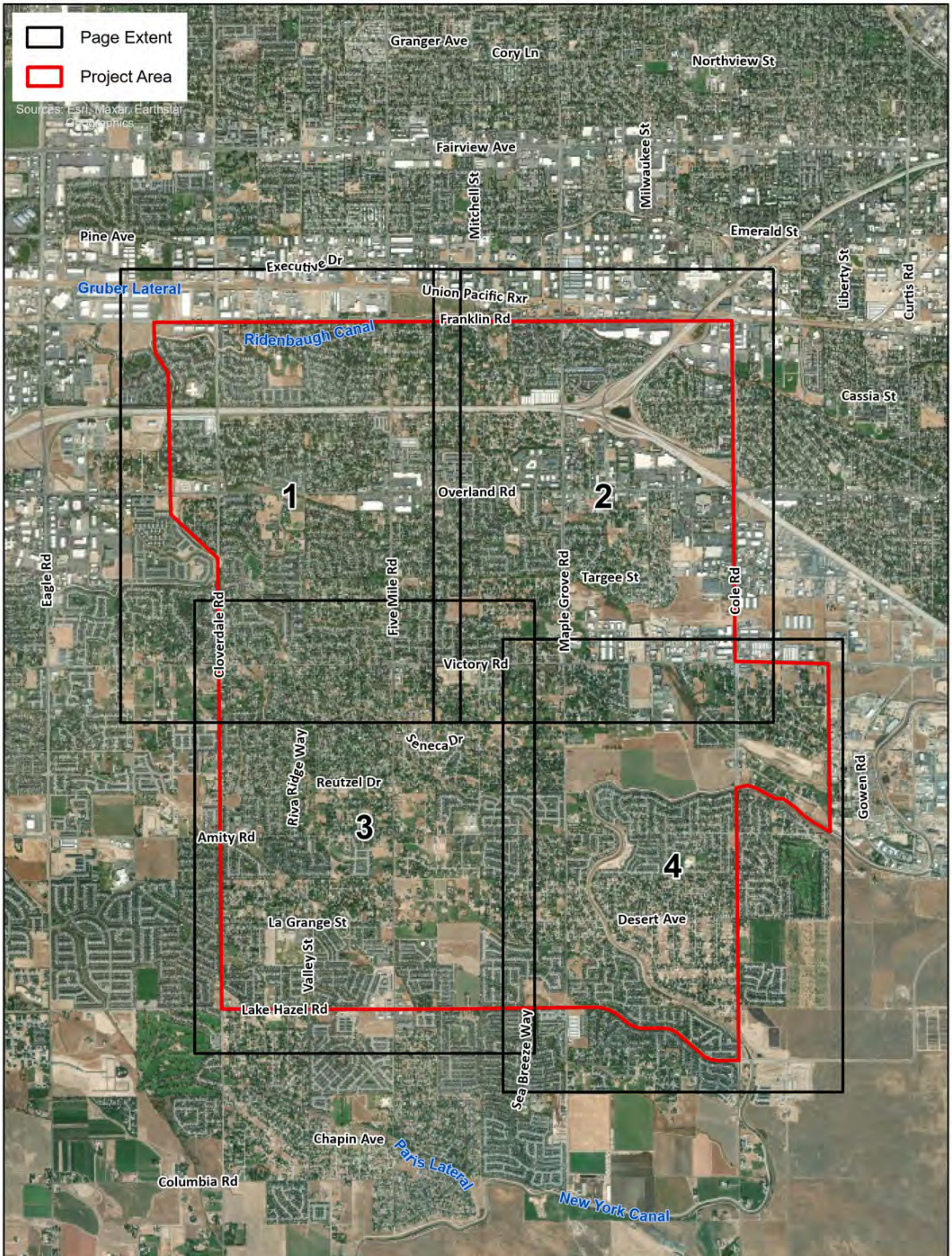
*Status based on well log

WELLS WITHIN PROJECT AREA: 2487

0 0.5 mi

HDR

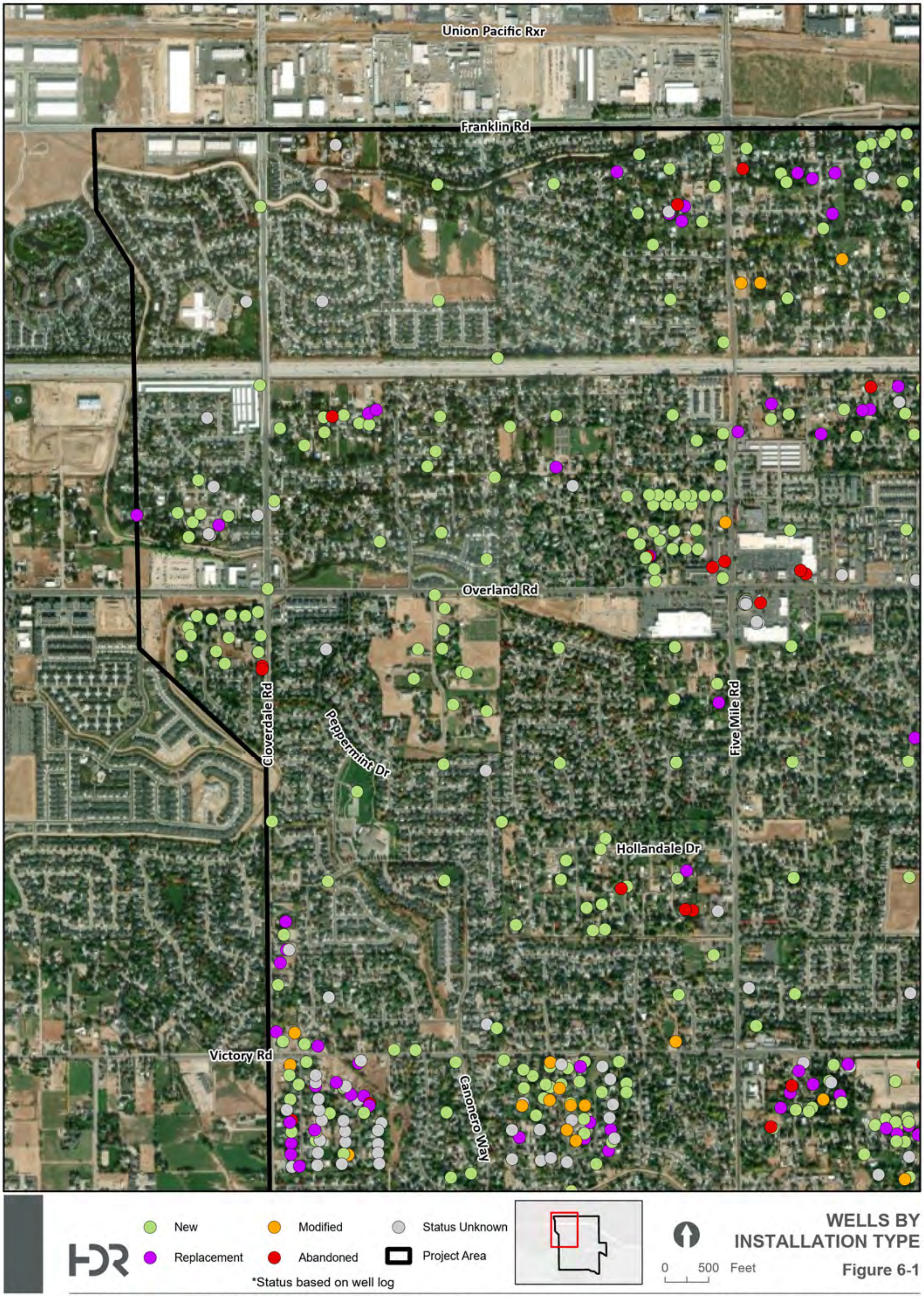
DATA OVERVIEW
INSTALLATION TYPE
Figure 5



HDR

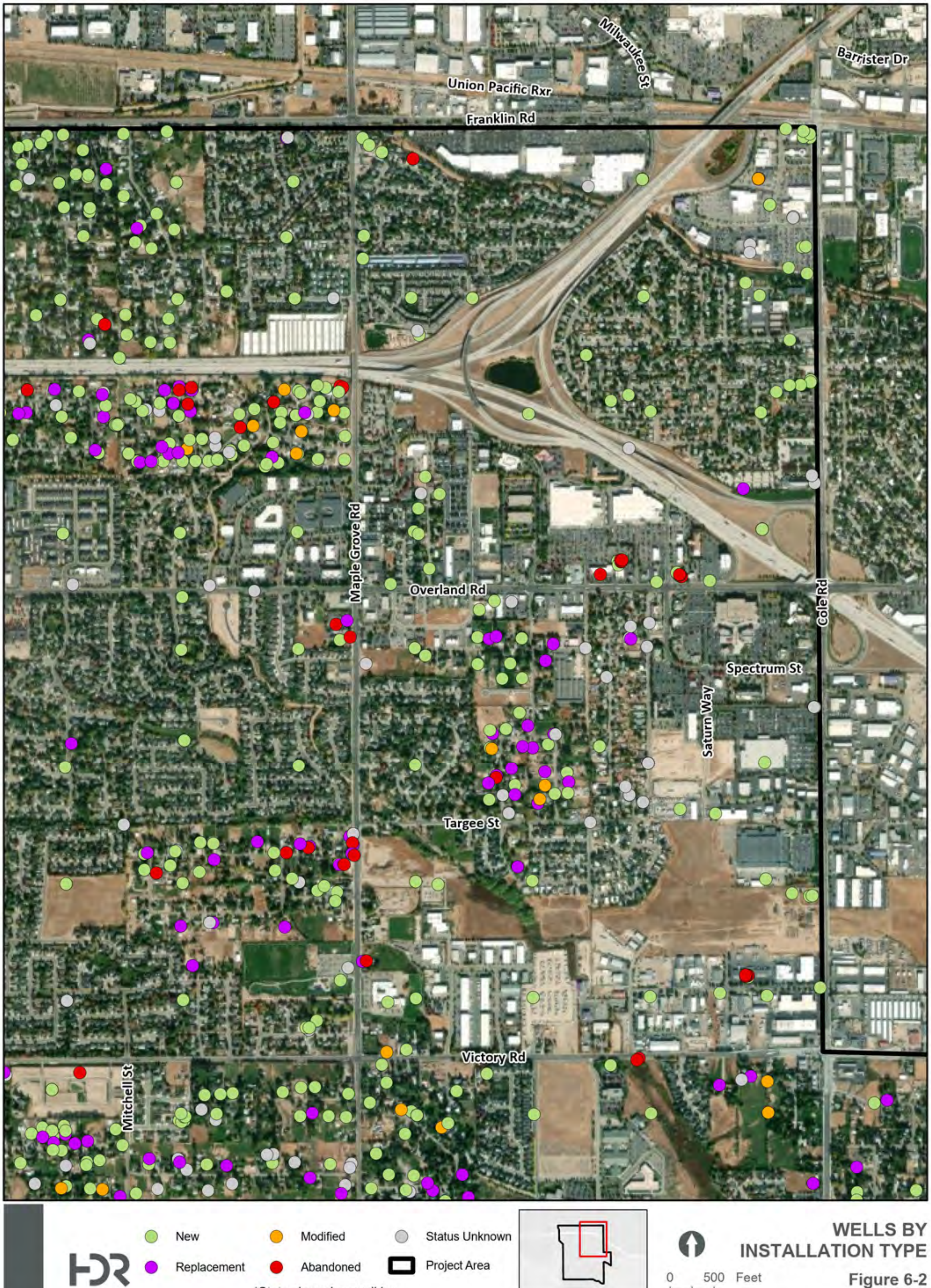
WELLS BY INSTALLATION TYPE

Figure 6



WELLS BY INSTALLATION TYPE

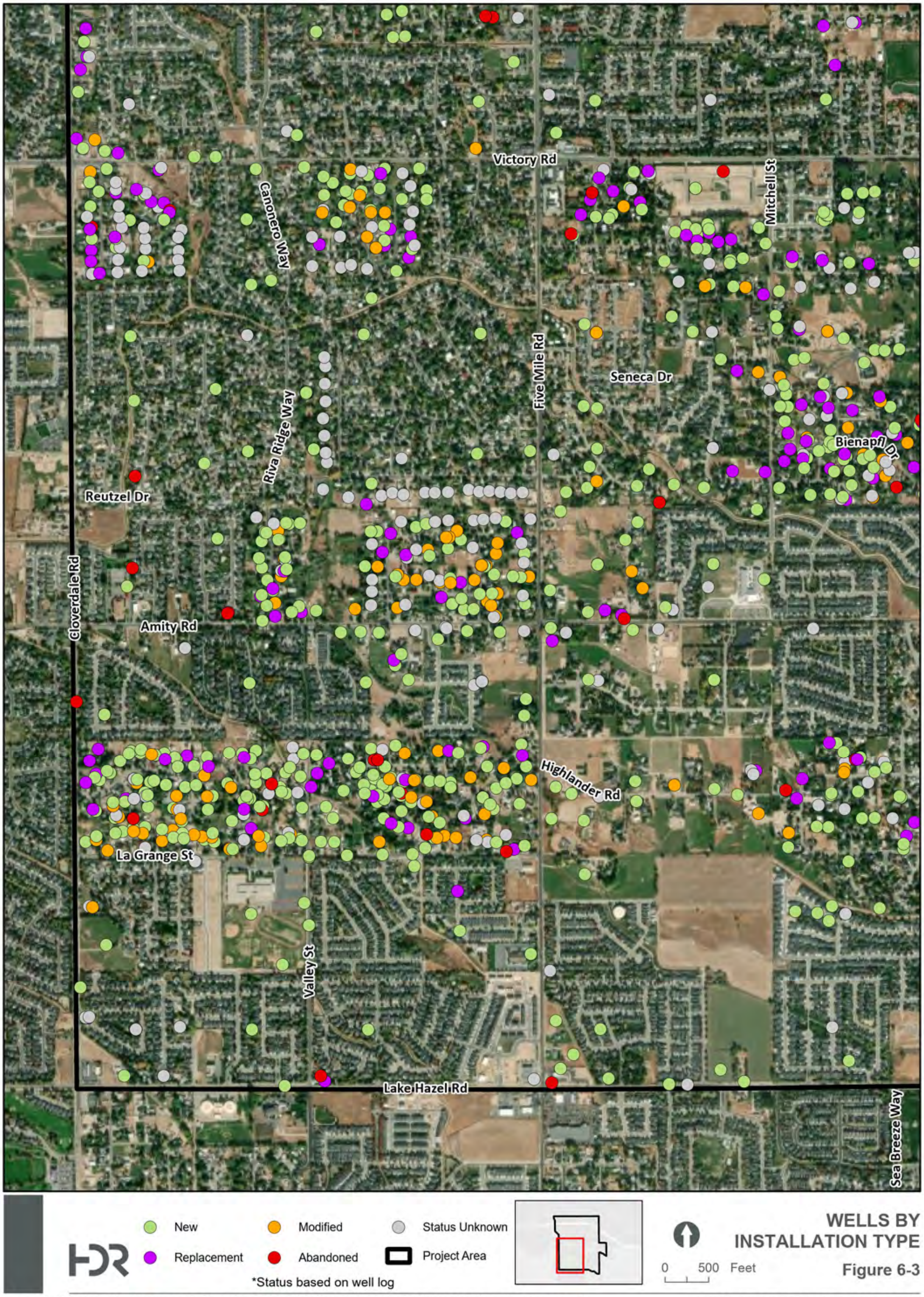
Figure 6-1



WELLS BY INSTALLATION TYPE

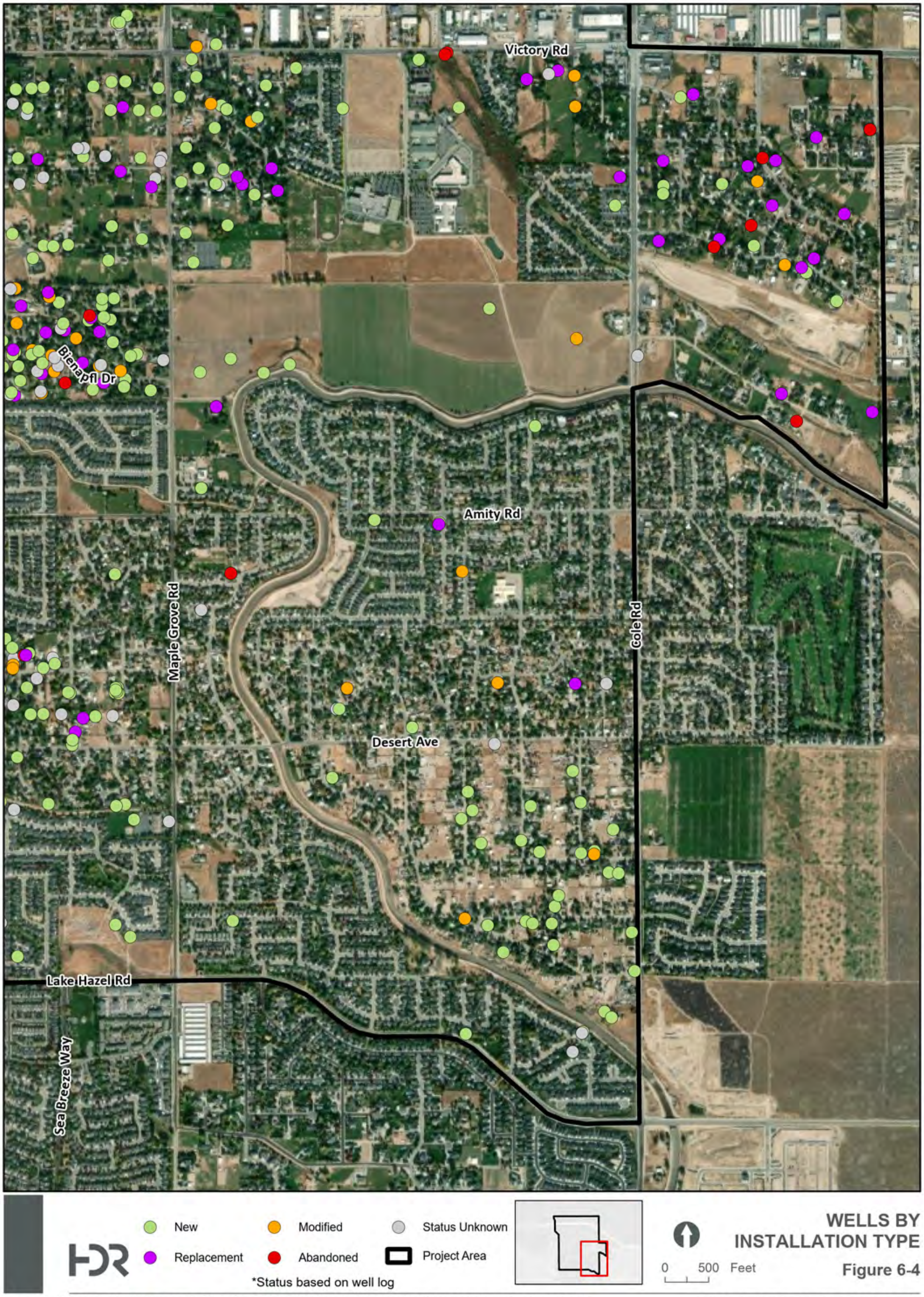
Figure 6-2

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 10/3/2023



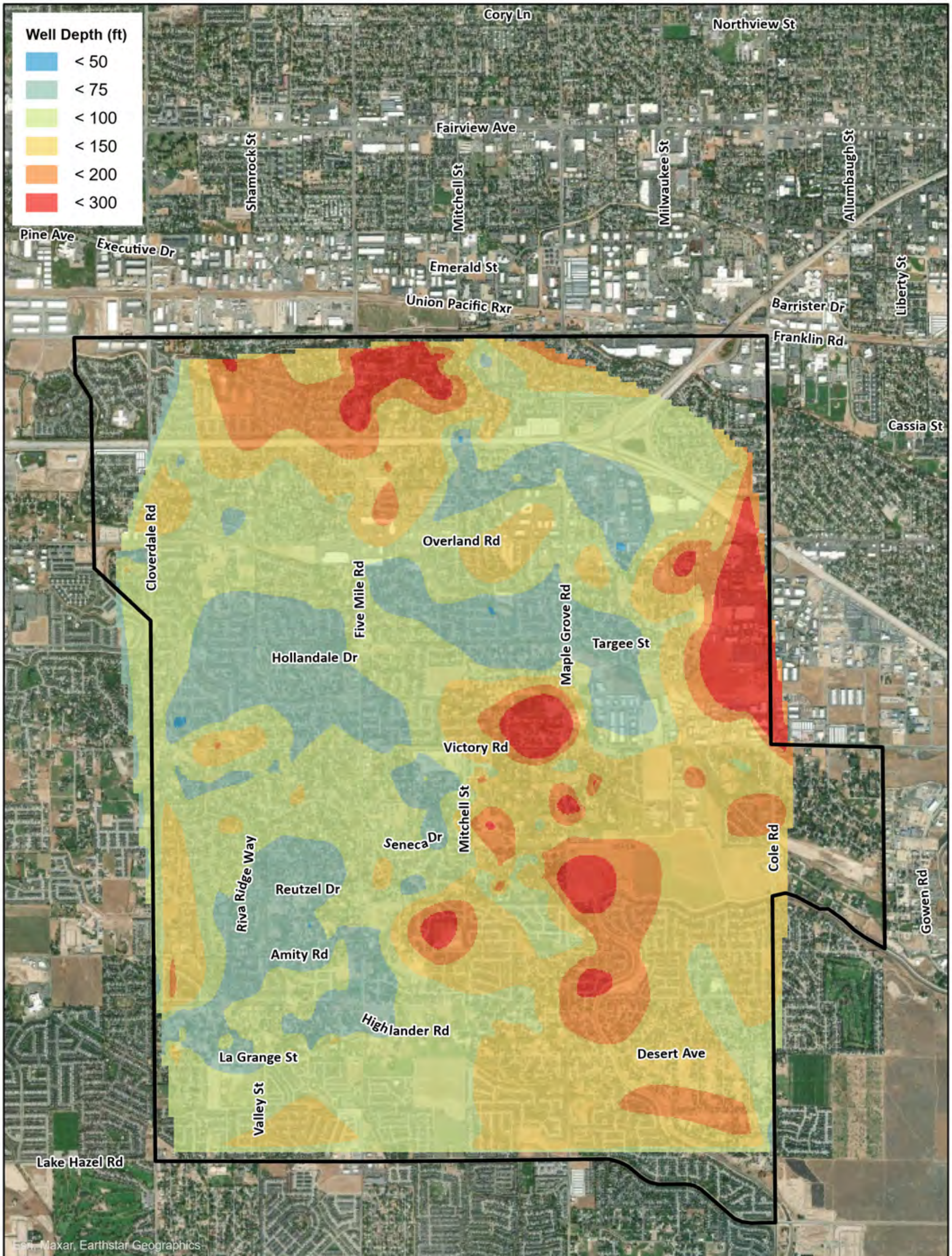
WELLS BY INSTALLATION TYPE

Figure 6-3



WELLS BY INSTALLATION TYPE

Figure 6-4

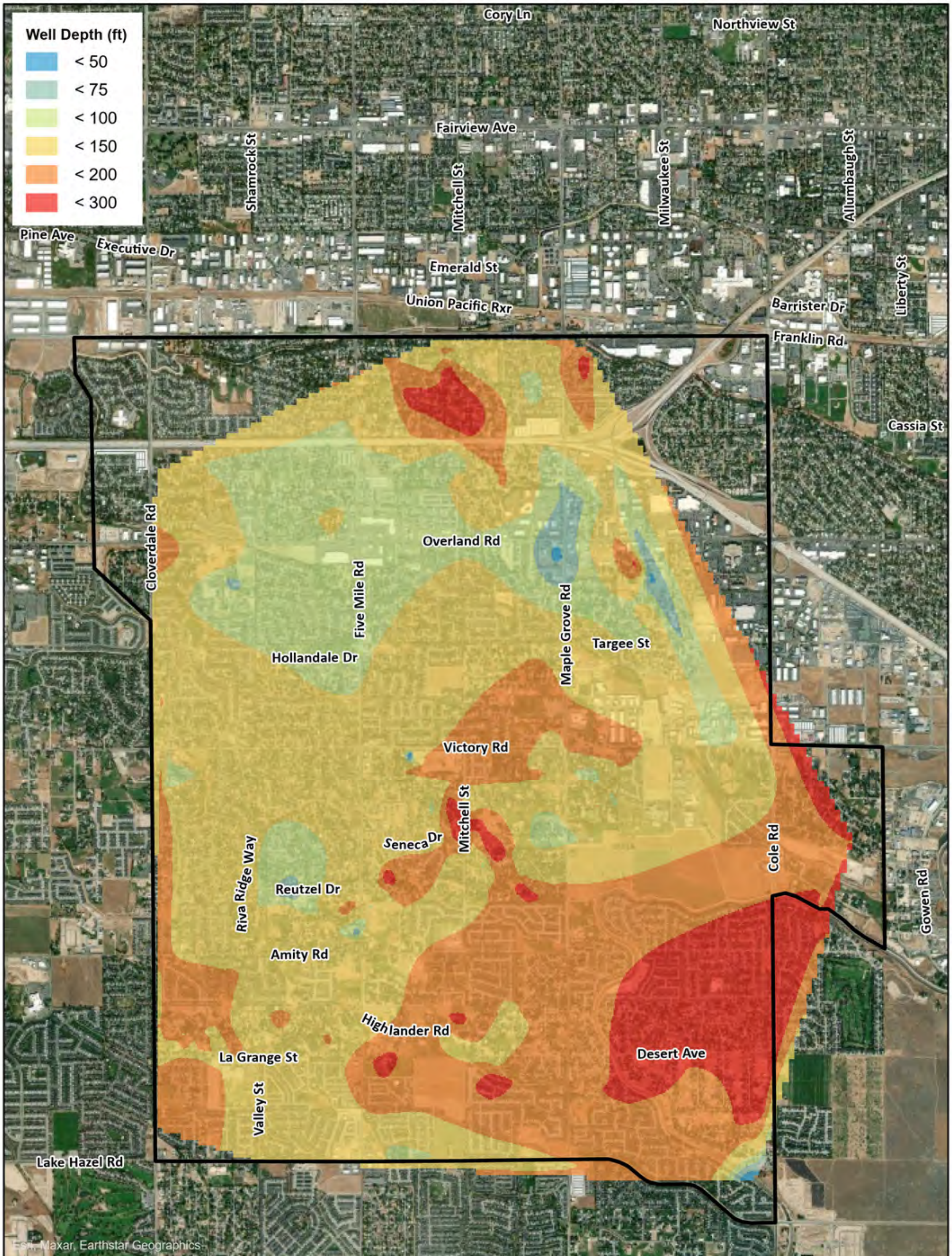


HDR

WELL DEPTH - 1970 TO 1979

Figure 7

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 10/3/2023

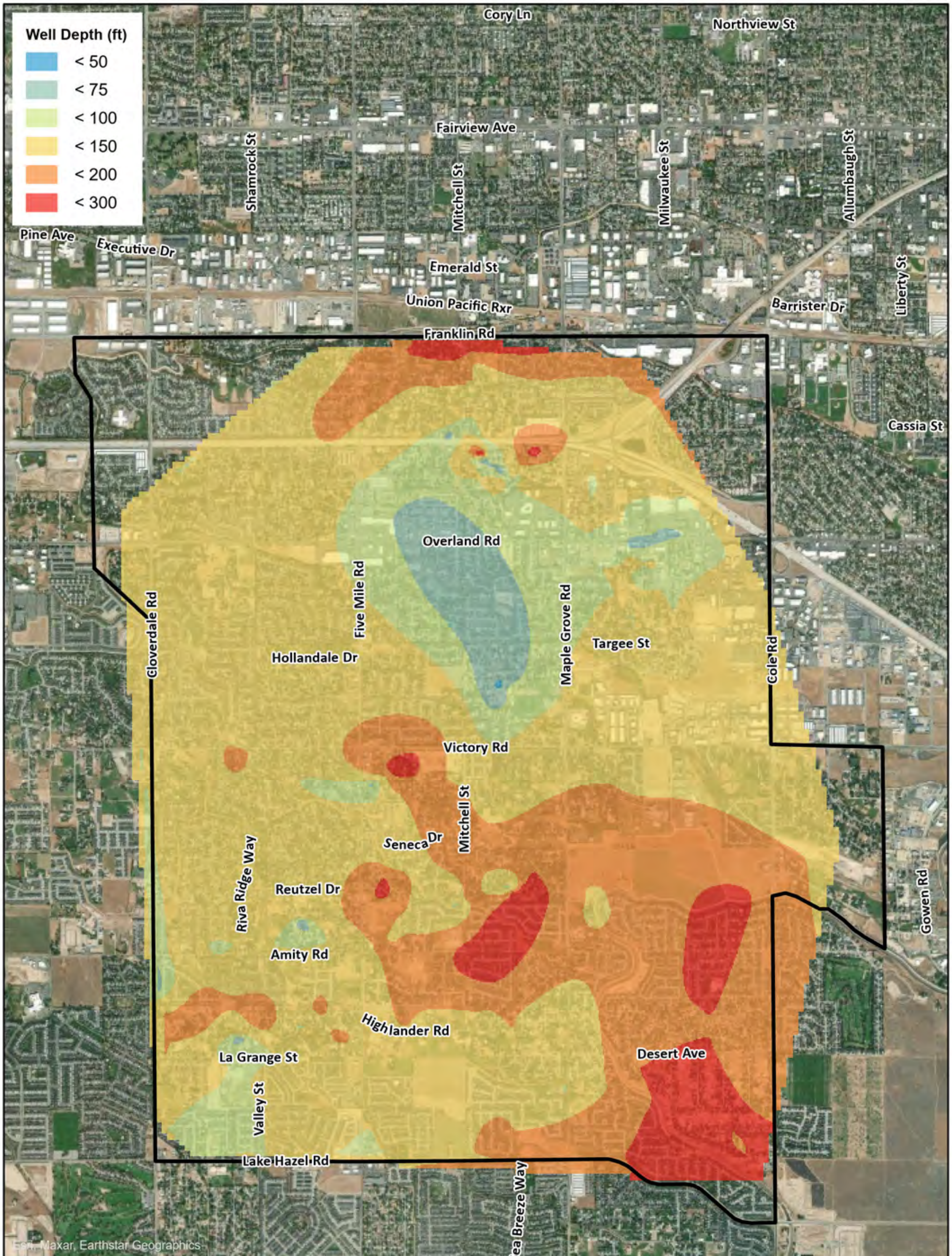


HDR

WELL DEPTH - 1990 TO 1999

Figure 8

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 10/3/2023



HDR

WELL DEPTH - 2000 TO 2009

Figure 9

2.2.4 Water Level Data

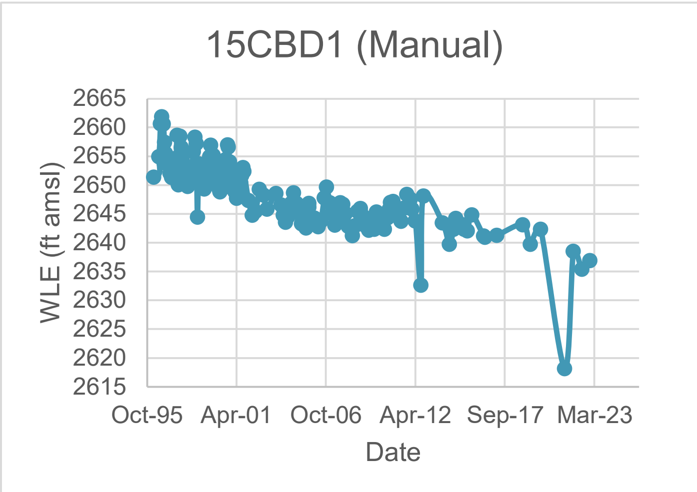
The study team reviewed available water level data from wells across the study area, with an emphasis placed on wells with multiple years' worth of data and wells with verified locations. For several wells across the study area, there are many years' worth of data due to fairly consistent long-term monitoring. These wells are shown in **Table 6** and are pulled from City Park well and USGS/IDWR well data (see **Figure 2** for locations). The wells for which there are many years of data provide a view of water level changes over time within and around the study area. The study team created hydrographs for wells with multiple data points to show the change in water levels over time. **Plot 4** shows the hydrographs for USGS/IDWR-monitored wells in the study area, while **Plot 5** shows the graph of water levels in the two park wells for the period of record. Most of the USGS/IDWR wells had both older manual readings and transducer readings for the last several years.

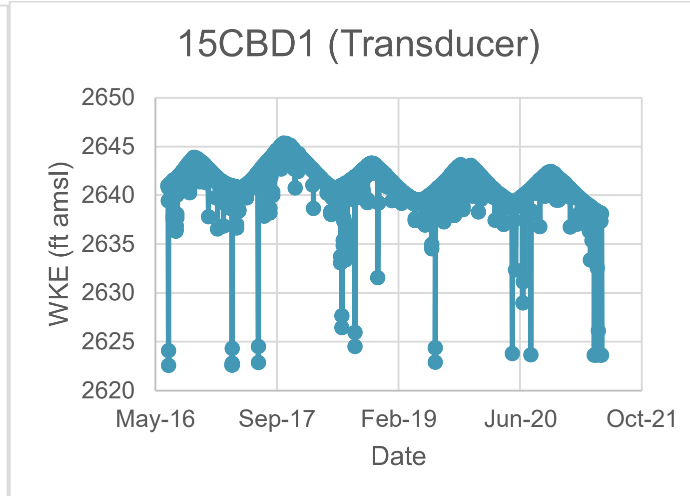
Table 6. Wells with Multiple Years' Worth of Data

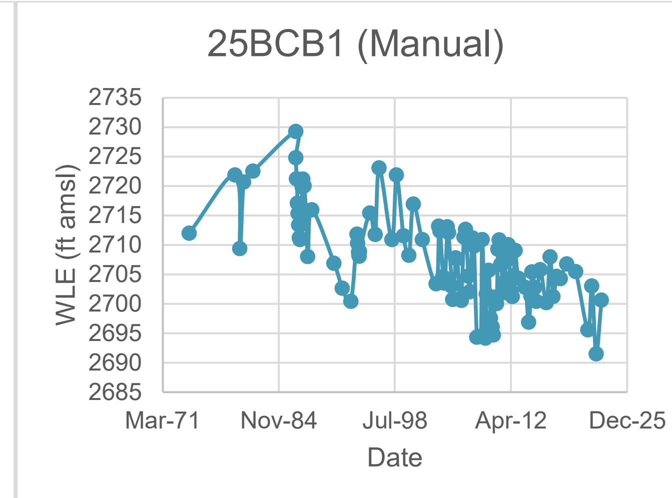
Well ID	Well Monitoring Type	Install Date	Depth (ft bgs)	Casing Depth or Screen Interval (ft bgs)	USGS Site ID	Original SWL	Most Recent SWL	Notes
03N 01E 14BBD1	WQ only	3/30/1970	183	159.5	433607116183301	43 (3/1970)	56.36 (5/2019)	
03N 01E 15CBD1	WL only	6/26/1970	90	90	433544116194601	28 (6/1970)	46.06 (12/2022)	
03N 01E 21DCA1	WQ only	10/24/1990	197	186	433442116202401	40 (10/1990)	36.3 (7/2000)	
03N 01E 26BAD1	WQ only	8/31/1969	195	182	433425116181301	30 (8/1969)	47.6 (6/2015)	
03N 01E 25BCB1	WL and WQ	5/21/1974	117	103-109	433417116172701	42 (5/1974)	59.6 (4/2022)	
03N 01E 27CBA1	WQ only	2/17/1978	558	381-550	433406116194901	31 (2/1978)	--	
03N 01E 28DCDD2	WL only	6/16/1991	125	117-122	433341116202102	45 (6/1991)	56.96 (12/2022)	outside project area to the west
03N 01E 27CDDB1	WL only	4/20/1993	118	113-118	433347116193101	65 (4/1993)	69.1 (12/2022)	
03N 01E 34CCCD1	WL and WQ	2/17/1970	95	95	433249116192801	50 (2/1970)	81.05 (7/2015)	
Park Wells								
Peppermint Park	Irrigation Well	4/20/2006	165	135-165	--	27 (4/2006)	37.8 (6/2022)	
Molenaar Park	Irrigation Well	1/15/2013	167	147-167	--	30 (1/2013)	50.8 (6/2022)	SWL has declined by 11 and 18 feet since 2020

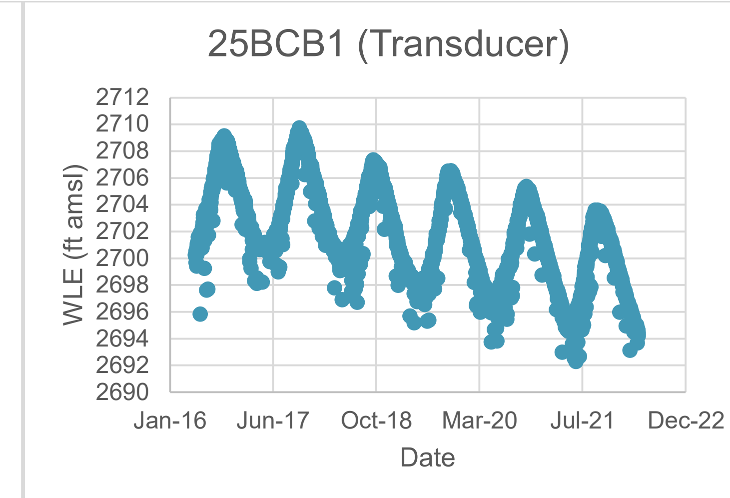
ft bgs = feet below ground surface; USGS = U.S. Geological Survey; SWL = static water level; WQ = water quality; WL = water level

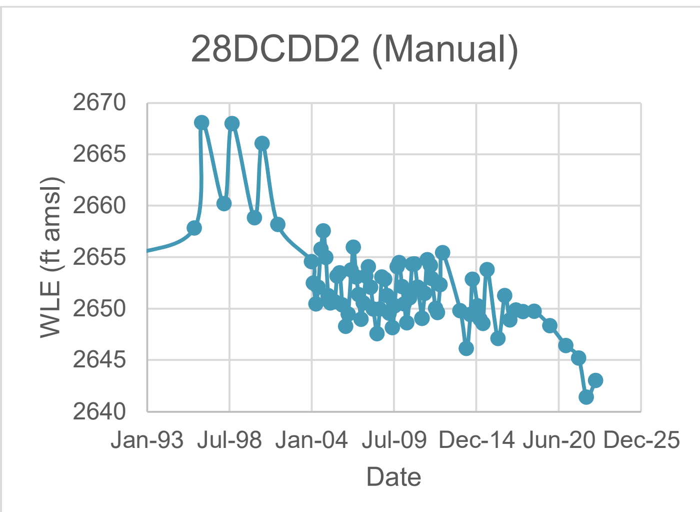
Plot 4. Hydrographs from Selected Wells Within Study Area

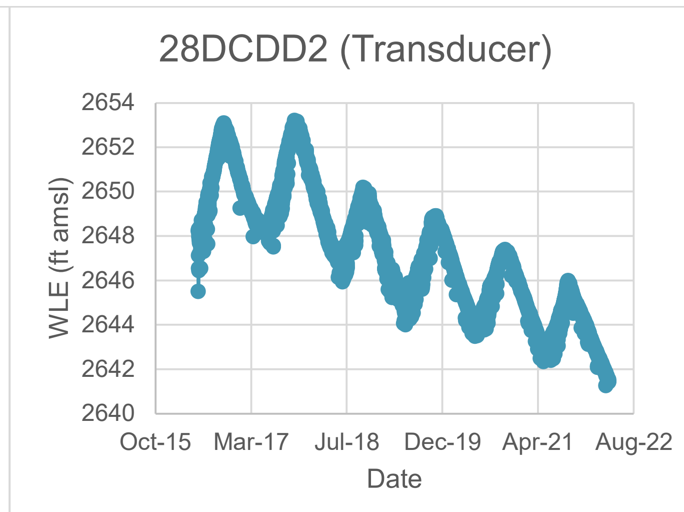


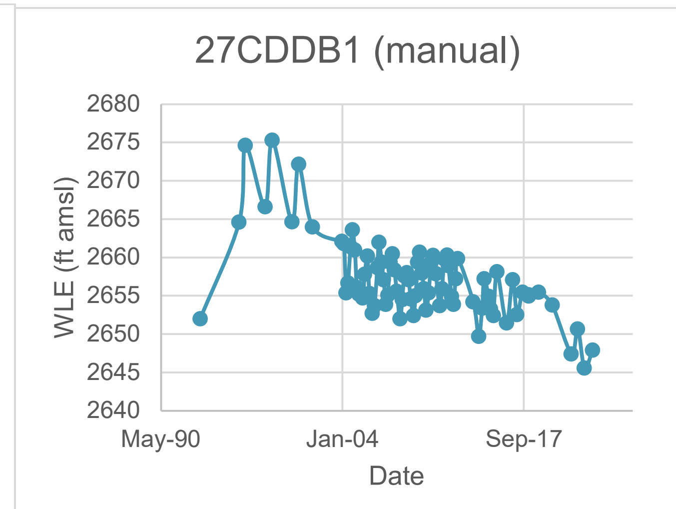


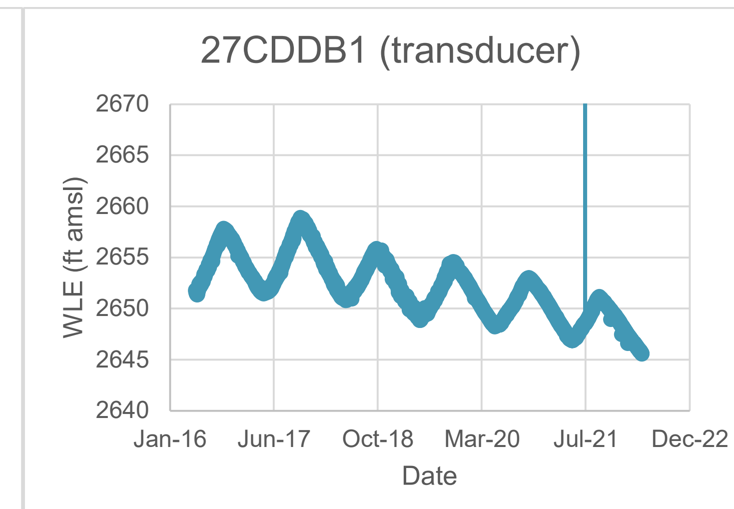


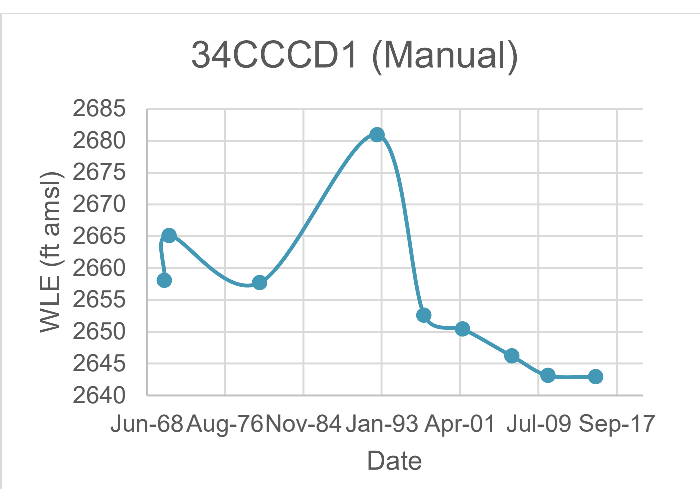




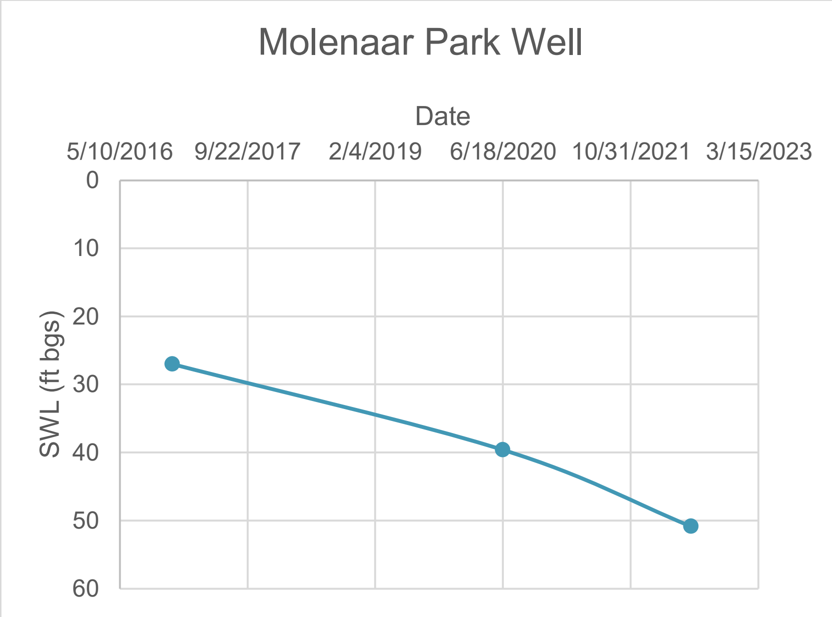


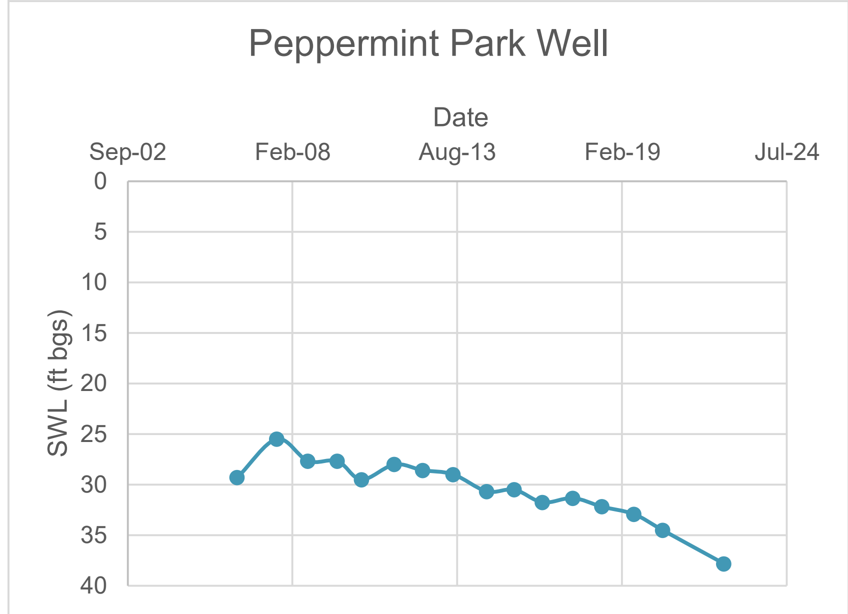






Plot 5. City Park Well Water Levels

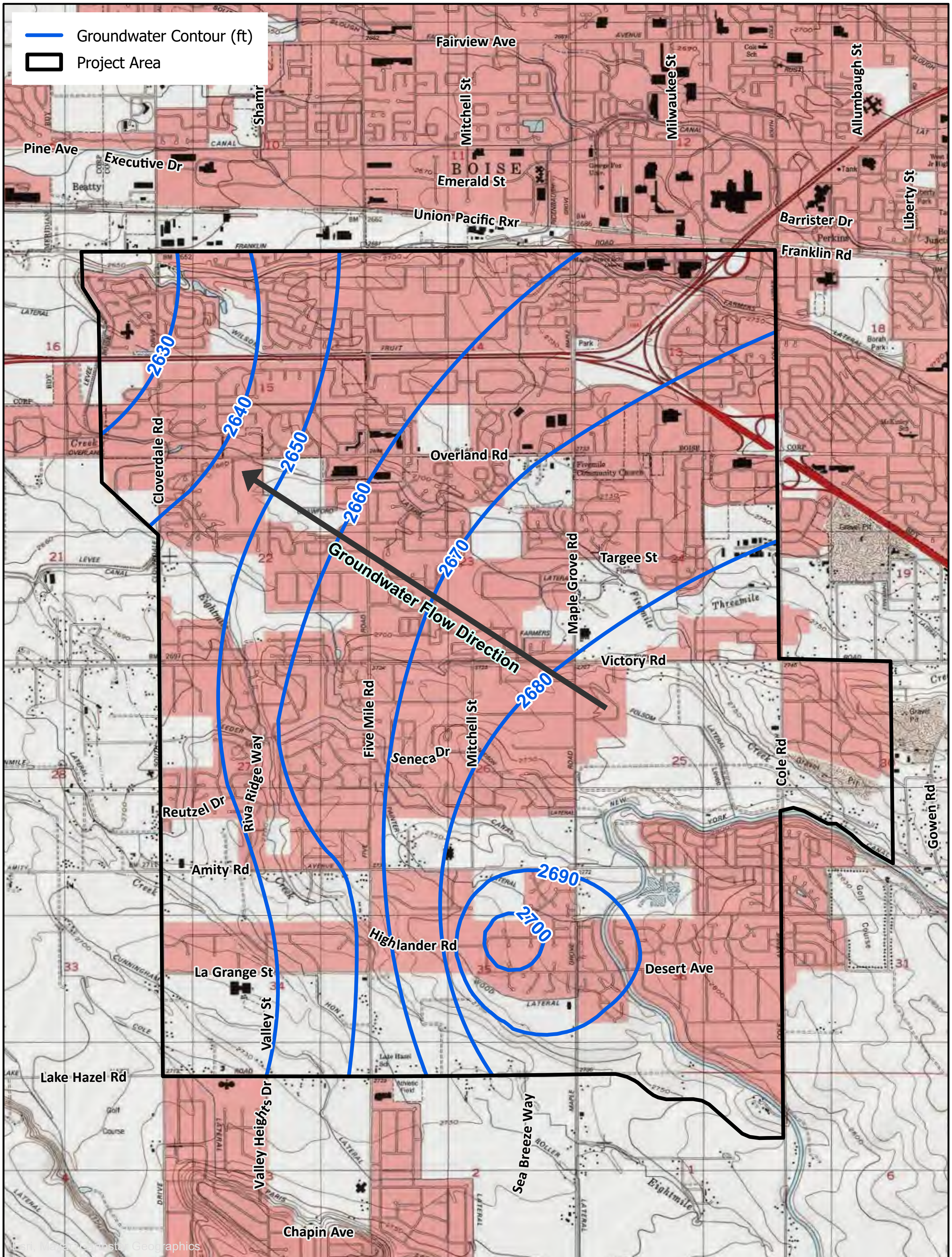




The hydrographs show a general trend of decreasing water levels for the wells across the study area over the period of record, as well as significant seasonal changes (mainly shown in the transducer data). Water levels are higher in the late spring and summer, coinciding with the irrigation season, and lower in the winter and early spring.

Based on the data, water levels in the study area are decreasing by an average of 0.93 feet per year. Average water level decreases per year were calculated from the four USGS/IDWR wells shown in the hydrographs above (using the transducer data as it more accurately reflects the current decrease in water levels).

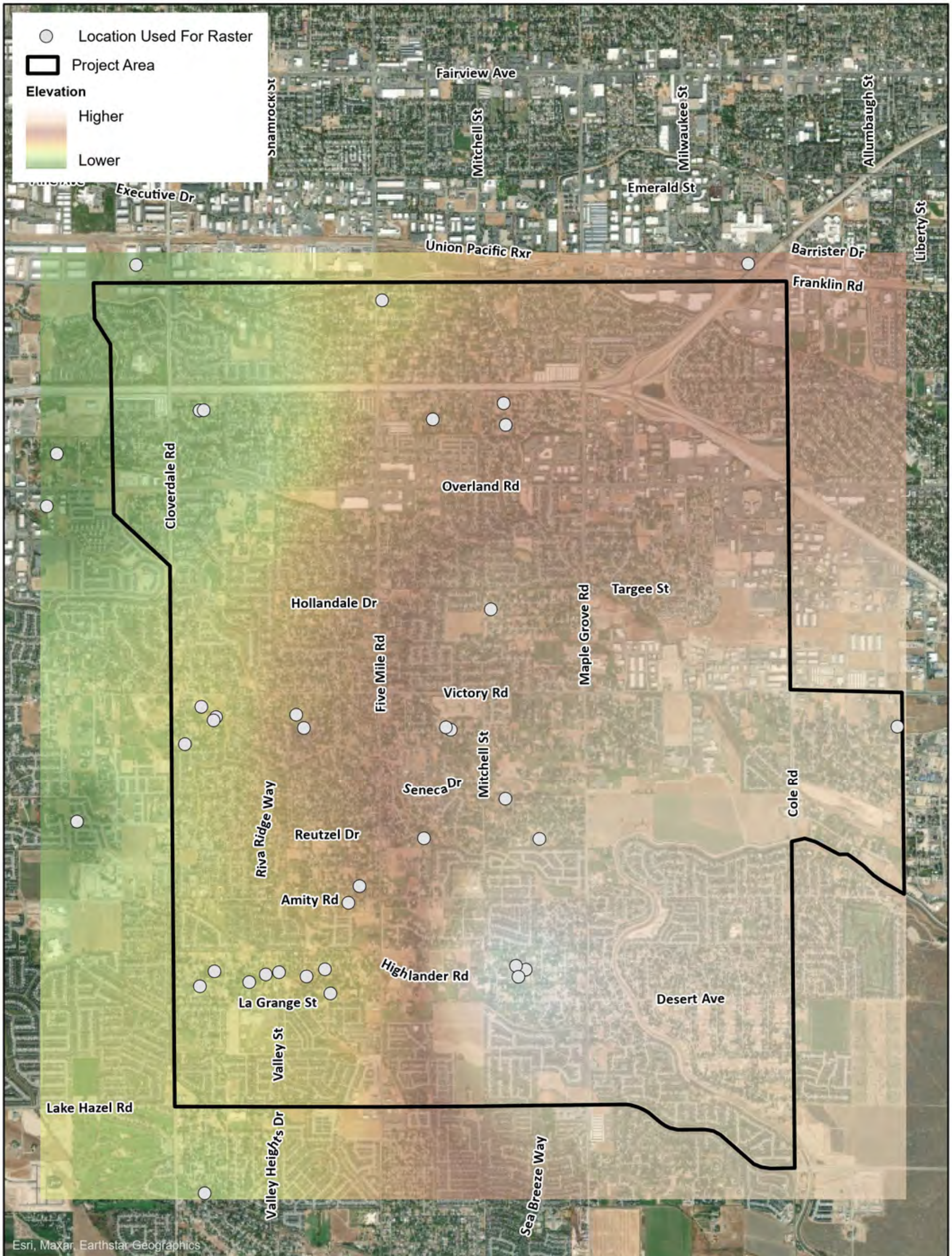
Using 1) non-irrigation season static water level measurements between 2022 and 2023 for those wells that are constantly monitored (IDWR and park wells), and 2) non-irrigation season static water level measurements from domestic wells with a verified location that were installed in 2022 and 2023 in the study area, the study team generated a projected 2022 groundwater elevation surface across the study area (well locations shown on **Figure 10**). Groundwater elevation at each well is calculated based on the depth to water measurement and estimated ground surface elevation. Wells selected for use for the groundwater elevation surface were selected if they had static water level measurements during non-irrigation season (November through March), data from 2022, and had defined well locations (emphasis on park wells and wells monitored continuously with IDWR or IDEQ). HDR initially used only wells that are monitored continuously (park wells, or IDEQ/IDWR wells that had defined elevations and locations), then used additional water level measurements from wells installed in 2022 during non-irrigation season (static water levels from well logs) in order to ensure contours could cover the entire study area. Ground surface elevation was derived from publicly available USGS elevation data (USGS 2023), with an accuracy of 30 meters. Wells that were sampled on a frequent basis had measured ground surface elevations that were used in their calculations. The groundwater contour map is shown in **Figure 10**.



0 0.5 mi

2022 GROUNDWATER ELEVATION CONTOURS

Figure 10a



2022 GROUNDWATER ELEVATION SURFACE

Figure 10b

2.3 New York Canal

Within the study area, the New York Canal is a significant source of local recharge, while drains (Tenmile Creek, Fivemile Creek, etc.) reflect aquifer discharge. The study team compiled diversion records for the New York Canal and flow records for local drains, where available, and analyzed this information for local aquifer level trends, recharge, and discharge characteristics.

2.3.1 New York Canal Aquifer Recharge

Using historical data of New York Canal diversion and measurements of static water levels for wells within the study area, the study team identified the effects of canal flow on shallow aquifer recharge.

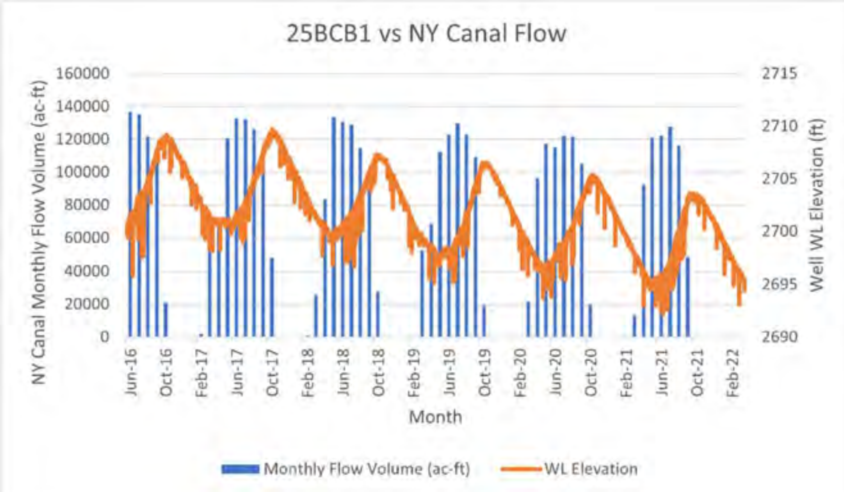
The Bureau of Reclamation reports daily discharge measurements into the canal dating back to 1927. Daily discharge measurements were compiled to represent canal flow as a value of total volume over annual and monthly intervals. This volumetric flow data was then plotted against well water level data obtained from IDWR to evaluate any correlations between canal flow and groundwater level.

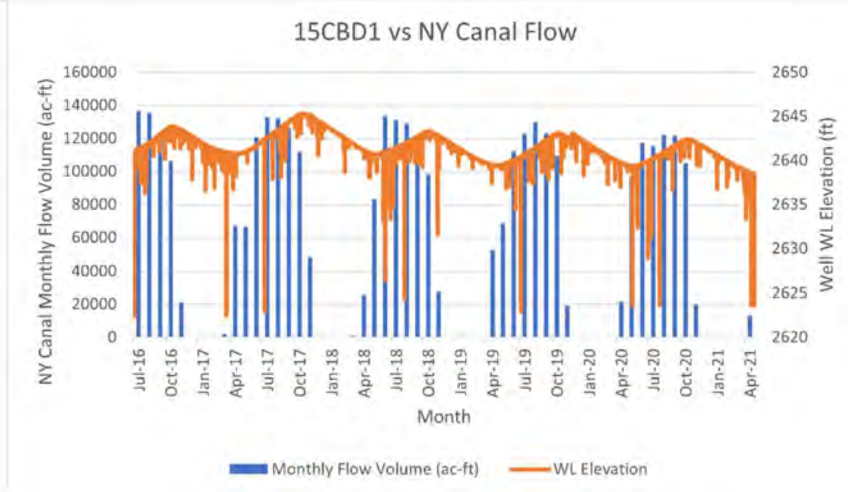
Four wells within the study area had sufficient water level data for analysis against canal flow. These wells were 27CDDB1, 25BCB1, 15CBD1, and 28DCDD2, and are shown in **Plot 6** in relation to the New York Canal flow data. The study team obtained available data for these wells from the IDWR Groundwater Data Portal, which included both compiled transducer data over the years 2016-2022 (measurements recorded twice daily) and discrete manual data provided by the USGS, dating back to as early as 1970.

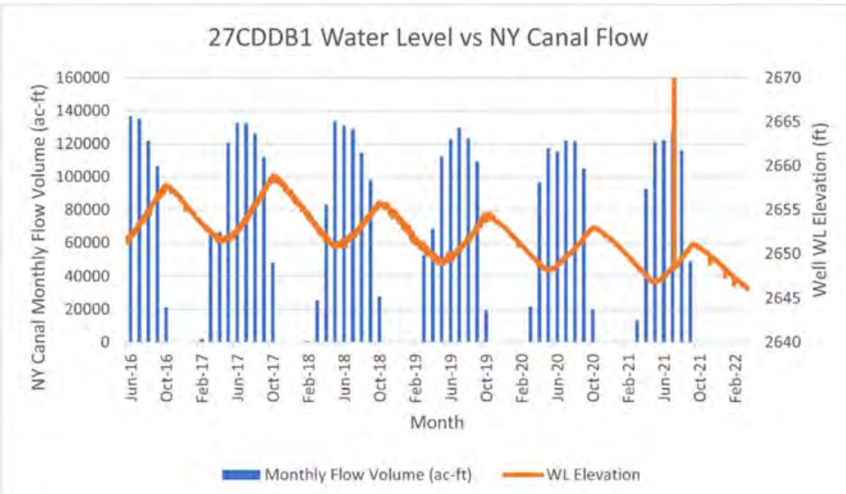
2.3.2 Monthly Canal Flow vs Well Transducer Data

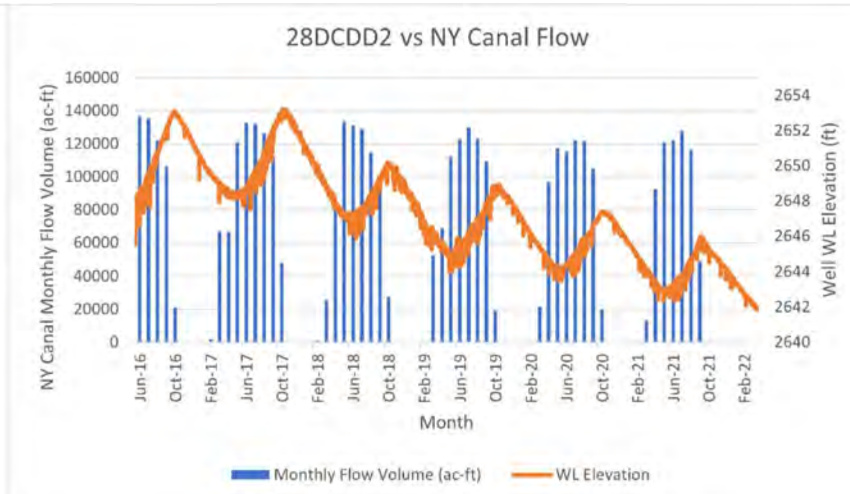
Plot 6 shows monthly canal flow volumes plotted against transducer water level data for all wells between 2016 and 2022. The plot only shows data back to 2016 as transducer data for the wells is only available between 2016 and 2022.

Plot 6. Groundwater Levels vs New York Canal Flow







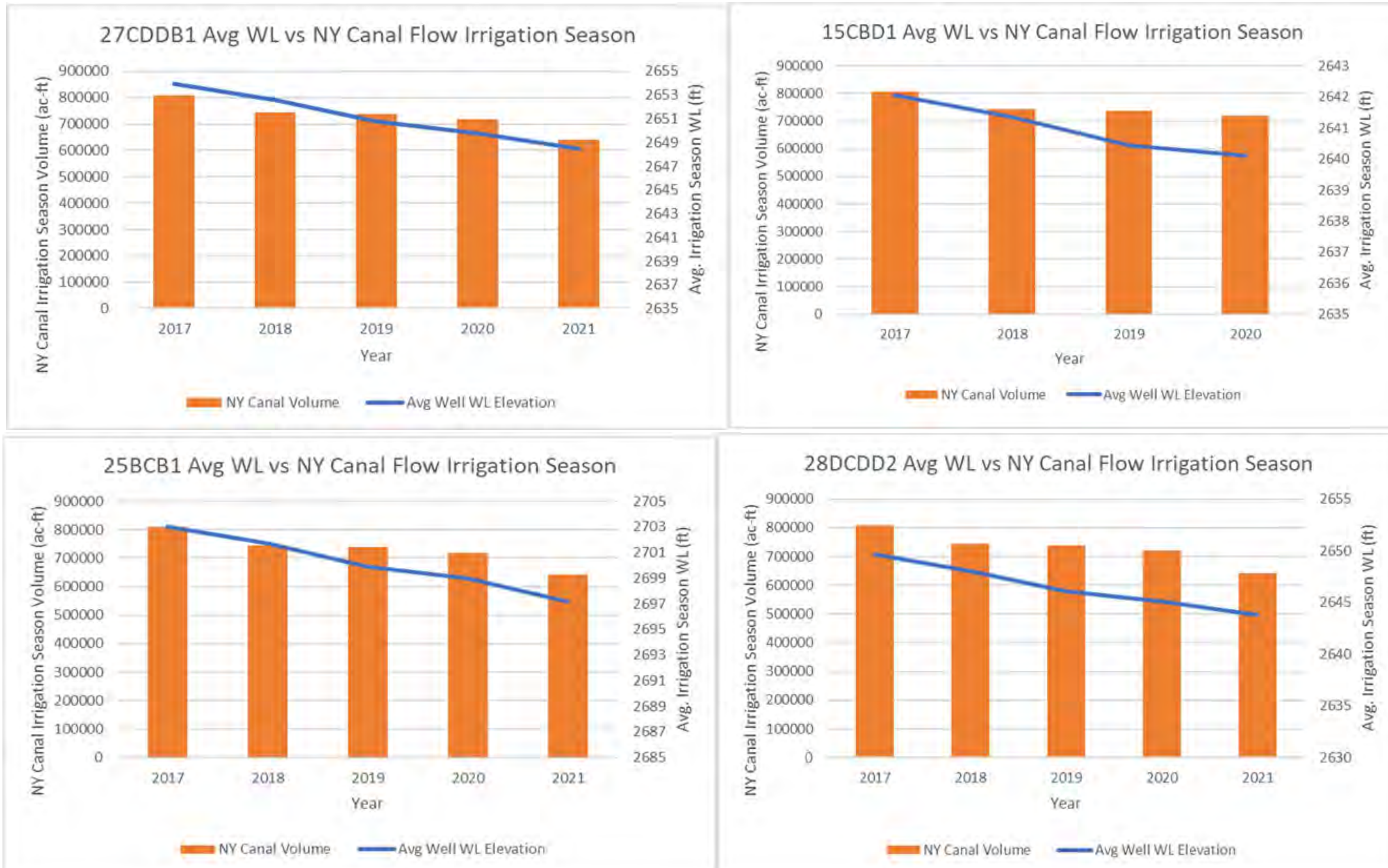


The plots suggest a cyclical correlation between New York Canal flow and groundwater level, and highlight the aquifer recharge effects of the canal over the course of the year. Additionally, previous studies indicate that seepage from the canal and infiltration from irrigation are major sources of recharge to the shallow groundwater system. During irrigation season, when the canal is flowing, water levels in each well tend to steadily increase to an annual peak, which occurs at the end of the irrigation season. In following months, when there is no flow in the canal, water levels steadily decrease to an annual minimum until canal flow is reintroduced, at which point water levels rebound and begin to increase once again. This pattern of water level fluctuation occurs on an annual basis and was consistently repeated in the data for each well. A steady declining trend in water levels from year to year is also evident, as the peak water levels for each cycle decrease with every year. This trend is further examined in relation to flow volume quantities in the following section.

2.3.3 Canal Flow versus Average Water Level During Irrigation Season

To quantify the year-to-year decrease in water levels and examine how canal flow may have contributed to this trend, the total annual volume of New York Canal flow is plotted against the average water level in each well over the course of the canal irrigation season in **Plot 7**. Water level data accounting for the entire irrigation season was available from 2016 to 2021 for most wells.

Plot 7. Average Groundwater Levels versus New York Canal Flow During Irrigation Season



As annual canal flow volume has decreased over recent years, so has the water level in surrounding groundwater wells, once again highlighting the significance of the canal for groundwater recharge. Comparing the average water level during the irrigation season when the canal is flowing to a total annual average (which includes non-irrigation season), isolates the recharge effects of the canal. Between the years 2017 and 2021, the New York Canal experienced a 20.6 percent decrease in flow volume. The three wells with water level data over the extent of this period experienced water level decreases described in **Table 7**.

Table 7. Water Level Decreases in Wells Analyzed with New York Canal

Well	Depth to Water May 1, 2017 (feet)[1]	Depth to Water May 1, 2021 (feet)[1]	Percent Decrease
27CDDB1	65.38	69.83	6.8%
25BCB1	53.06	58.86	10.9%
28DCDD2	51.71	56.92	10.1%

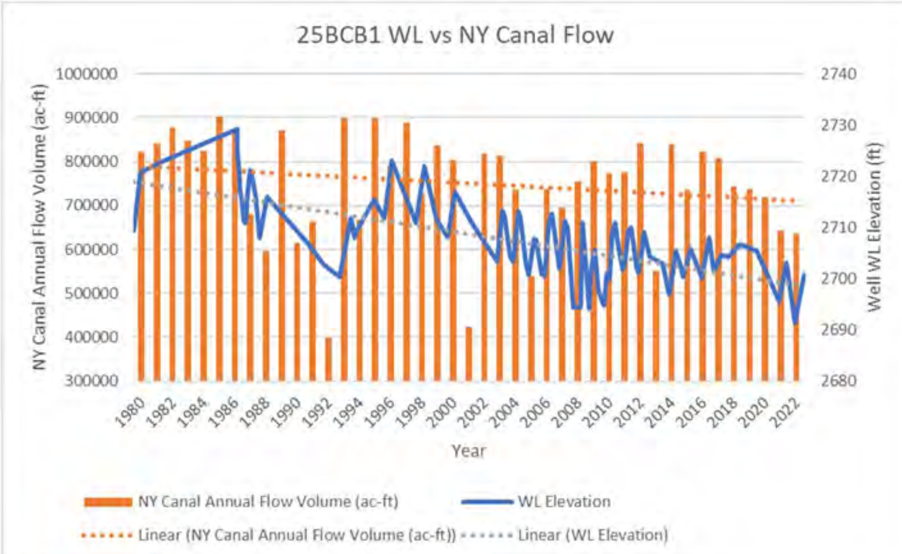
[1]Water levels are from transducer data from IDWR

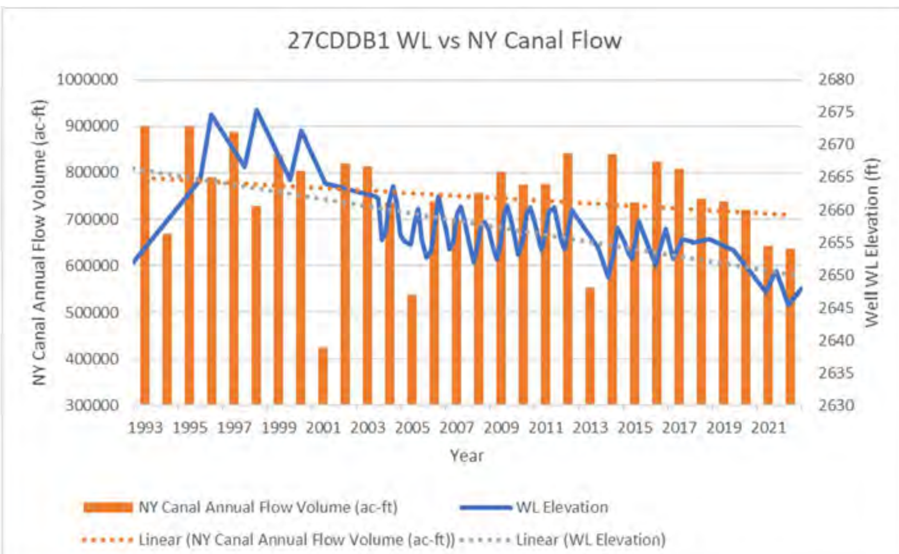
The total annual flow volume for New York Canal decreased an additional 5,000 acre-feet from 2021 to 2022, continuing the declining trend in diversion. Once more recent IDWR well data becomes available, the continued effects of declining canal flow volumes on groundwater recharge can be evaluated.

2.3.4 Long Term Annual Canal Flow vs Water Level

Though the transducer data for wells in the study area is more comprehensive and better represents seasonal fluctuation in water levels, the discrete USGS data available through IDWR spans a longer collection period and is useful for examining historical trends on canal flow and groundwater levels. Wells 25BCB1 and 27CDDB1 are both closest in proximity and in the direction of groundwater flow from the canal, and thus are likely under greatest influence from canal recharge. **Plot 8** shows the relationship between canal flow and water level over the entire collection period of manual measurements for these two wells, including trendlines for both flow volume as well as observed water levels.

Plot 8. **Long Term Annual Canal Flow Versus Groundwater Levels**





The trendlines in these plots once again suggest a relationship between declining canal flow and lower groundwater levels in the study area, over a greater period of time.

2.3.5 Summary

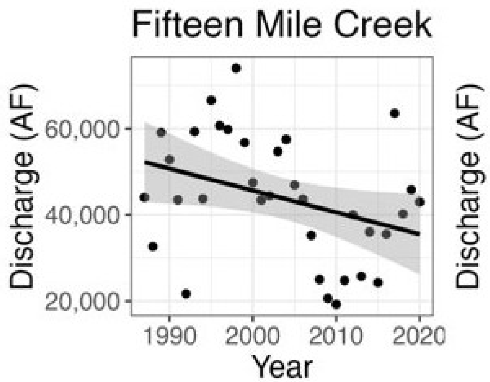
The data trends described in this section indicate a significant correlation between New York Canal flow and groundwater levels in the study area. Though it is hard to precisely quantify this relationship, it is relevant to consider the effects that canal usage has on the surrounding aquifer as irrigation practices and water demands evolve in coming years, leading to changes in canal diversion and subsequently changes in groundwater levels. Previous studies, as described in Section 2.1.1, indicate a strong connection between shallow aquifer recharge due to canal seepage and infiltration due to irrigation, which is corroborated in the plots above.

2.4 Irrigation Drains

Fifteen Mile Creek is the irrigation drain under the greatest influence from the study area. Though declining drainage volumes can be correlated to lower groundwater levels, it is difficult to isolate the contribution of groundwater flow to total drainage due to the complex nature of the irrigation system upstream of the outlet.

In her recent graduate research, Boise State master's student Bridget Bittmann collected data to analyze historical trends of drainage flows into the Boise River. **Plot 9** shows Fifteen Mile Creek drainage data included in her thesis presentation (Bittmann et al, 2022), which identifies a declining historical trend for the drain since 1990.

Plot 9. Fifteen Mile Creek Drainage Plot from Bridget Bittmann Thesis



In her report, Bittman identifies several factors that have contributed to declining drain flows in the Boise area. As the Treasure Valley continues to expand and urbanize, the resulting increase in impervious surface areas from land development reduces groundwater recharge from irrigation, thus impacting both drain flows and groundwater levels. Also, as mentioned previously, canal flows also have a significant impact on groundwater recharge. Based on her model of Boise area drainages, Bittman states that 50,000 acre-feet of additional canal flow in a drainage's watershed leads to a 495 acre-foot increase in flow for that drainage. With continued urbanization and the decrease of irrigated land in Boise, reductions in irrigation canal flow and decreases in infiltration from irrigation pose implications for groundwater levels and drainage flows.

3 Evaluation of Well Failures and Future Risk

The study team analyzed which domestic wells are at current risk of failure and in the near future (5, 10, and 15 years). Using data from the hydrogeological evaluation described in **Section 2**, HDR analyzed risk to the verified domestic wells within the study area. Data used included wells that had verified locations (verified to the address/lot), well construction information for those verified wells (screened interval or bottom of casing if no screen was present), 2022 groundwater surface (as calculated/estimated in Section 2.2.4, and future groundwater surfaces based on an average water level decrease per year in routinely monitored wells (see IDWR/USGS wells/hydrographs shown in **Plot 4**).

The study team took the following steps to evaluate the current risk for domestic wells within the study area:

1. Determined which wells had verified locations (verified to the address/lot)[1].
2. Removed those wells that were determined to have been abandoned/replaced. If a property had multiple verified wells, with one shown as a replacement or a well log showed a second as deeper and installed at a later date, the older well was assumed to have been replaced and was hence removed from the evaluation.
3. Included those wells that Ada County provided that showed as dry (see map in Appendix A).
4. Determined the ground surface elevation at each well point based on available geographic information system (GIS) data.
5. Calculated current groundwater elevations at each well (labeled as the 2022 groundwater elevation surface).
6. Calculated the elevation of the top of screen or bottom of casing if no screen was installed in the well.
7. Compared the 2022 groundwater elevation surface in each well to the calculated elevation of the top of screen or bottom of casing in each well.
8. Calculated the failure risk for each well based on how close the groundwater surface elevation was to the elevation of the top of screen or bottom of casing.

Wells were analyzed for risk by categorizing each well as low, moderate, or high risk.

- Low Risk: projected water levels are greater than 20 feet above the top of screen or bottom of casing in the well.
- Moderate Risk: projected water levels are between 5 and 20 feet of the top of screen or bottom of casing in the well.
- High Risk: projected water levels are within 5 feet of the top of screen or bottom of casing in the well.

The risk calculations for the domestic wells within the study area are a rough estimate based on the publicly available data. The primary factors that may affect the reliability of the analysis include (1) the accuracy of the ground surface elevation assigned to each well due to the elevation data available and the spatial accuracy of each well location and (2) the limited recent water-level data available to generate the 2022 groundwater elevation map. Ground surface elevations in the study area are estimated, and the actual well locations for the verified wells could only be determined to the address/lot, so there is likely to be some variance in the actual groundwater level in each well in comparison to the top of the screen or the bottom of casing. Additionally, the locations of many wells could not be verified; therefore, those wells were not included in the analysis. As such, this risk analysis should be considered a high-level planning tool to characterize failure risk within discrete areas of the study area, and not to identify specific wells at risk of failure. The results should be

[1]A well whose location could not be verified was not included in the risk analysis.

interpreted with caution as some discrepancy between predicted and actual results is likely without additional field verification of well elevations, locations, and water levels.

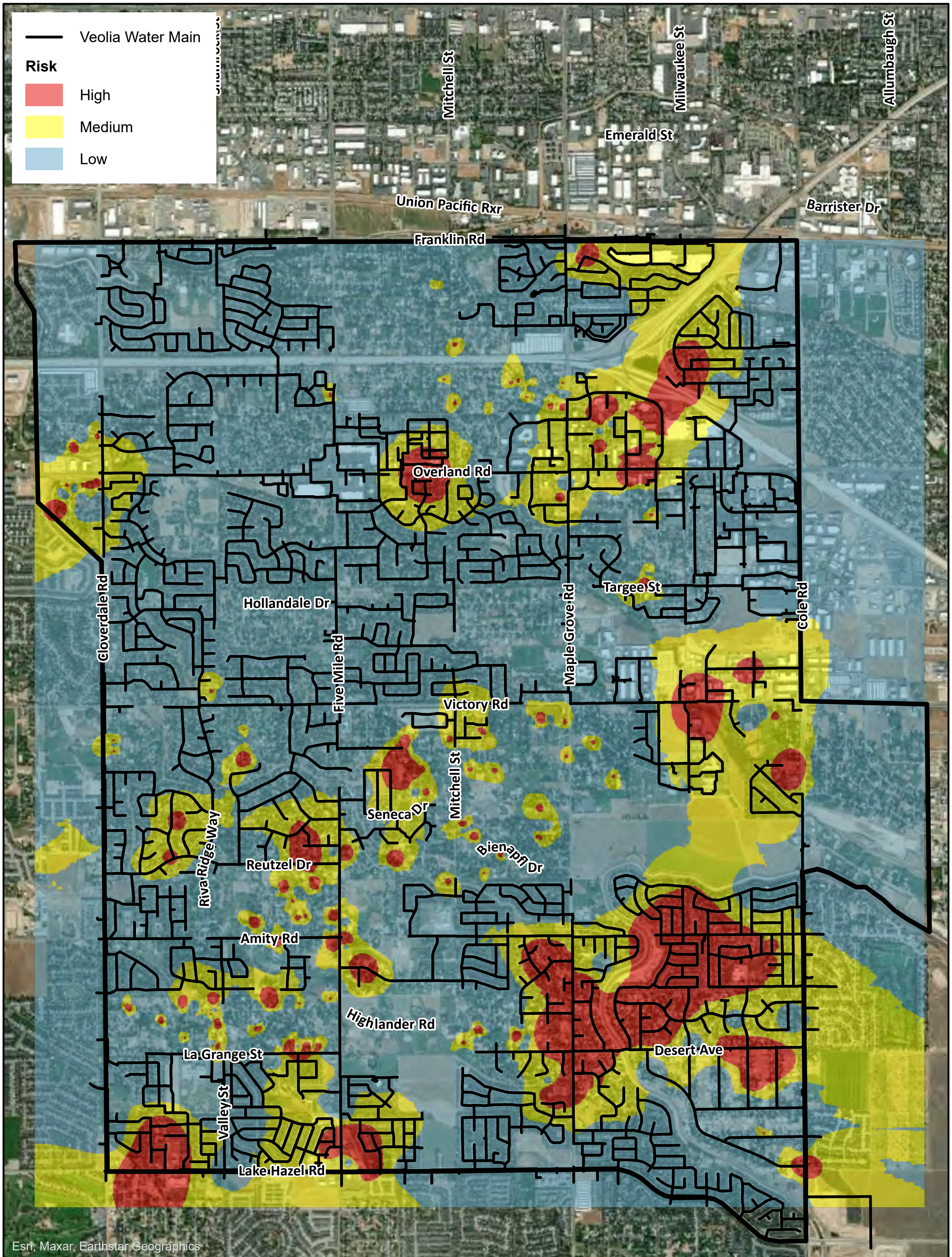
The study team included a total of 939 wells in the risk evaluation. The evaluation was performed for the years 2022, 2027, 2032, and 2037. **Table 8** shows the breakdown of risk for each of the years evaluated. For projections of risk in 5, 10, and 15 years, the study team calculated the average yearly water level decrease from the wells shown in **Plot 4** by using the transducer data (looking at the average decrease in water level in the four wells since 2016). The study team used the transducer data instead of the full data set because this data more accurately reflects groundwater usage in the study area. The calculated average water level decrease per year is approximately 0.93 feet per year. Using this average, the projected 2022 groundwater surface was lowered by the appropriate amount (4.65-foot decline by 2027, 9.29-foot decline by 2032, and 13.94-foot decline by 2037). The study team then compared the updated water level estimate to the elevation of the top of screen or bottom of casing to determine the risk for the future risk projections.

Table 8. Distribution of Wells by Risk

		Low	Moderate	High
2022	**Number**	786	69	84
	Percent	84%	7%	9%
2027	**Number**	752	95	92
	Percent	80%	10%	10%
2032	**Number**	720	100	119
	Percent	77%	11%	13%
2037	**Number**	692	100	147
	Percent	74%	11%	16%

As shown in **Table 8**, the number of wells that are identified as high risk increased by 1 to 3 percent every 5 years. Specific areas of risk are described more in Section 5.

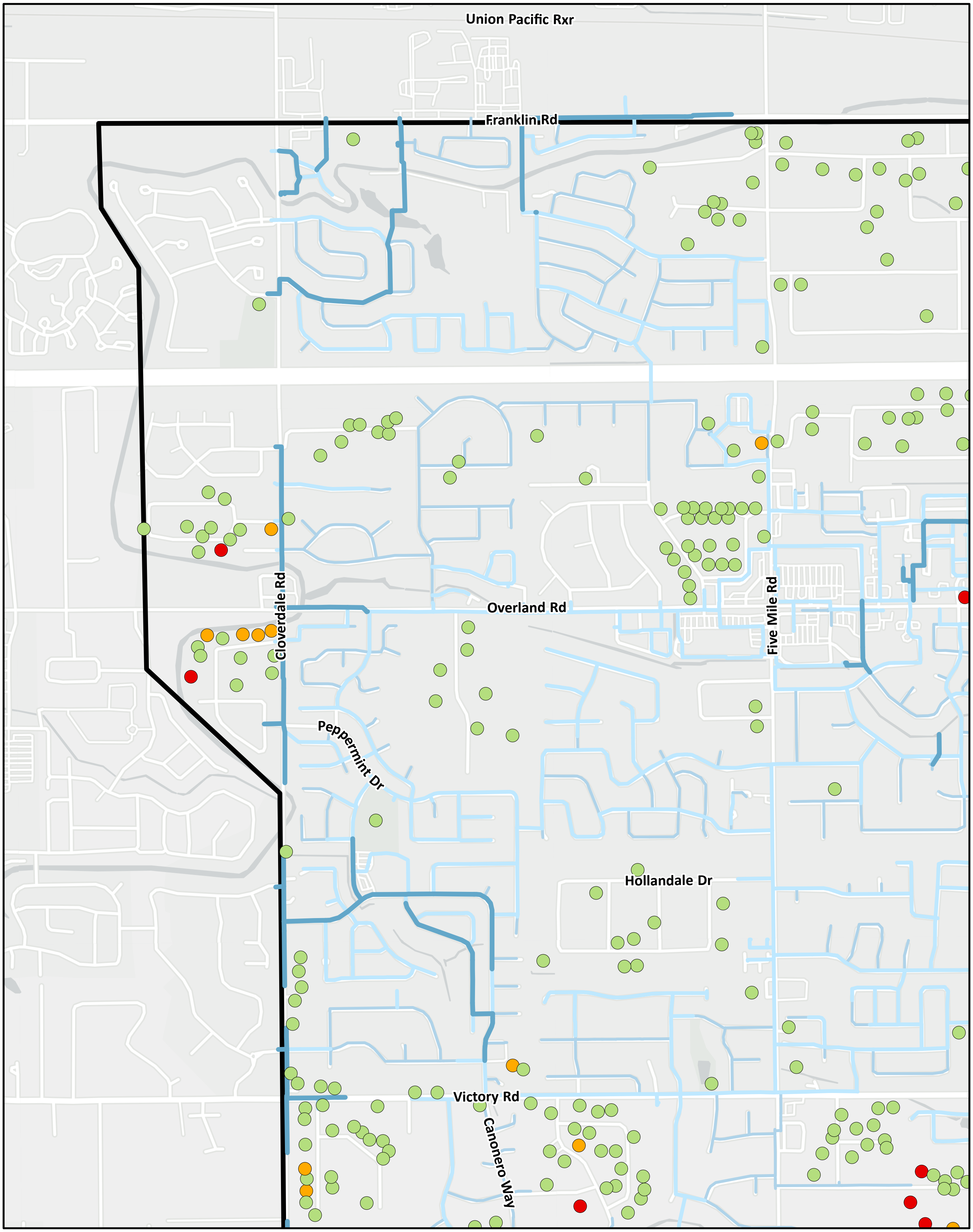
The study team calculated risk for the years 2022 (**Figure 11**), 2027 (**Figure 12**), 2032 (**Figure 13**), and 2037 (**Figure 14**). The figures for these evaluations are shown both as an overall heat map (created using an inverse distance weighted or Kriging GIS interpolation method) based on all wells used in the risk evaluation, and as point maps to better show the spread of wells and what influenced the heat map creation. The heat maps may show areas as high risk; however, a closer examination of the point maps shows that some of these high-risk areas are characterized by only one well, or very few wells. Also, though some higher risk areas are shown in areas with somewhat shallower groundwater (based on the contour map shown in **Figure 10**), those wells marked as high risk may not have been drilled as deep as those in areas with deeper groundwater levels when initially drilled. The domestic wells in the study area were likely drilled to their specific depths based on the depth of the water identified in each area during installation (i.e., shallower groundwater would correlate to shallower wells, and deeper groundwater would correlate to deeper wells).



2022 RISK ASSESSMENT AND FEASIBILITY

Figure 11a

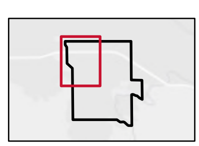
Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 2/15/2024



High Risk
Moderate Risk
Low Risk
Project Area

Diameter (in)

0.0 - 6.0
8.0 - 10.0
12.0

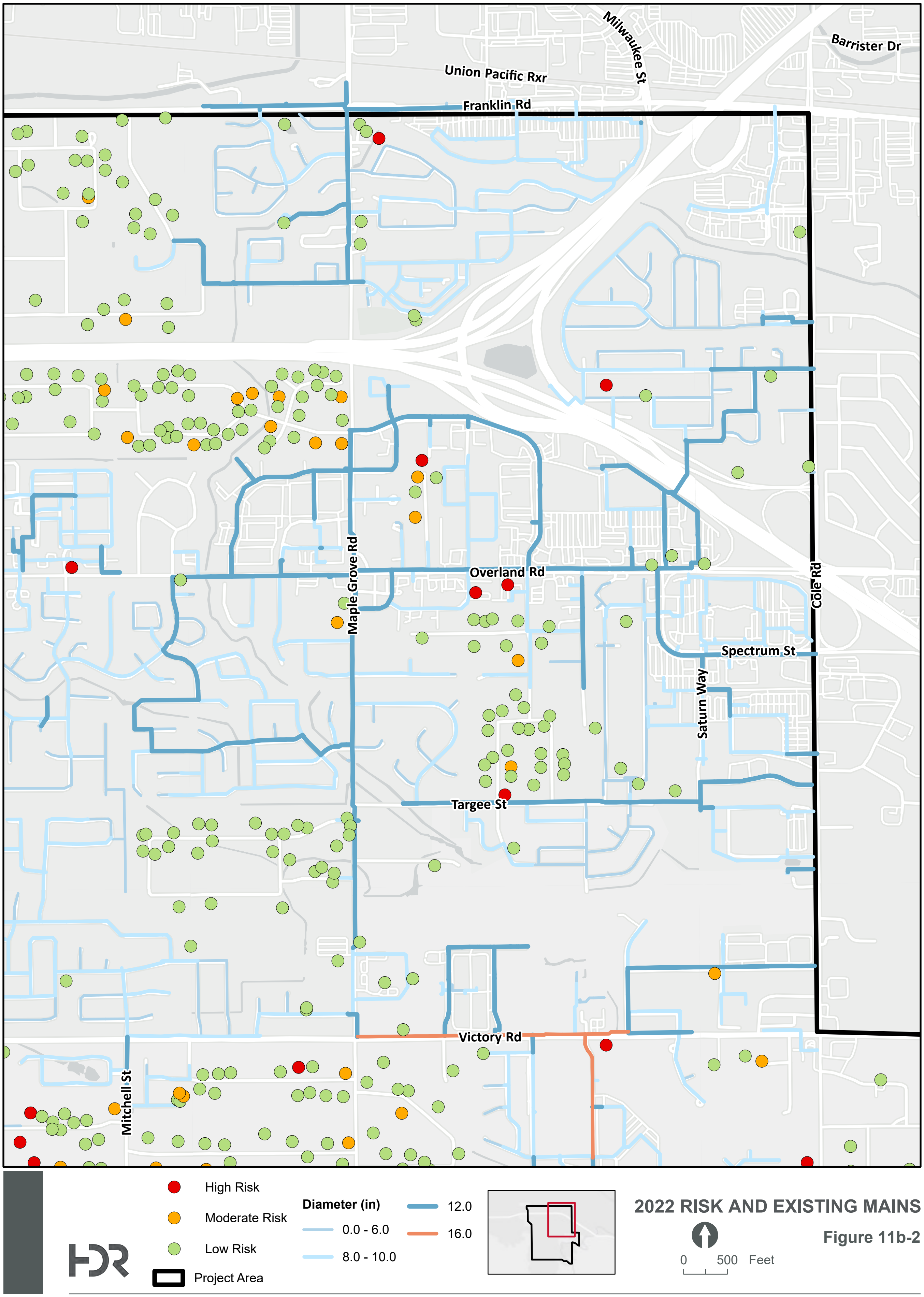


2022 RISK AND EXISTING MAINS

0 500 Feet

Figure 11b-1

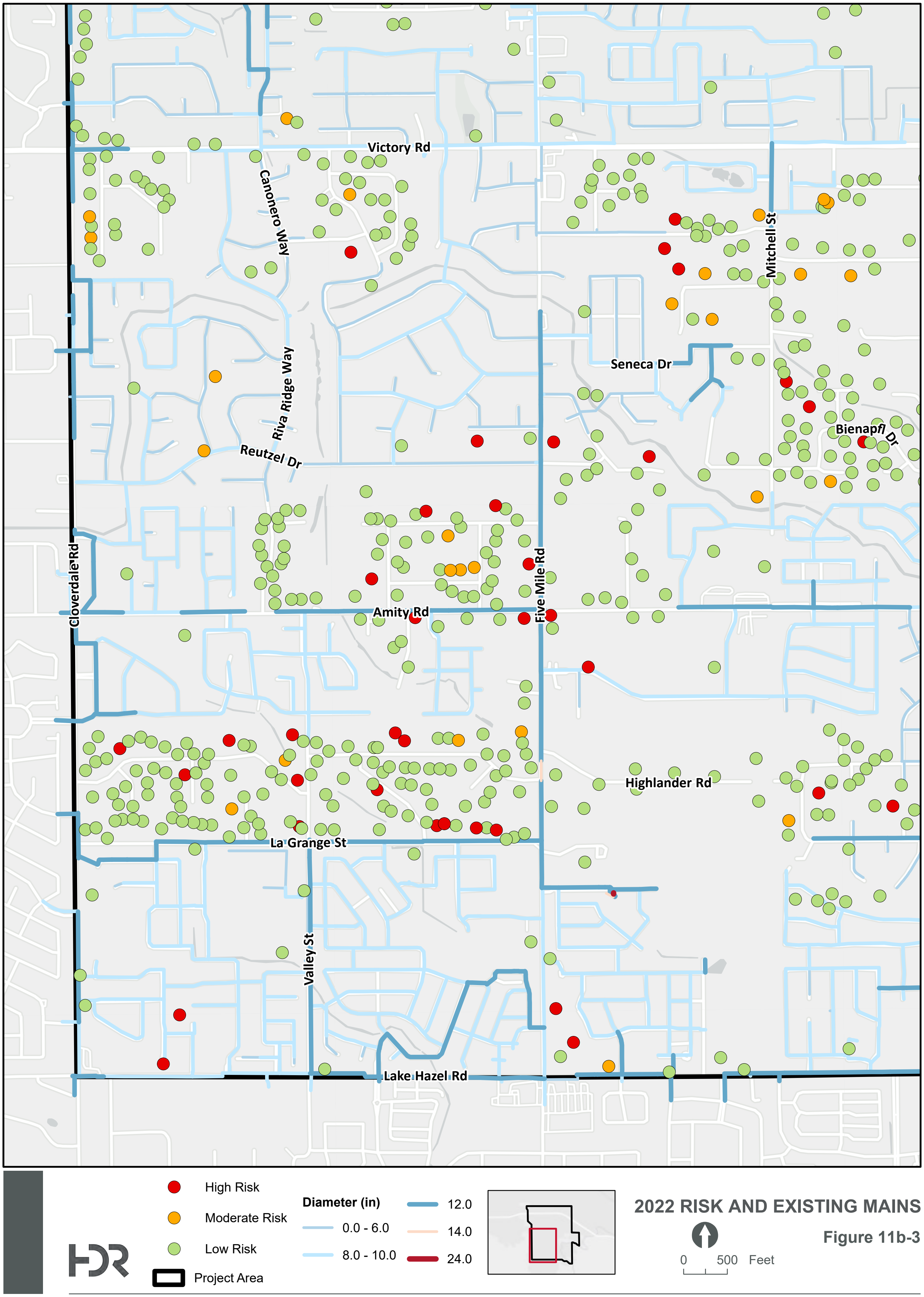
Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 2/15/2024



2022 RISK AND EXISTING MAINS

Figure 11b-2

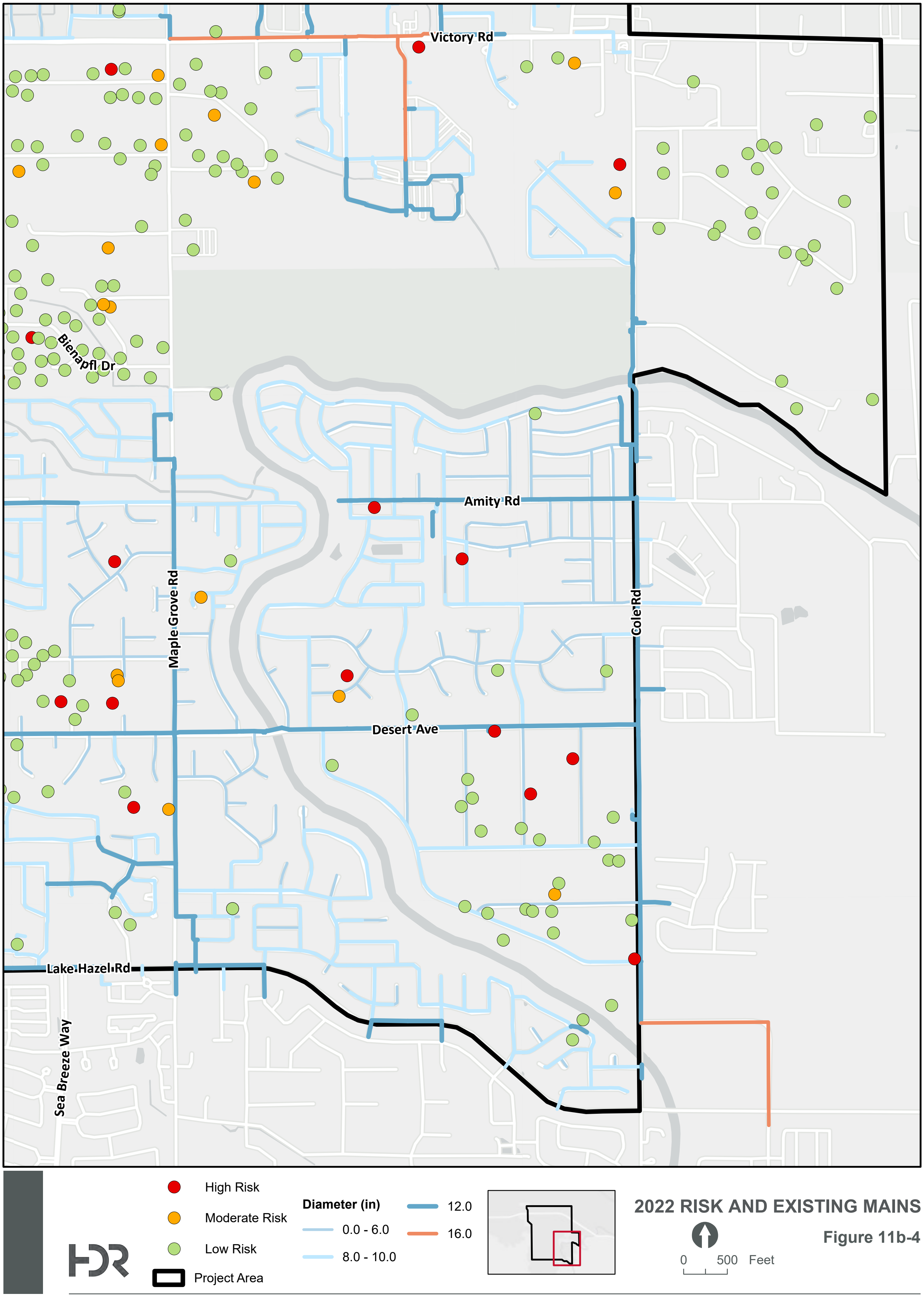
Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 2/15/2024



2022 RISK AND EXISTING MAINS

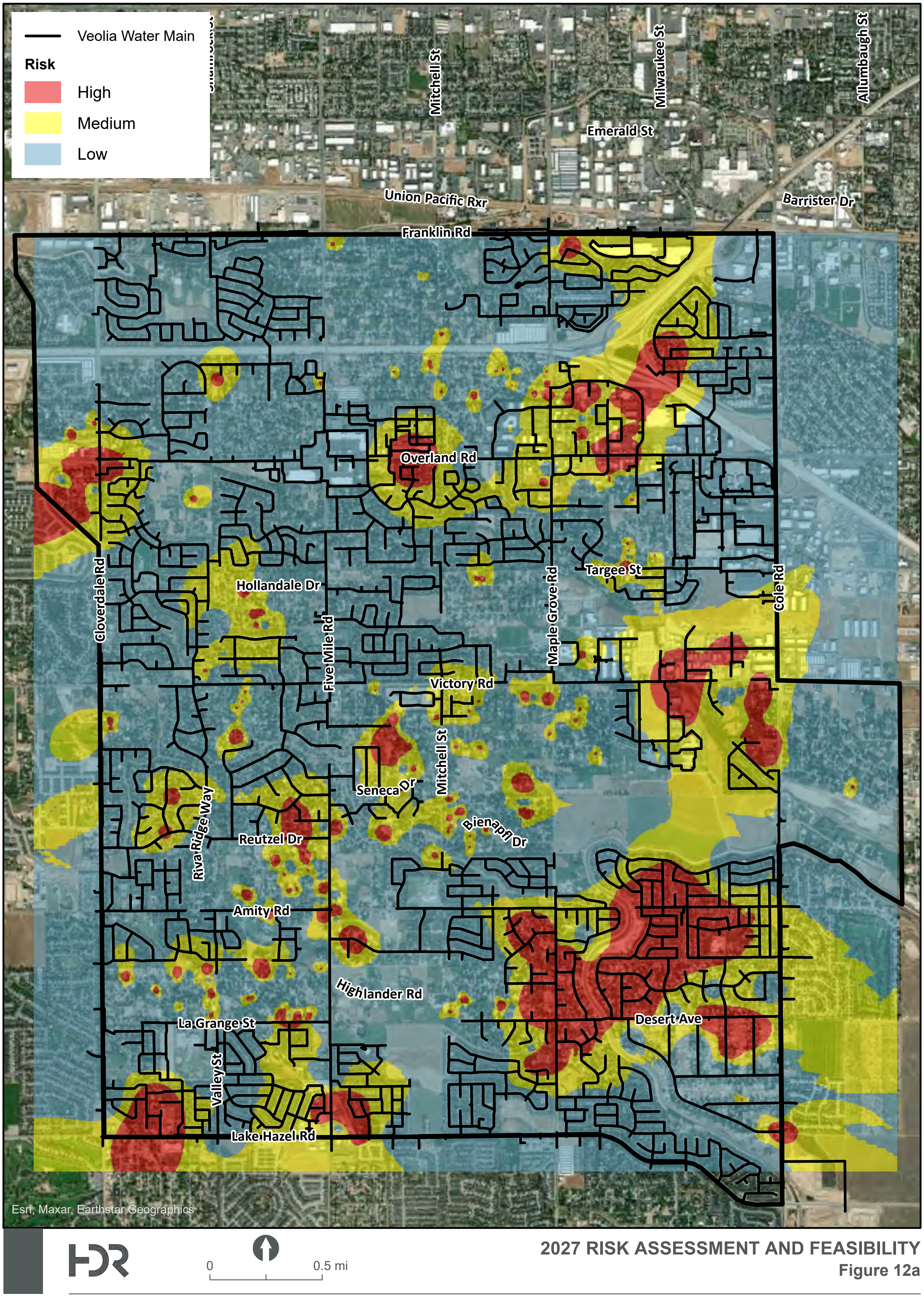
Figure 11b-3

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 2/15/2024



2022 RISK AND EXISTING MAINS

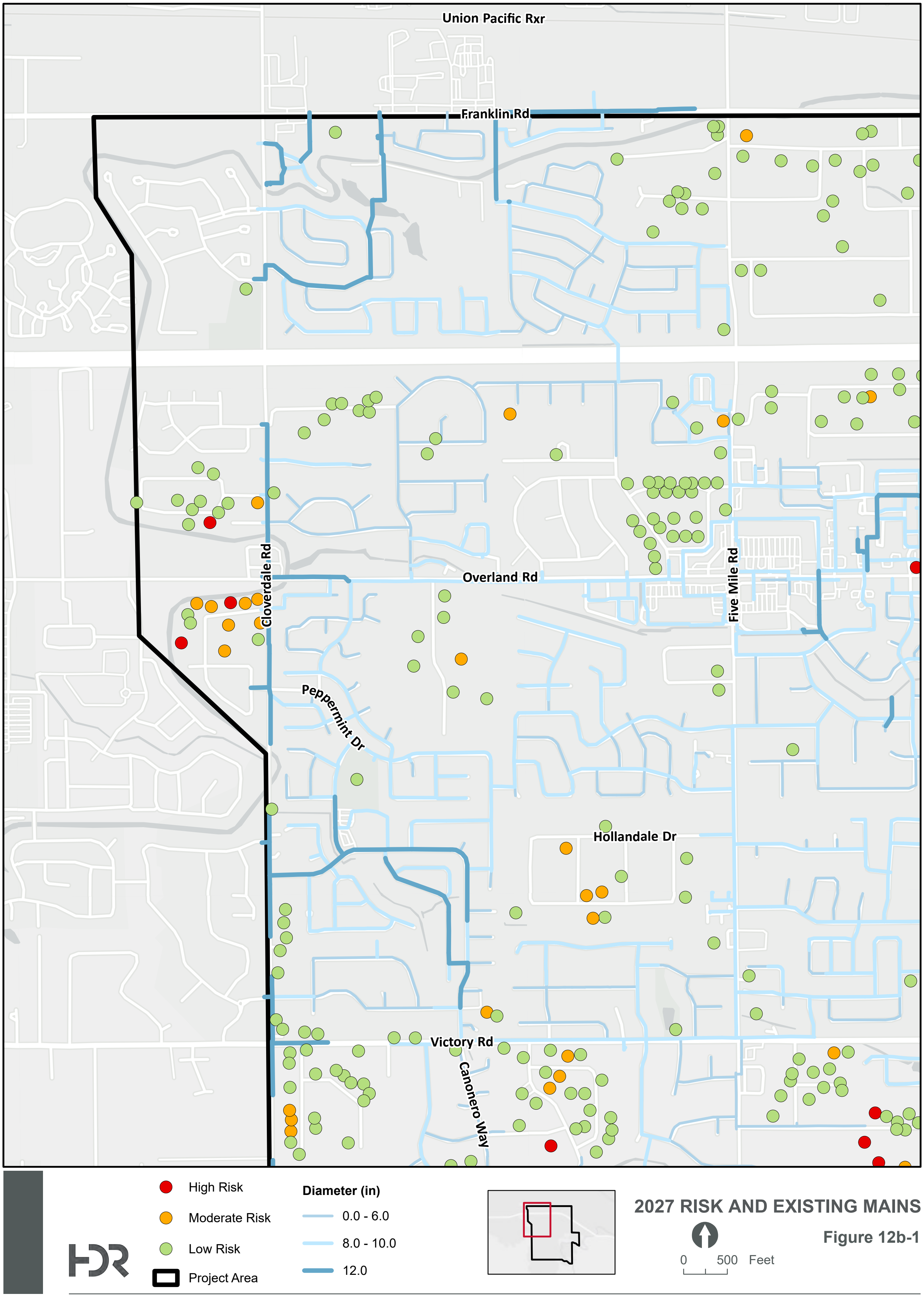
Figure 11b-4



2027 RISK ASSESSMENT AND FEASIBILITY

Figure 12a

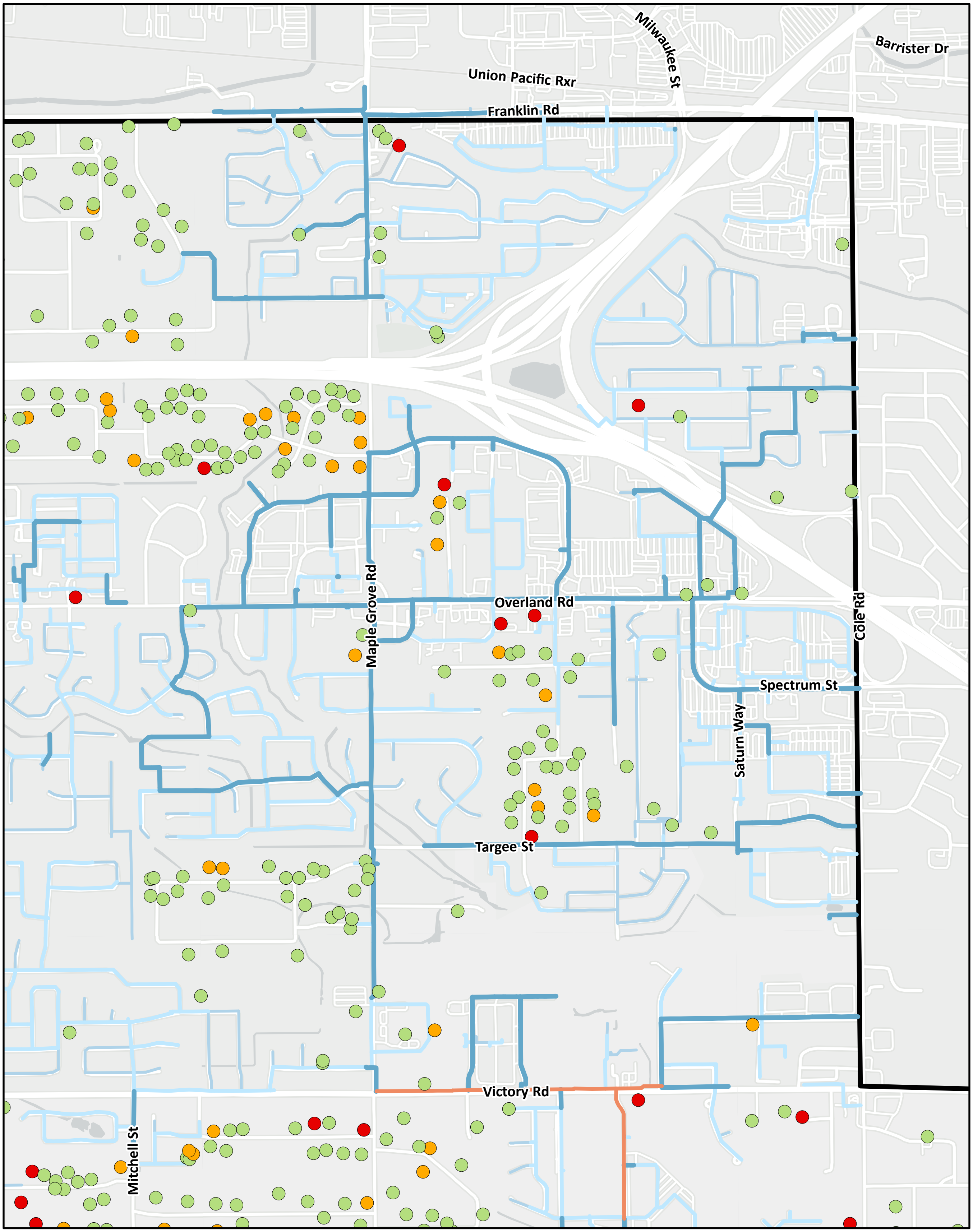
Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 2/15/2024



2027 RISK AND EXISTING MAINS

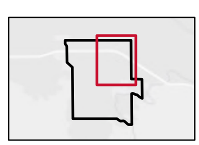
Figure 12b-1

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 2/15/2024



High Risk
Moderate Risk
Low Risk
Project Area

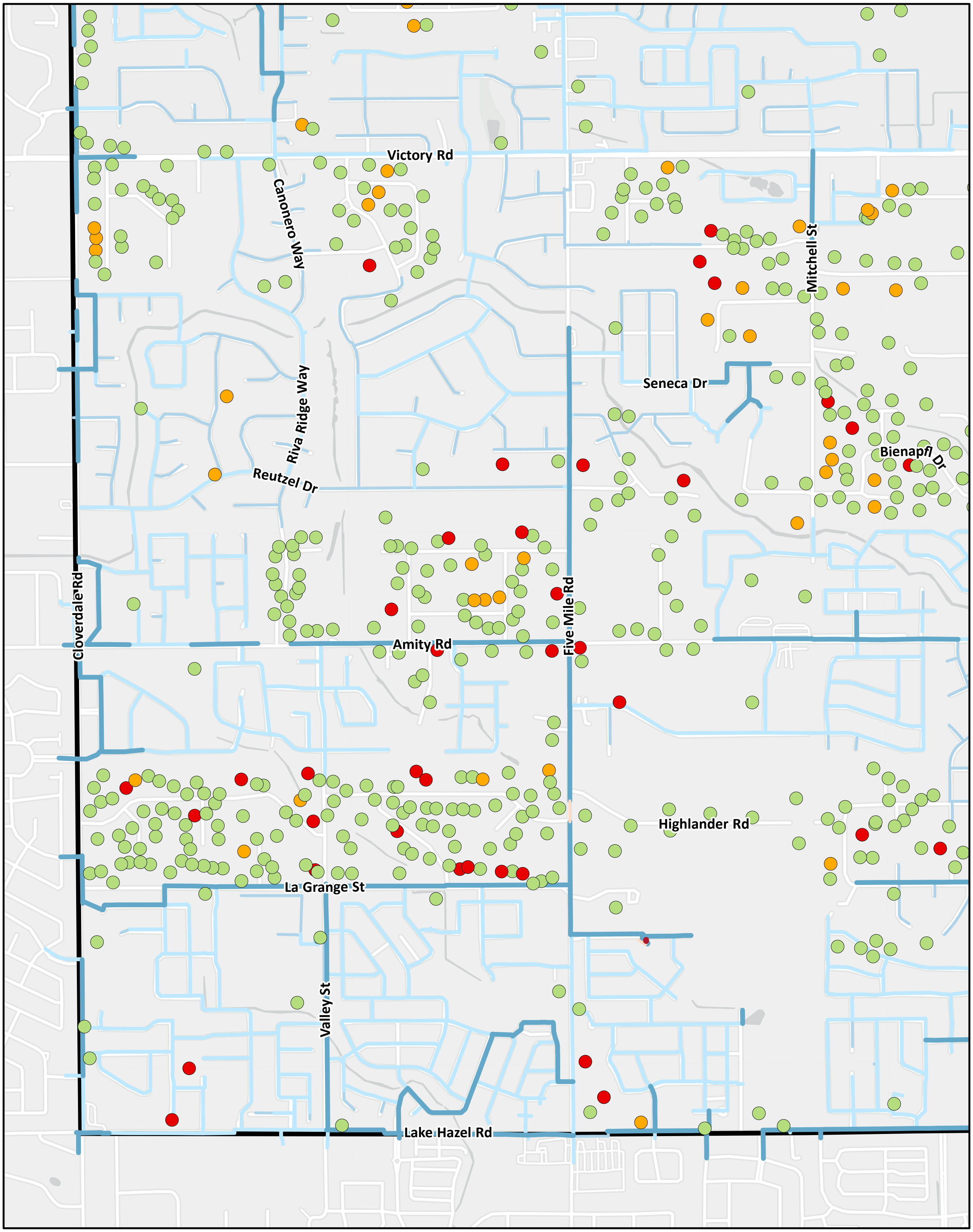
Diameter (in)
0.0 - 6.0
8.0 - 10.0
12.0
16.0



0 500 Feet

2027 RISK AND EXISTING MAINS

Figure 12b-2



High Risk
Moderate Risk
Low Risk
Project Area

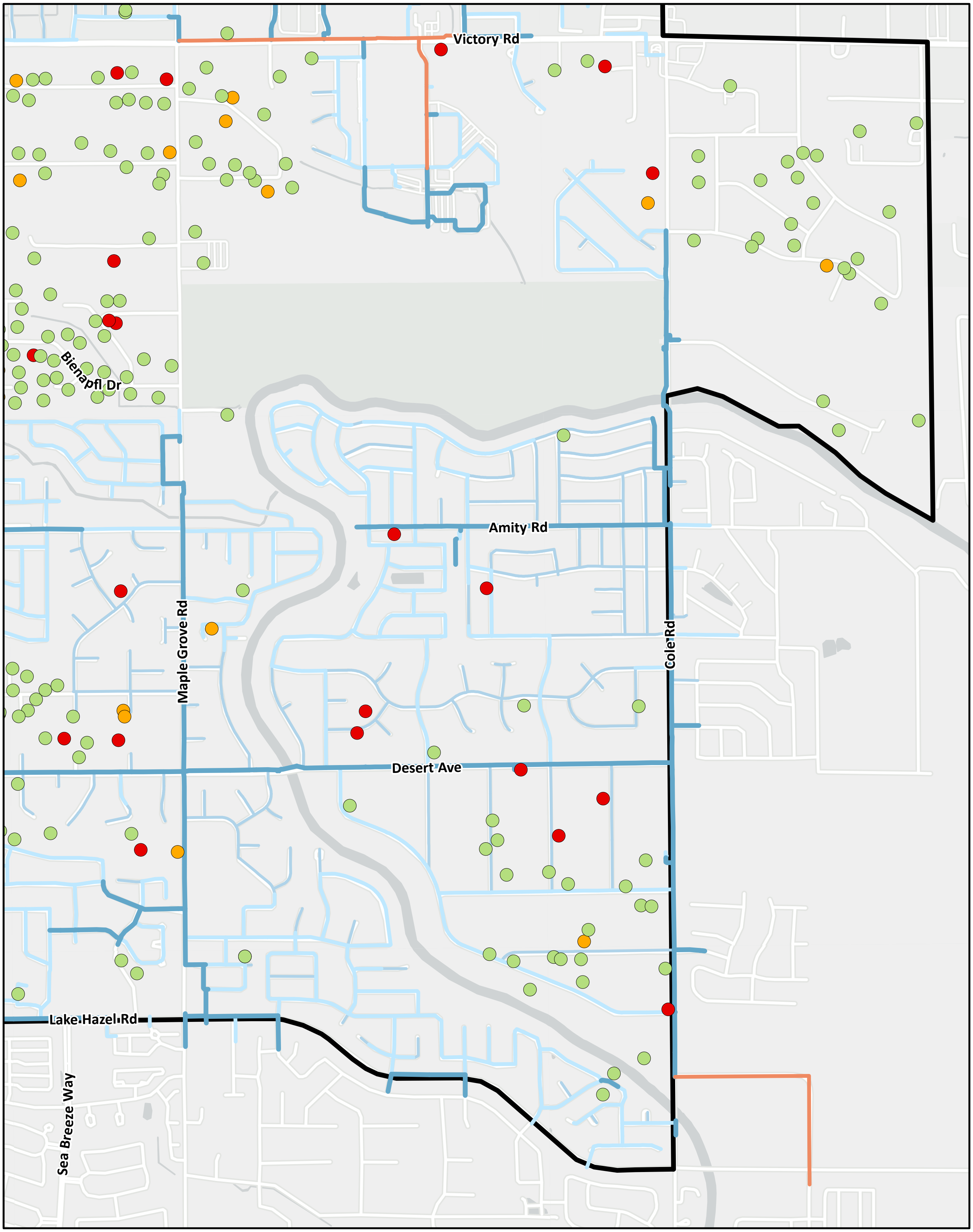
Diameter (in)
0.0 - 6.0
8.0 - 10.0
12.0
14.0
24.0

HDR

2027 RISK AND EXISTING MAINS

Figure 12b-3

0 500 Feet



High Risk
Moderate Risk
Low Risk
Project Area

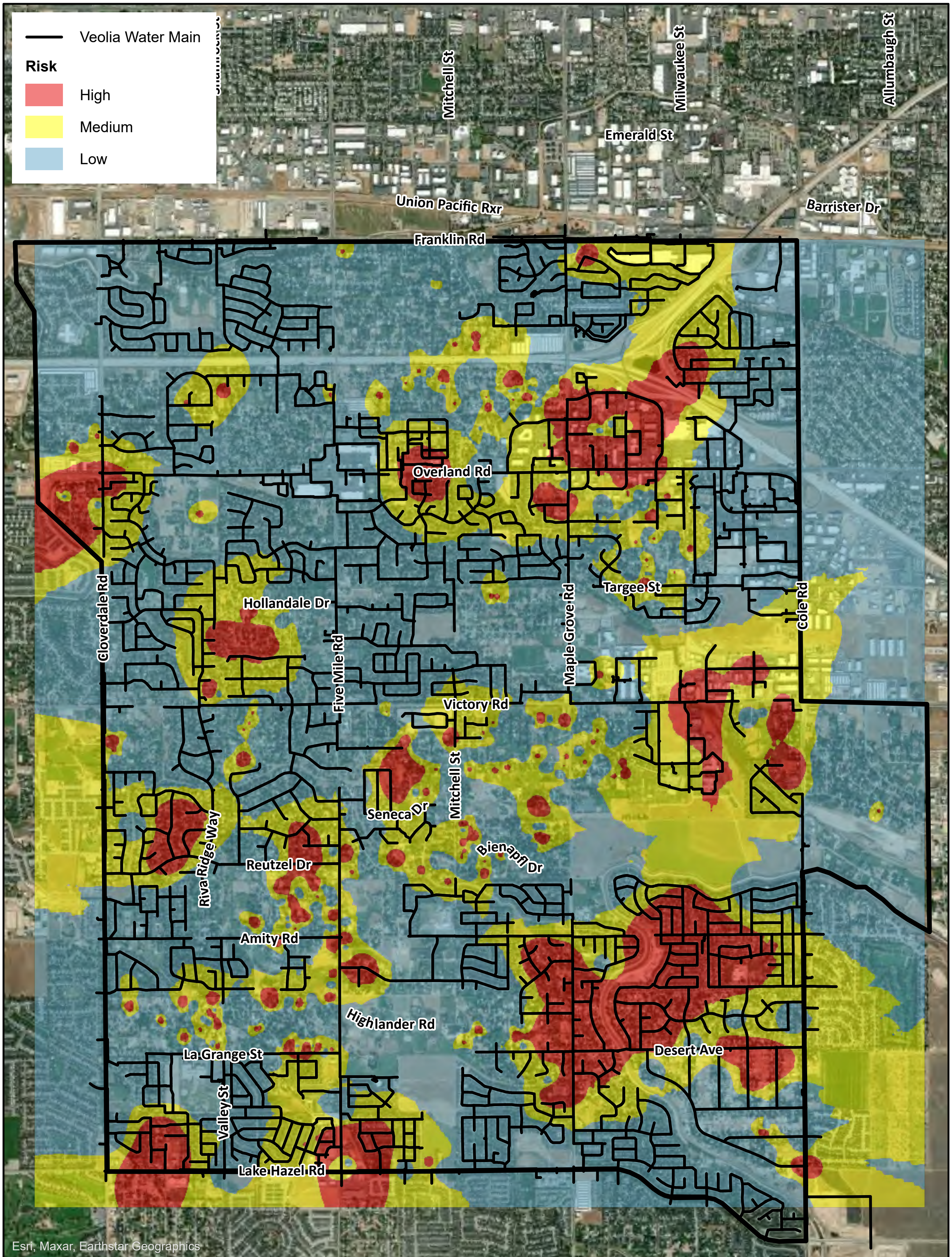
Diameter (in)
0.0 - 6.0
8.0 - 10.0
12.0
16.0

HDR

2027 RISK AND EXISTING MAINS

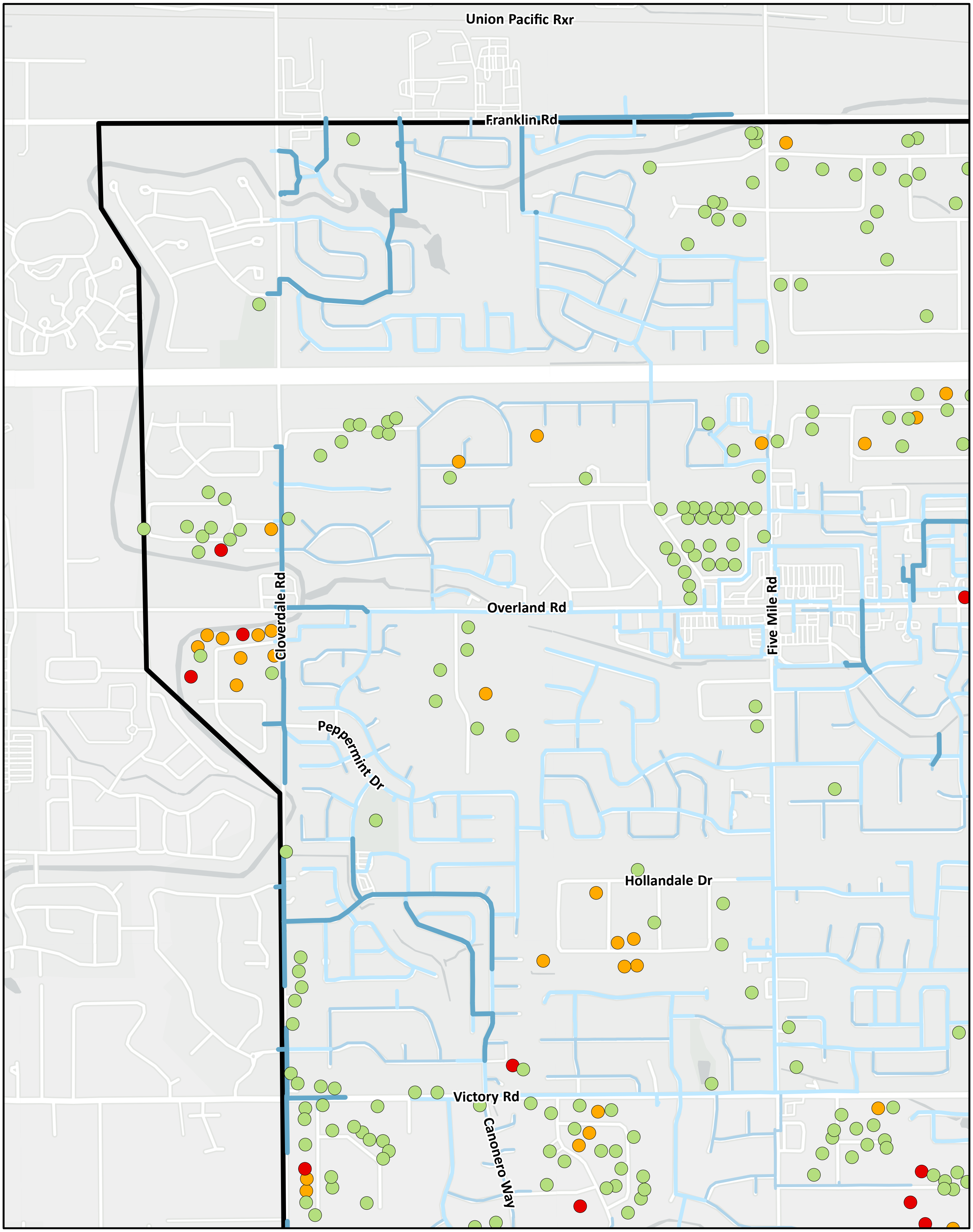
Figure 12b-4

0 500 Feet



2032 RISK ASSESSMENT AND FEASIBILITY

Figure 13a



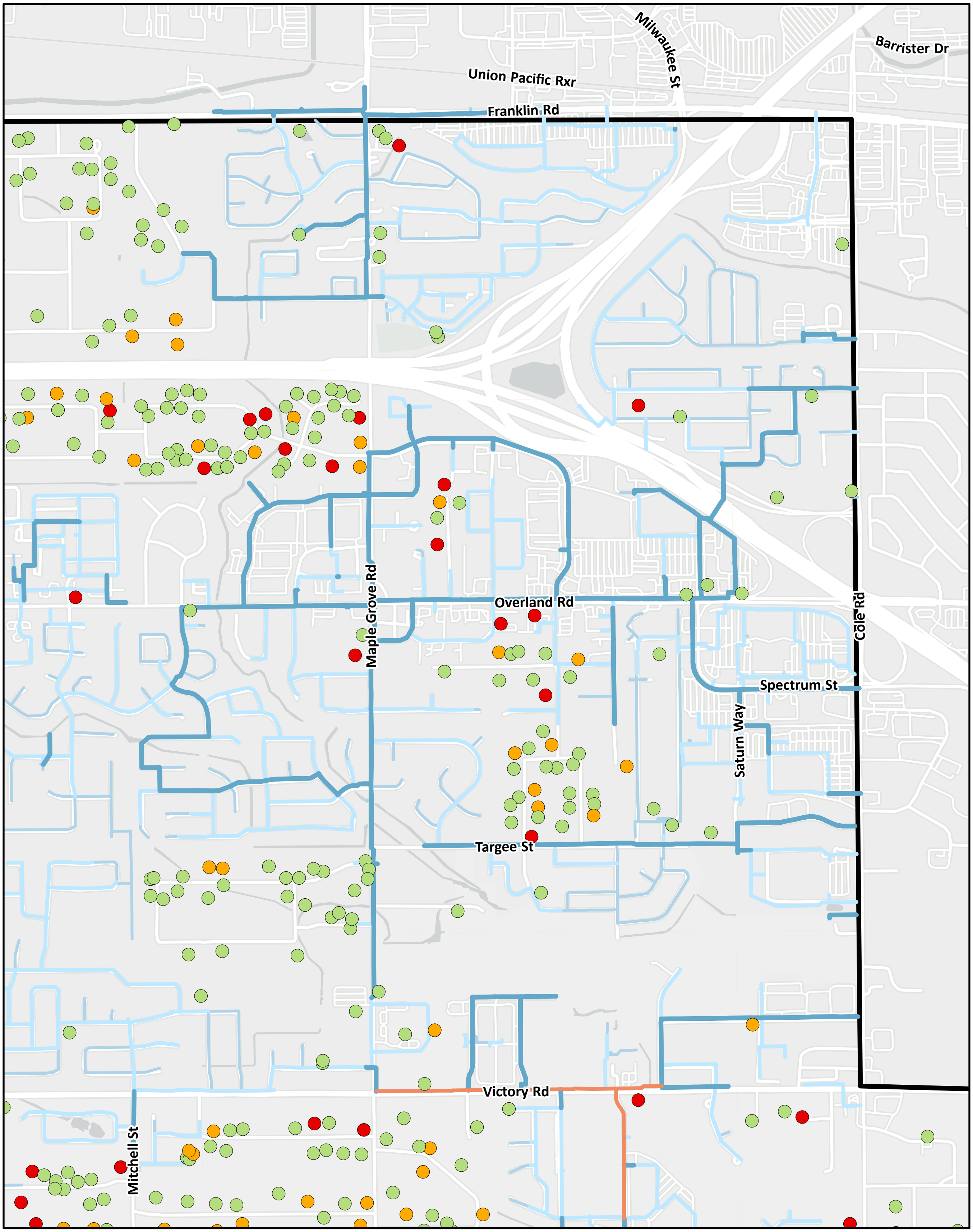
High Risk
Moderate Risk
Low Risk
Project Area

Diameter (in)
0.0 - 6.0
8.0 - 10.0
12.0

2032 RISK AND EXISTING MAINS

Figure 13b-1

0 500 Feet



High Risk

Moderate Risk

Low Risk

Project Area

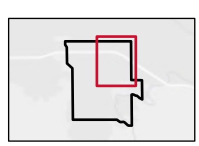
Diameter (in)

0.0 - 6.0

8.0 - 10.0

12.0

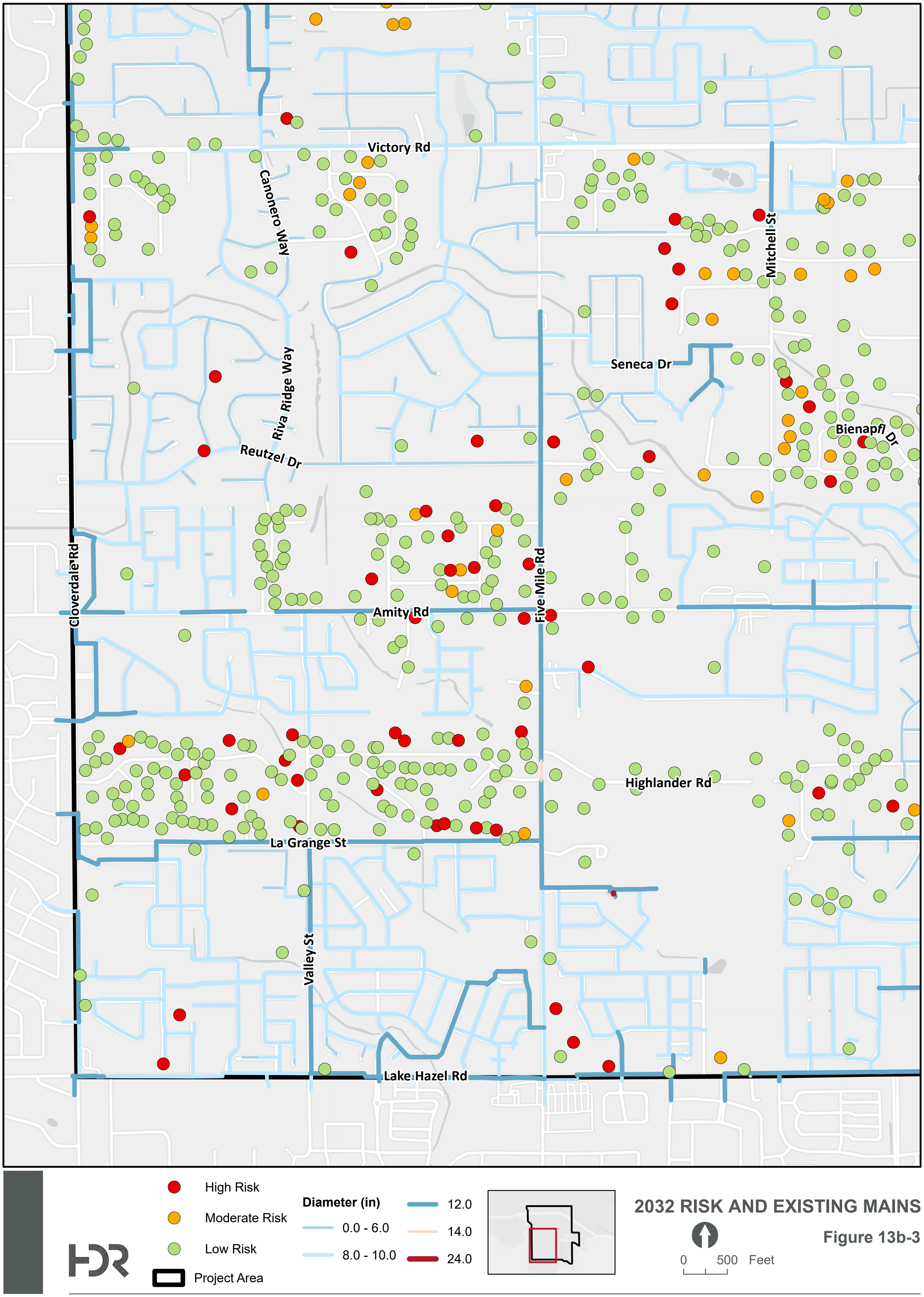
16.0



2032 RISK AND EXISTING MAINS

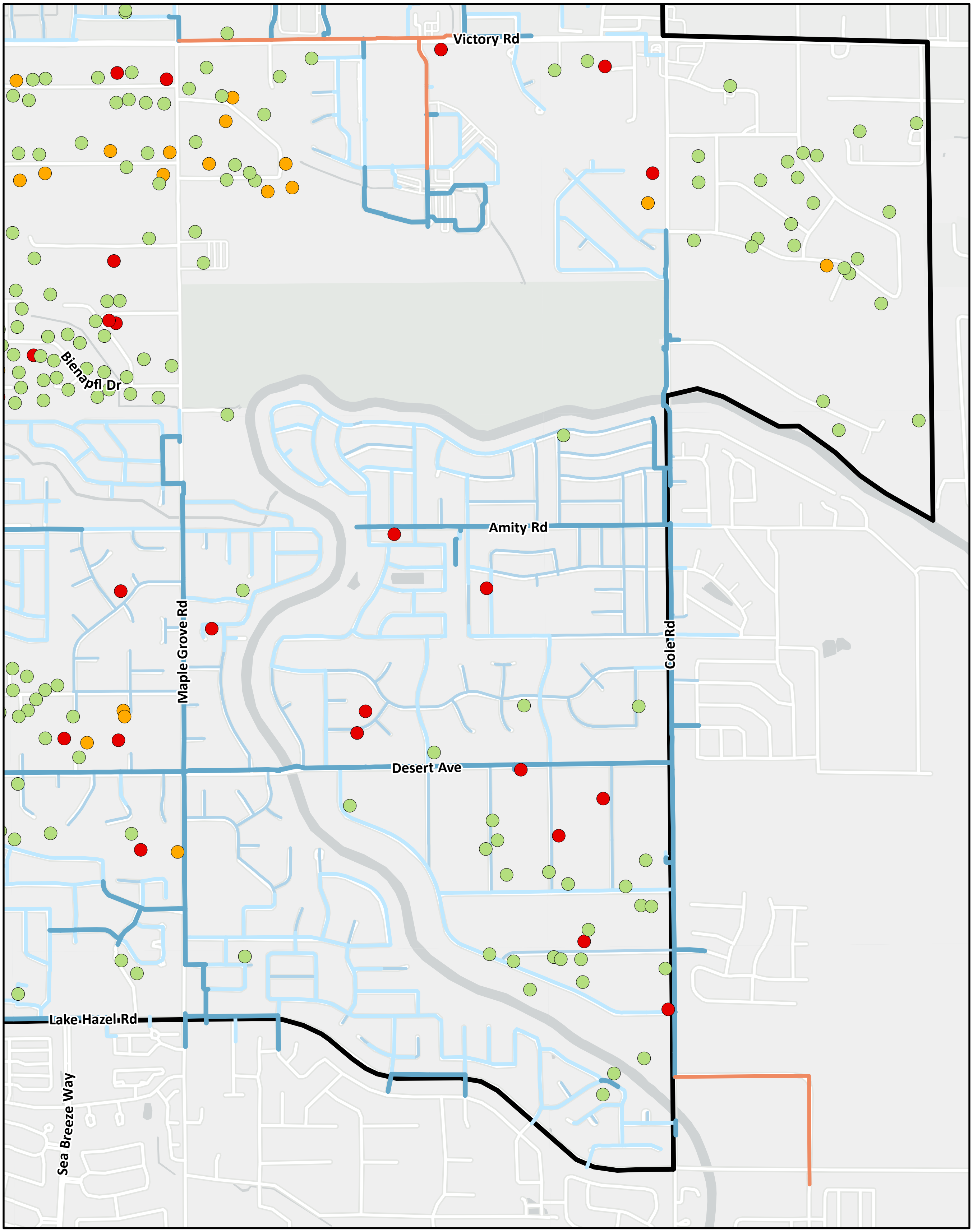
0 500 Feet

Figure 13b-2



2032 RISK AND EXISTING MAINS

Figure 13b-3



High Risk
Moderate Risk
Low Risk
Project Area

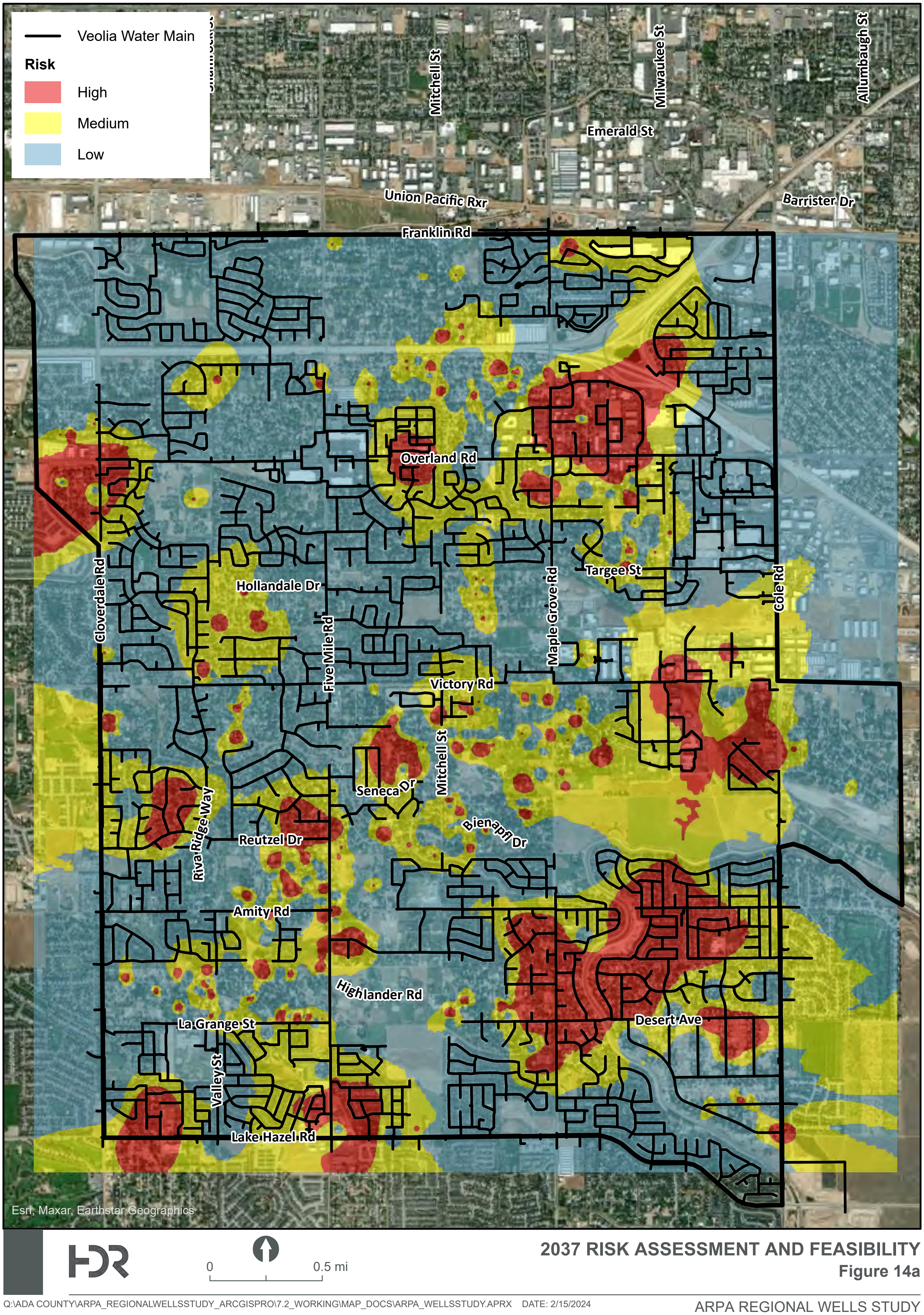
Diameter (in)
0.0 - 6.0
8.0 - 10.0
12.0
16.0

HDR

2032 RISK AND EXISTING MAINS

Figure 13b-4

0 500 Feet

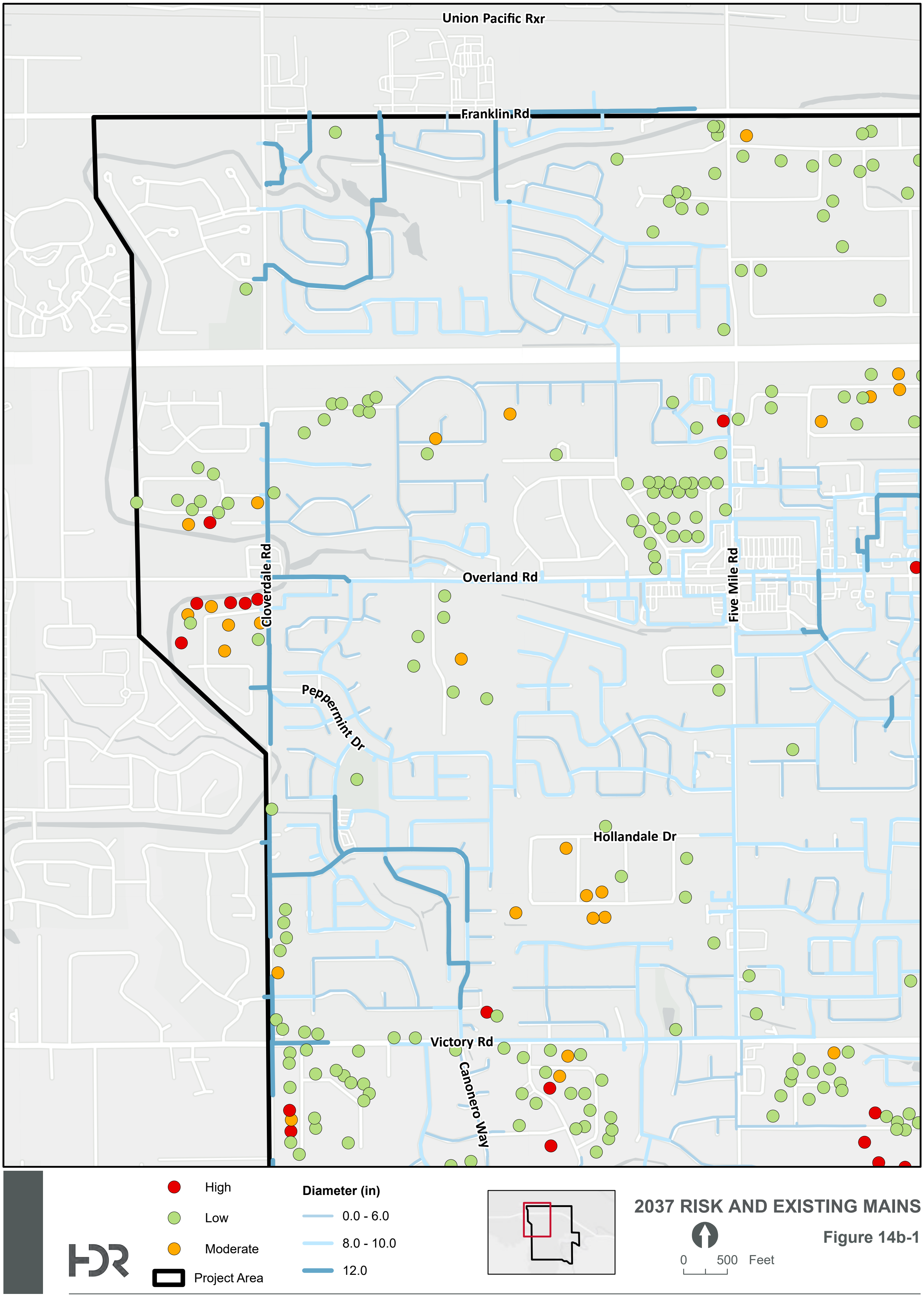


HDR

2037 RISK ASSESSMENT AND FEASIBILITY

Figure 14a

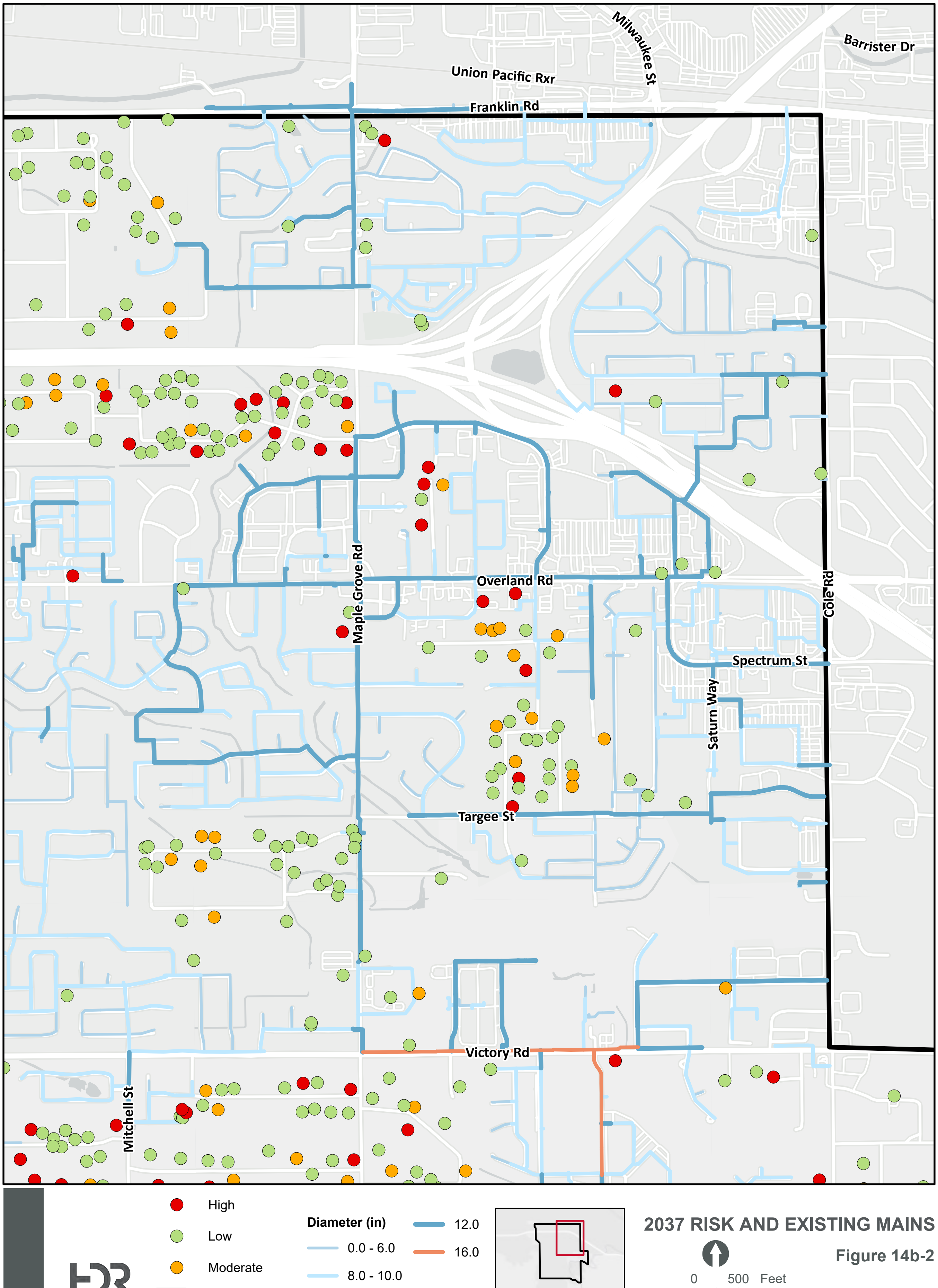
Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 2/15/2024



2037 RISK AND EXISTING MAINS

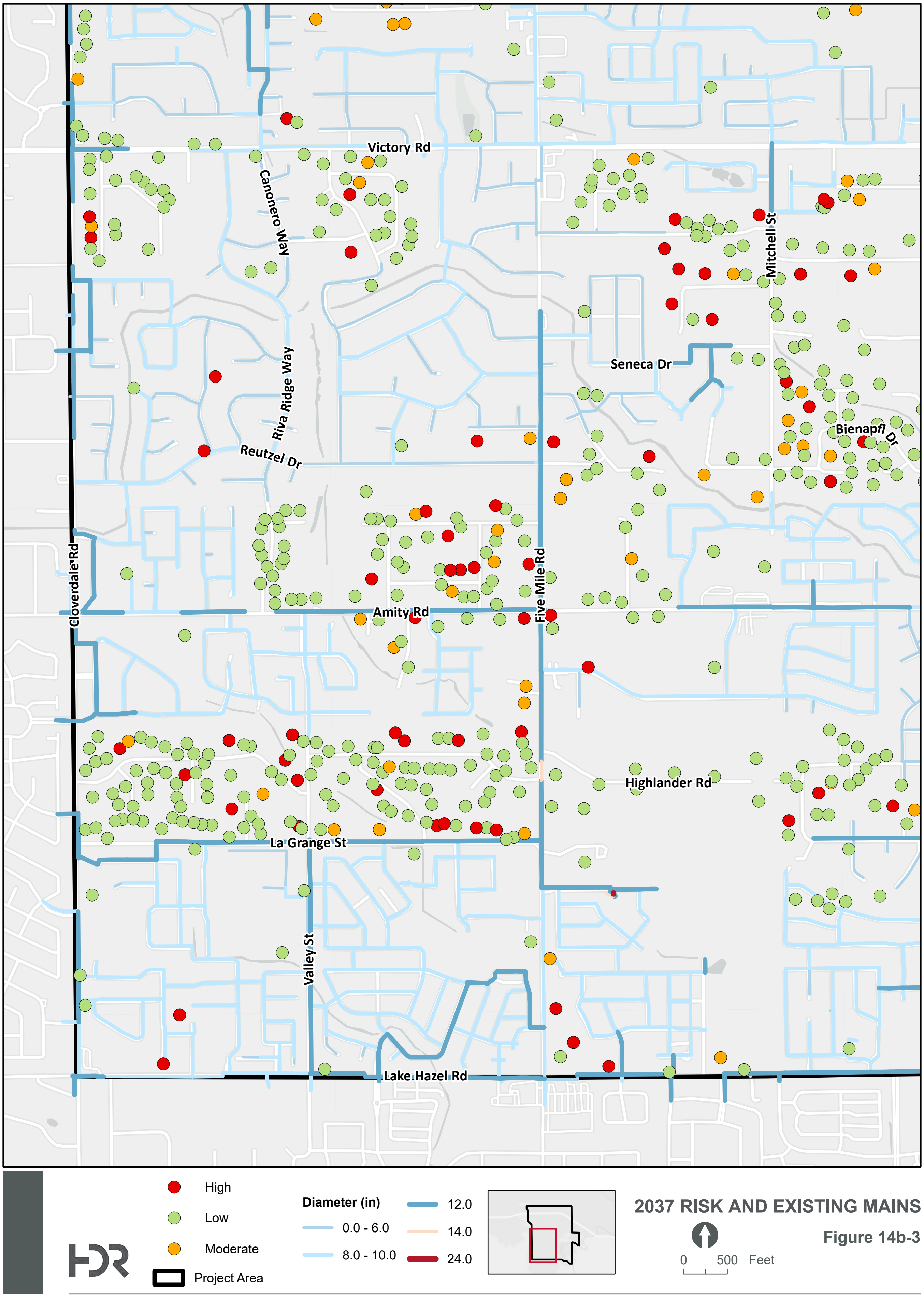
Figure 14b-1

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 2/15/2024



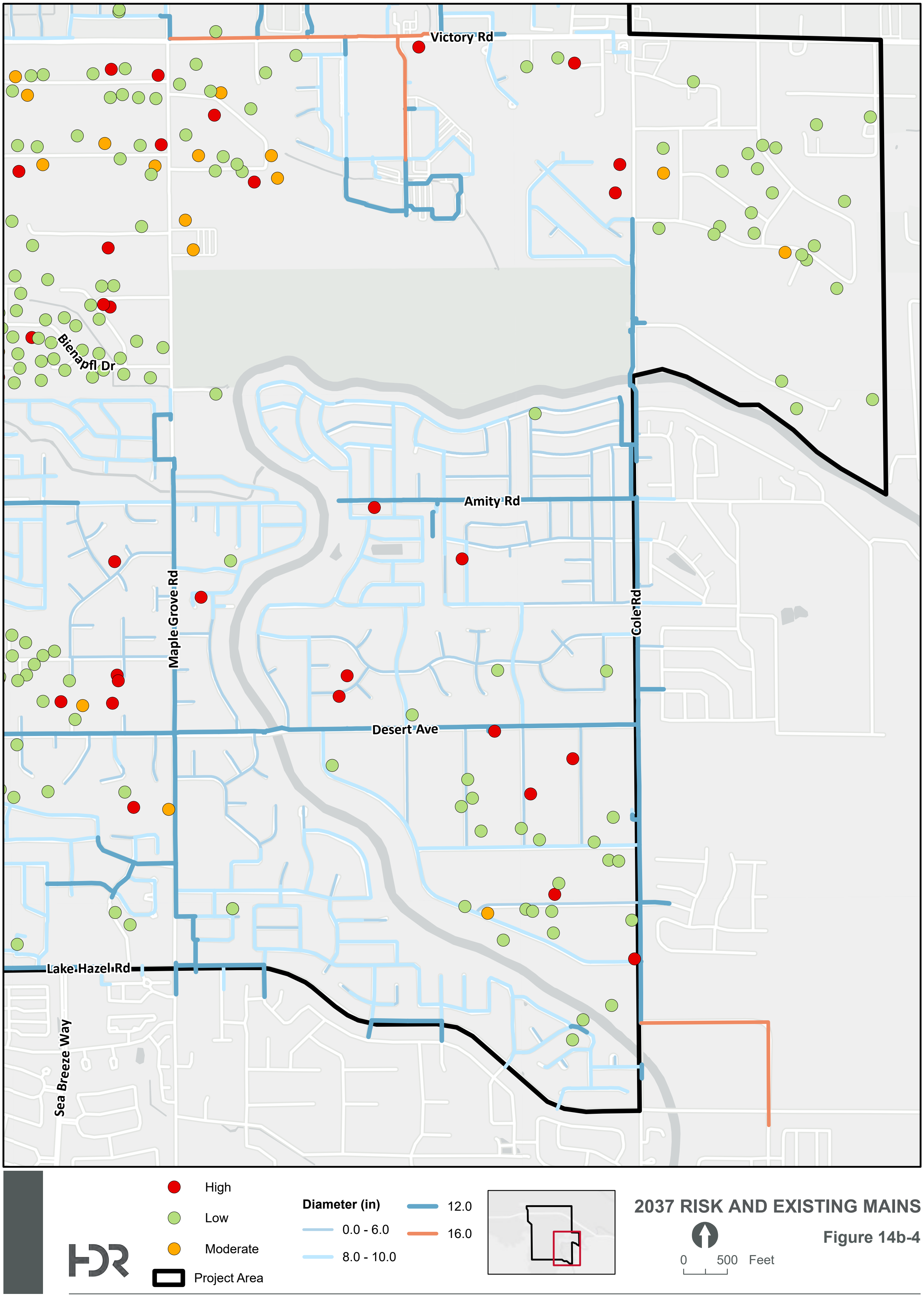
2037 RISK AND EXISTING MAINS

Figure 14b-2



2037 RISK AND EXISTING MAINS

Figure 14b-3



2037 RISK AND EXISTING MAINS

Figure 14b-4

4 Groundwater Quality Evaluation

4.1 Background

The study team compiled publicly available groundwater quality data for selected analytes of concern to evaluate the current shallow aquifer contaminant levels in the study area. Analytes were selected based on public health effects and aesthetic concerns. The analytes, collected from the IDEQ drinking water branch database, the IDWR Water Resources Map Data Hub, and Veolia, include arsenic, nitrate, and uranium. Using this data, the study team created maps to simultaneously characterize wells by depth (denoted by point shape) and contaminant concentration level (denoted by point color). To classify the concentration levels as either low, moderate, or high, both Idaho State and federal drinking water standards for maximum allowable contaminant concentrations were referenced and included in the maps. The concentrations displayed for each well are the most recent measurements available. These maps can be used to better understand both the overall quality of groundwater in the study area, along with how concentration levels differ with depth in the aquifer. If domestic, shallow aquifer wells are significantly impacted by harmful analytes and municipal wells are not, connection to municipal water supply may offer water quality benefits. It is additionally important to note that municipal wells are required to comply with state drinking water standards, whereas domestic wells are not.

4.2 Constituents of Concern

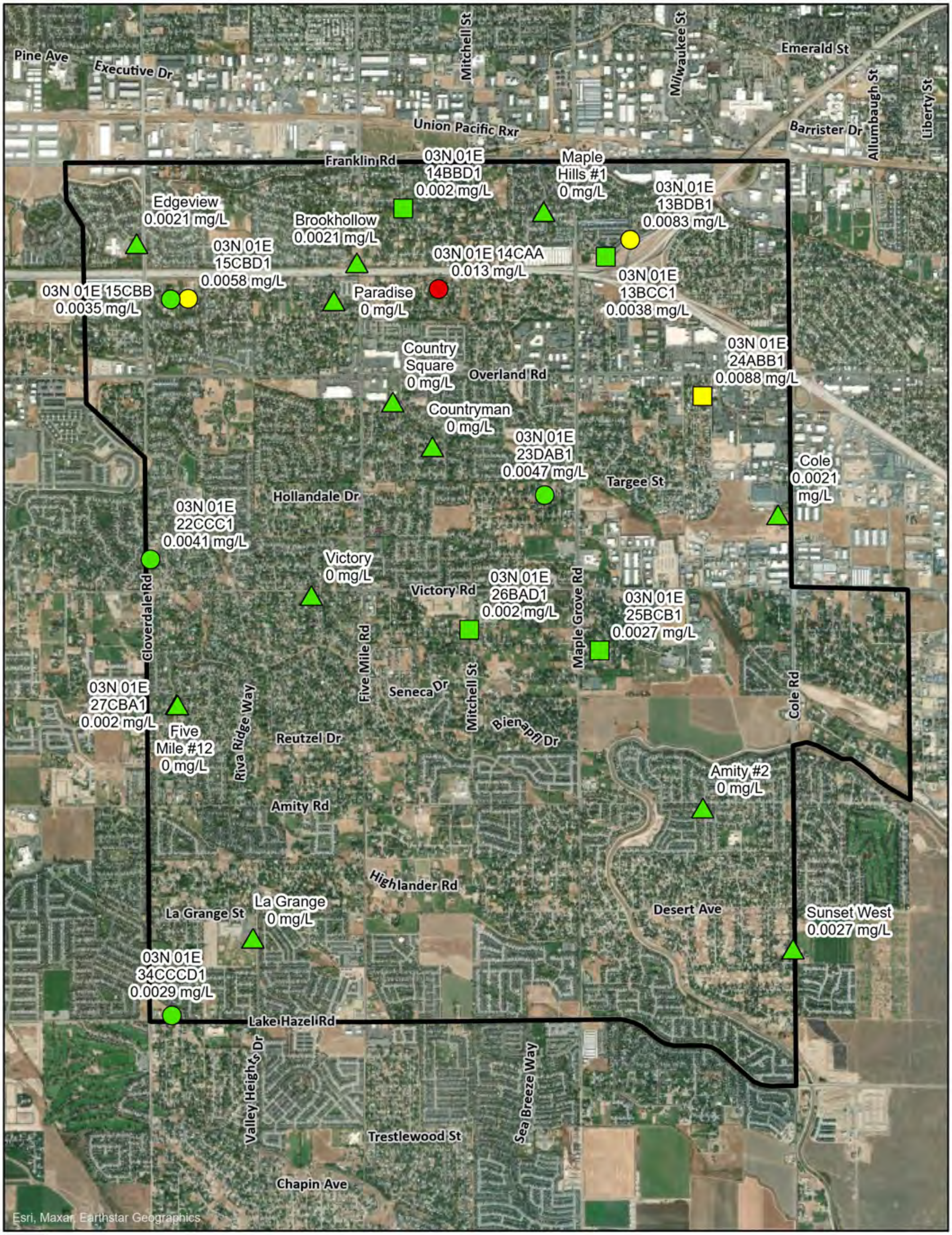
4.2.1 Arsenic

Figure 15 displays arsenic detected in wells within the study area. Detected levels of arsenic were ranked at three levels:

- High: arsenic detected above 0.01 milligrams per liter (mg/L)
- Moderate: arsenic detected between 0.005 and 0.01 mg/L
- Low: arsenic detected below 0.005 mg/L

Idaho Groundwater Quality Rule standards have an arsenic standard of 0.5 mg/L while the federal EPA maximum contaminant limit (MCL) is 0.01 mg/L in groundwater.

Of the 24 wells with water quality data, 20 are classified as having low concentrations of arsenic, 3 as having moderate levels, and 1 as having high levels. Of the 4 wells with concentrations above "low," 3 of them are domestic wells with a depth of 100 feet or less.



HDR

0 0.5 mi

Analyte Concentration (mg/L)
- Low
- Moderate
- High

Sample Depth (ft bgs)
- <100
- 100-300
- >300

Project Area

The Idaho State standard for Arsenic is 0.5 mg/L while the Federal maximum contaminant level is 0.01 mg/L.

ARSENIC

WATER QUALITY REVIEW

Figure 15

4.2.2 Nitrate

Figure 16 displays nitrate concentrations detected in wells within the study area. Overlayed in yellow is the Nitrate Priority Area identified by IDEQ, which includes a large portion of the study area. Nitrate concentrations are ranked as follows.

- High: concentrations above 10 mg/L
- Moderate: concentrations between 5 and 10 mg/L
- Low: concentrations below 5 mg/L

The EPA drinking water standard and the Idaho Groundwater Quality Rule standard for nitrate-N is 10 mg/L.

Of the 25 wells, 19 are classified as having low concentrations of nitrate, while the remaining 6 are classified as moderate. Of the 6 moderate wells, 5 have a depth of 100 feet or less, and all are domestic wells. Several of the moderate wells are above 9 mg/L and getting close to the EPA and Idaho standard of 10 mg/L.

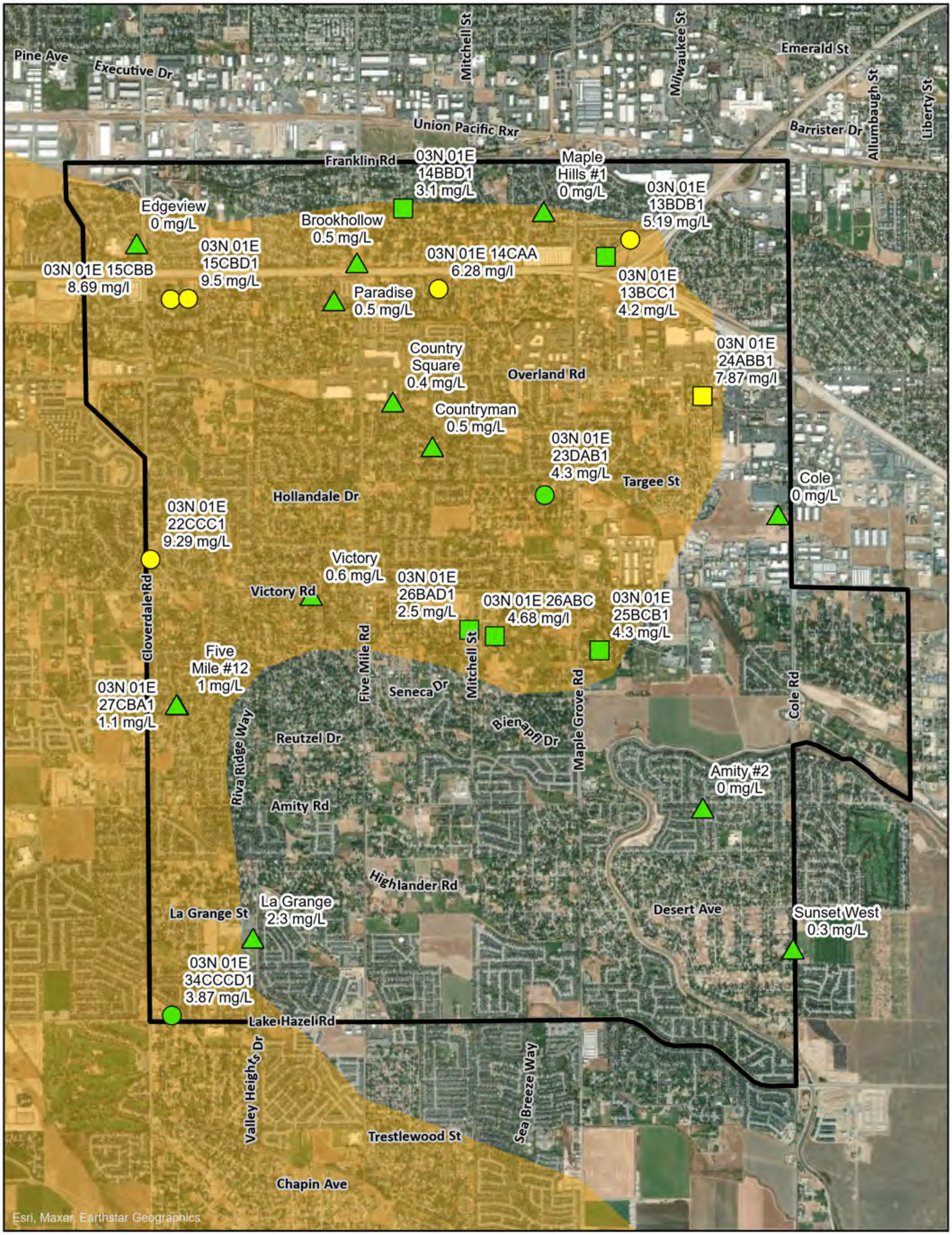
IDEQ established the overlayed Nitrate Priority Area as part of an initiative to monitor areas susceptible to nitrogen degradation across the state, and provide guidance on future groundwater quality protection efforts. Areas were classified into risk categories based on the criteria of population, current groundwater quality conditions, and trends in groundwater quality. As of August 2021, the Ada County Nitrate Priority Area was designated a High Priority Area with the eighth highest risk-score of the 35 total state-wide priority areas. The 2007-2016 trend in nitrate levels was listed as “no trend,” suggesting that testing levels have remained steady throughout the time period. Though there are currently no measurements of nitrate above the Idaho standard of 10 mg/L within the study area (indicated by the most recent data), several detections are close (within 1 mg/L) and the intersection with the Nitrate Priority Area is noteworthy when evaluating the future safety of shallow aquifers in the area.

4.2.3 Uranium

Figure 17 displays uranium concentrations detected in wells within the study area. Uranium concentrations in the study area are ranked as follows.

- High: detected concentration above the EPA primary drinking water standard of 30 μg/L
- Moderate: detected concentration between 5 μg/L and 30 μg/L
- Low: detected concentrations below 5 μg/L

Of the 9 wells shown, 4 are classified as having moderate concentrations of uranium and 5 as having high concentrations (concentrations over the MCL of 30 microgram per liter [μg/L]). All the wells shown are domestic wells, as data for uranium concentrations in Veolia wells was unavailable.



Analyte Concentration (mg/L)
- Low
- Moderate

Sample Depth (ft bgs)
- <100
- 100-300
- >300

Nitrate Priority Area

Project Area

The Idaho State standard for Nitrate is 10 mg/L.

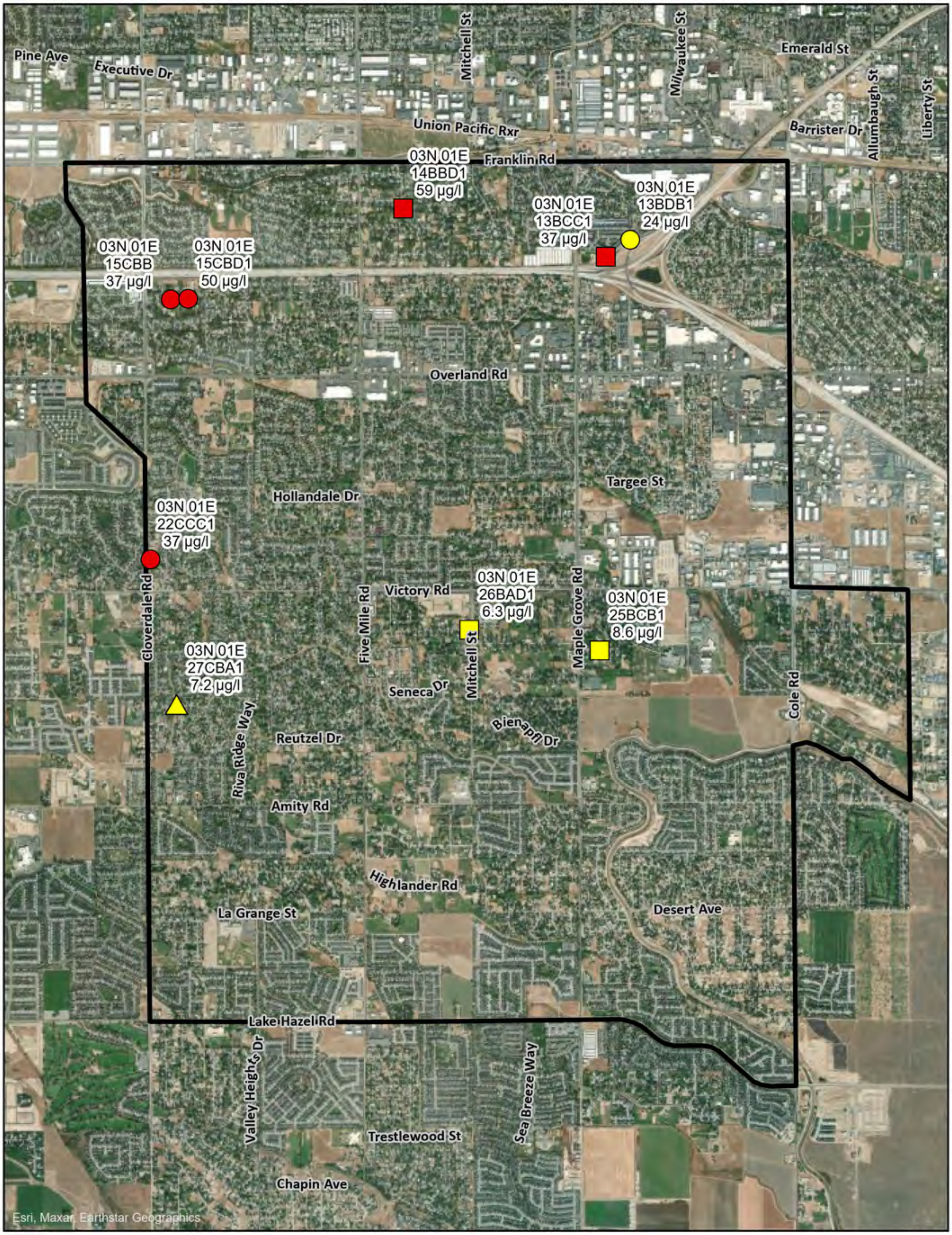
0 — 0.5 mi

HDR

NITRATE

WATER QUALITY REVIEW

Figure 16



Analyte Concentration (mg/L)
- Moderate
- High

Sample Depth (ft bgs)
- <100
- 100-300

Project Area

The Federal maximum contaminant level is 30 µg/L.

HDR

0 0.5 mi

URANIUM

WATER QUALITY REVIEW

Figure 17

Uranium has historically been a contaminant of concern in the Treasure Valley; however, there have not been many studies about the distribution, source, or release mechanism. A recent study of uranium presence in the Treasure Valley Aquifer System (TVAS) (Womeldorph 2019), initiated due to the need for more information following the IDWR denial of the West Ada Area of Drilling Concern, found 37 percent of the wells studied had uranium levels over the federal MCL of 30 µg/L. The highest concentration of uranium detected in groundwater in the valley was 100 µg/L. From the small sample size of wells in this 2019 study, over half exceed the limit. Though spatial trends of uranium in the TVAS are difficult to define and sparsely studied, Womeldorph concluded that shallower wells, associated with higher oxygen levels, are at greater risk of high uranium concentrations. Due to both the vast number of domestic shallow wells and the prominence of uranium in the study area, the water quality benefits of supplying households in the area with regulated municipal water seem to be most significant regarding uranium than the other analytes studied.

5 Administrative Areas

5.1 Groundwater Management Areas

IDWR defines a critical groundwater area (CGWA) as a groundwater basin that does not have sufficient volume to support irrigation and other uses of withdrawal at current and projected rates (IDWR 2023b). A groundwater management area (GWMA) is defined as a groundwater basin that is determined to be approaching the conditions of a CGWA.

The Boise Front GWMA overlaps the study area on the northeast corner (see **Figure 2**). IDWR established the Boise Front GWMA in 1987 in order to protect groundwater that is greater than 300 feet and/or a temperature above 85 degrees Fahrenheit (i.e., geothermal water in the Treasure Valley). Currently, a moratorium on new development and increased use of the geothermal resource has been extended to May 5, 2024 (initial moratorium began in 1988 and has been extended over 5-year periods since 1993).

IDWR designated a second GWMA in Boise in 1994 (the Southeast Boise GWMA). This GWMA is outside the study area to the southeast and was established in response to declining water levels.

Under the distinction of GWMA, IDWR aims to monitor water supply and usage, enact policies to protect water supply and current users, and to maximize the public benefit of water resources. The established Boise Front GWMA that overlaps with the study area only slightly overlaps to the northeast, southwest of the Franklin Road and Cole Road intersection.

5.2 Areas of Drilling Concern

Overlapping the northeast corner of the study area is a small portion of the active West Boise Area of Drilling Concern (ADC), established by IDWR in 2001 in response to a perchloroethylene (PERC) plume (see **Figure 2**). The area of overlap with the study area is similar to that of the Boise Front GWMA. The boundary of the ADC was established by delineating the total area that registered measurements of at least 5 µg/L of PERC in groundwater samples following the spill, and covers just over 2 square miles (IDWR 2001b). It is one of only two active ADCs in Idaho (the other being in northern Idaho). The study area is upgradient of the ADC and only slightly overlaps it.

5.3 Proposed Area of Drilling/Groundwater Concern

In 2015, the City of Meridian petitioned IDWR to designate an ADC in west Ada County (West Ada Area of Drilling Concern) that overlaps most of the study area, seeking IDWR support in the promotion of more rigorous well sealing and drilling standards (see **Figure 2**). The proposed boundary was created based on groundwater source areas for Meridian wells and is bound by the New York Canal to the east.

The designation was requested based on the historical presence of contaminants in the shallow aquifer below Meridian and the vulnerability of the aquifer to future contamination. In their ADC proposal, Meridian stated a desire to protect the City's future groundwater supply by establishing more stringent drilling regulations for all new wells drilled in the area and by requiring the annular space of wells to be sealed in an approved fashion upon abandonment. Both measures are aimed at reducing potential conduits of contaminant spread from the shallow aquifer system to deeper aquifers. In September of 2016, IDWR concluded that more data was needed to designate an ADC and that designation prior would be "premature." In their declination, IDWR pointed to the technical reports referenced in the proposal, showing evidence that hydrogeologic conditions and contamination is present throughout the Treasure Valley or beyond the proposed boundaries and the lack of data of the surrounding area undermined the designation of an ADC.

The ADC area was proposed as a protective measure rather than in response to a localized contamination threat. With the number of potentially abandoned wells and the continued drilling of new wells in the study area, the drilling and sealing methods discussed in Meridian's ADC proposal offer proactive principles to protect the future groundwater quality both in the study area and downstream.

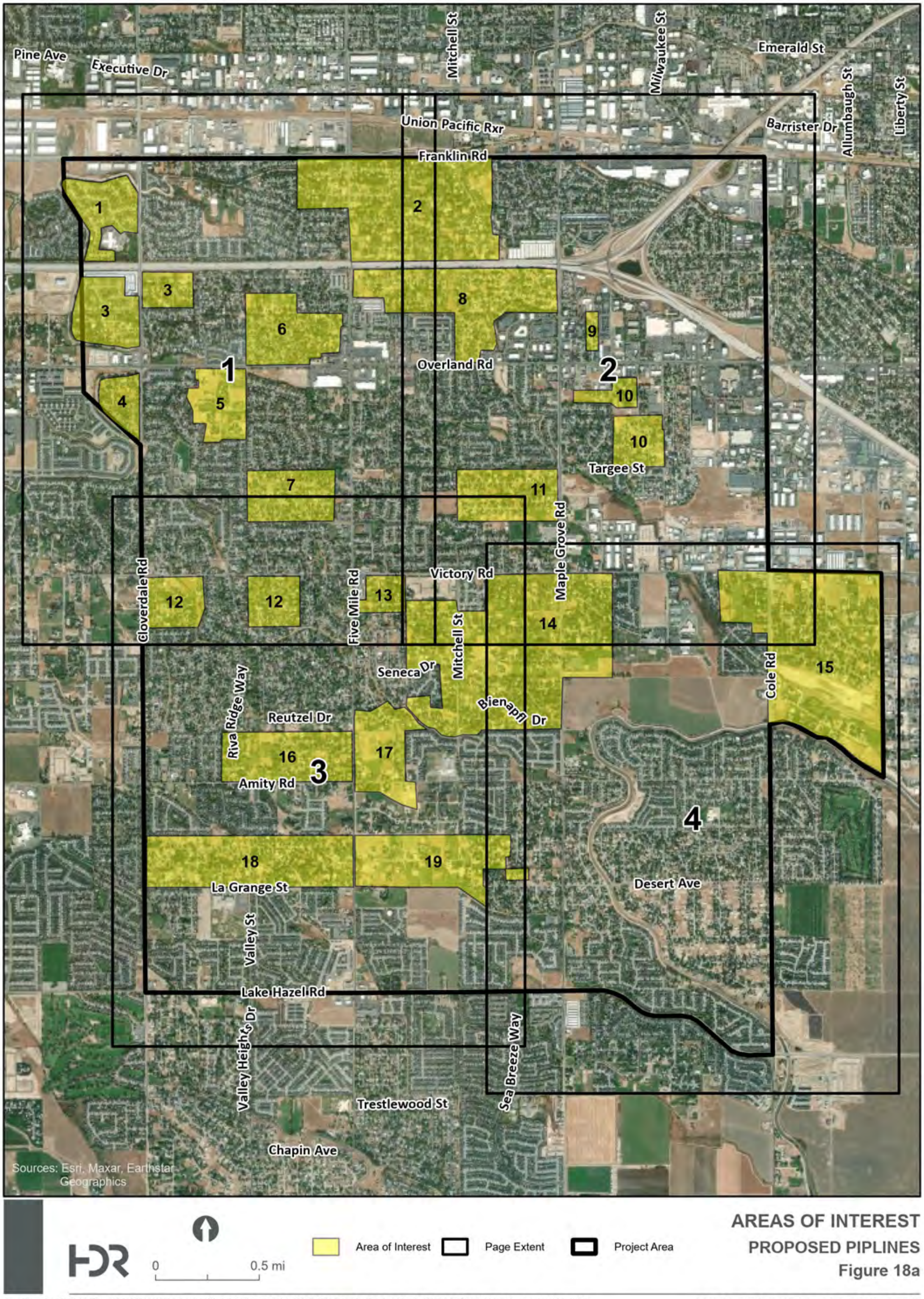
One recommendation as part of the final order (IDWR 2016) recommended that consideration be made to require water quality sampling for nitrate, arsenic, and uranium for all wells within the proposed ADC following well installation and development in order for groundwater users to be aware of the quality of the groundwater they are using.

6 Feasibility and Cost Alternatives Analysis

Mitigating water level declines and the associated risk to domestic wells in the study area may be accomplished by connecting homeowners to the local municipal water purveyor Veolia. Another option is for homeowners to continue to replace existing shallow wells with deeper wells. Assuming an approximate cost of $100 per foot for a new well, and an estimated depth of 200 feet, a new domestic well would cost approximately $20,000, not including any needed pump upgrades (assume new pump will be an addition $5,000).

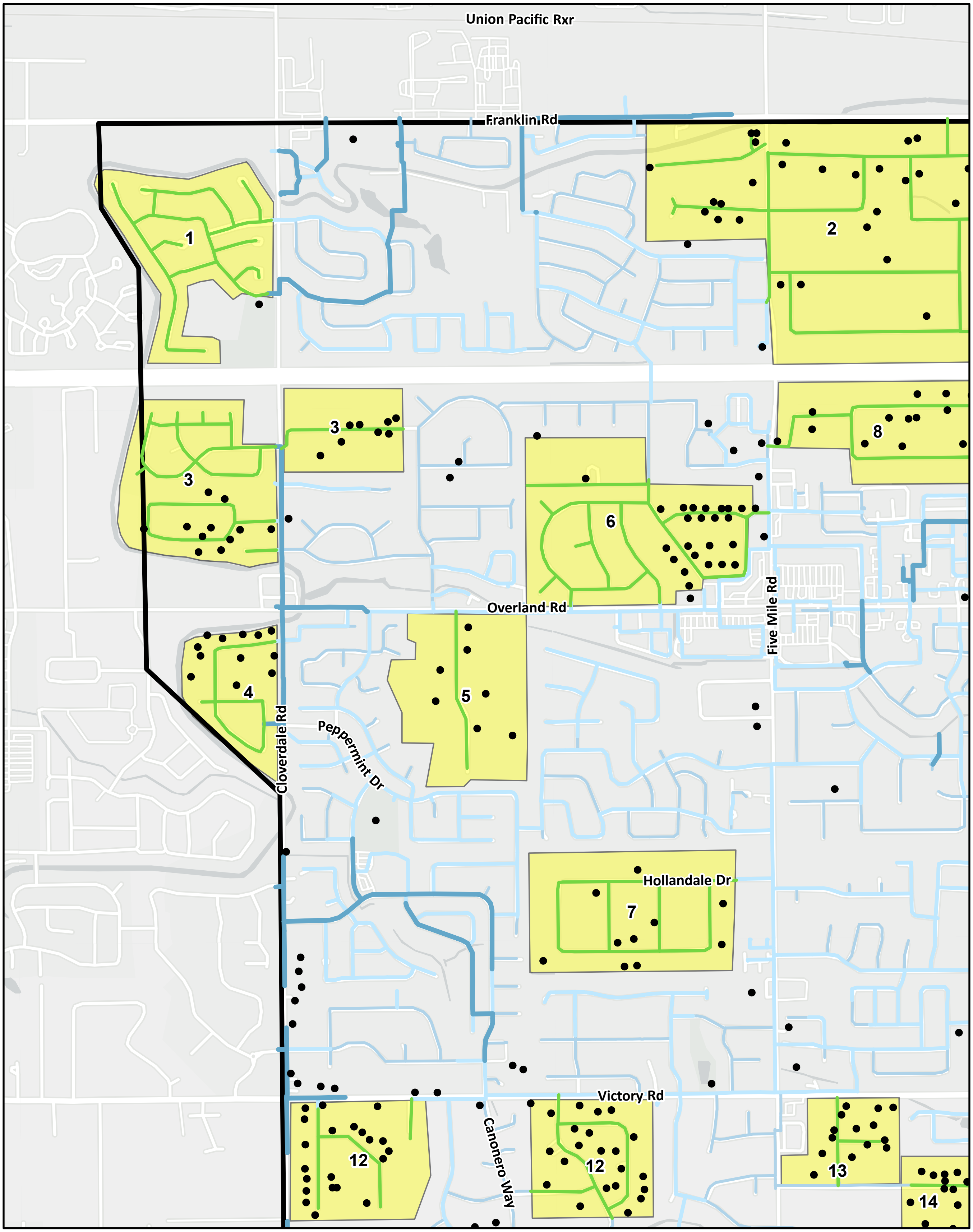
Based on the results of the risk analysis, the study team identified zones where it is reasonable to analyze cost for the installation of new Veolia lines and hookups. The study team determined zones based on areas without existing Veolia lines and their proximity to one another. Generally, if an area appeared to be a set subdivision or had a distinct large roadway division from another, it was labeled as a separate zone.

Figure 18 shows the identified zones, the verified wells identified in each area, and the estimated new Veolia lines needed to connect all houses within these zones (if all houses in the area were to be connected to Veolia). **Table 9** shows a breakdown of wells per area and their associated risk for each of the years of risk analysis. The last column in the table ranks the risk of each area based on the percentage of wells that were classified as moderate and high risk. Risk ranking was determined by calculating a weighted average of the percent of high/moderate risk wells in 2022 and the percent of high/moderate wells in 2037, with a higher weight placed on the 2022 high/moderate wells (0.75 for the 2022 wells, 0.25 for the 2037 wells).



AREAS OF INTEREST
PROPOSED PIPLINES
Figure 18a

Q:\ADA COUNTY\ARPA_REGIONALWELLSSTUDY_ARCGISPRO\7.2_WORKING\MAP_DOCS\ARPA_WELLSSTUDY.APRX DATE: 10/3/2023



- Well
- Proposed Pipeline
- Area of Interest
- Project Area

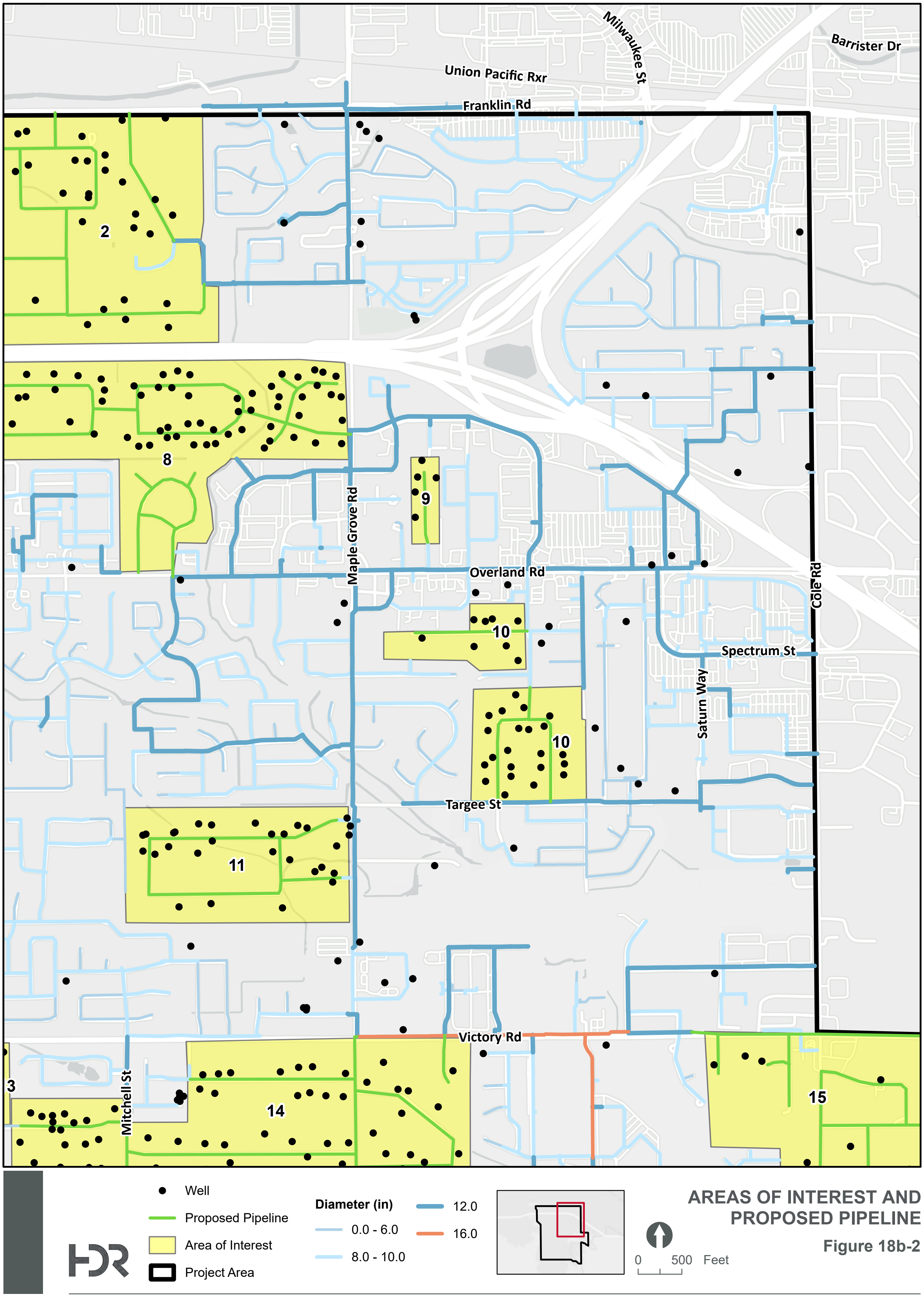
Diameter (in)

- 0.0 - 6.0
- 8.0 - 10.0
- 12.0

0 500 Feet

AREAS OF INTEREST AND PROPOSED PIPELINE

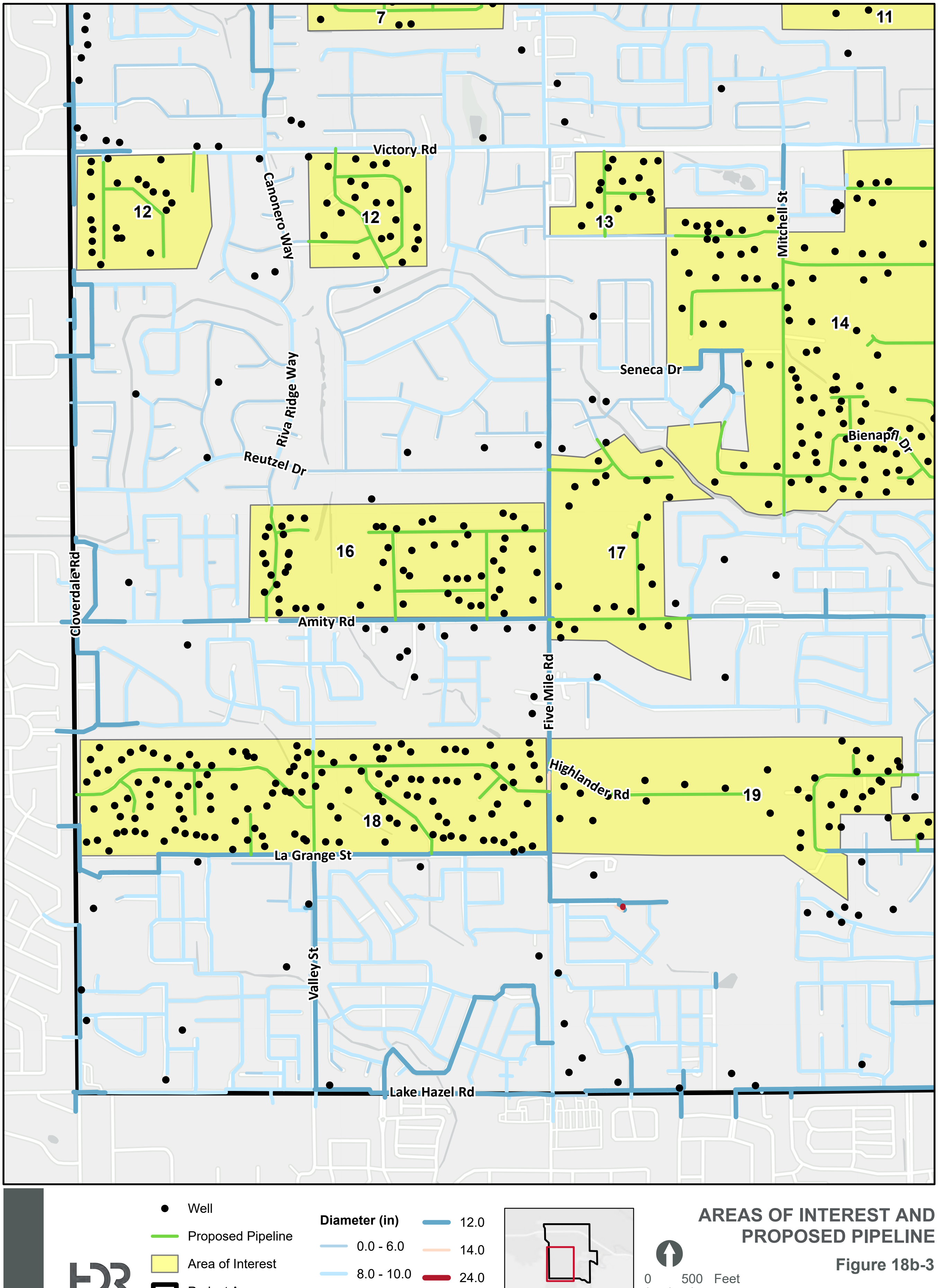
Figure 18b-1



HDR

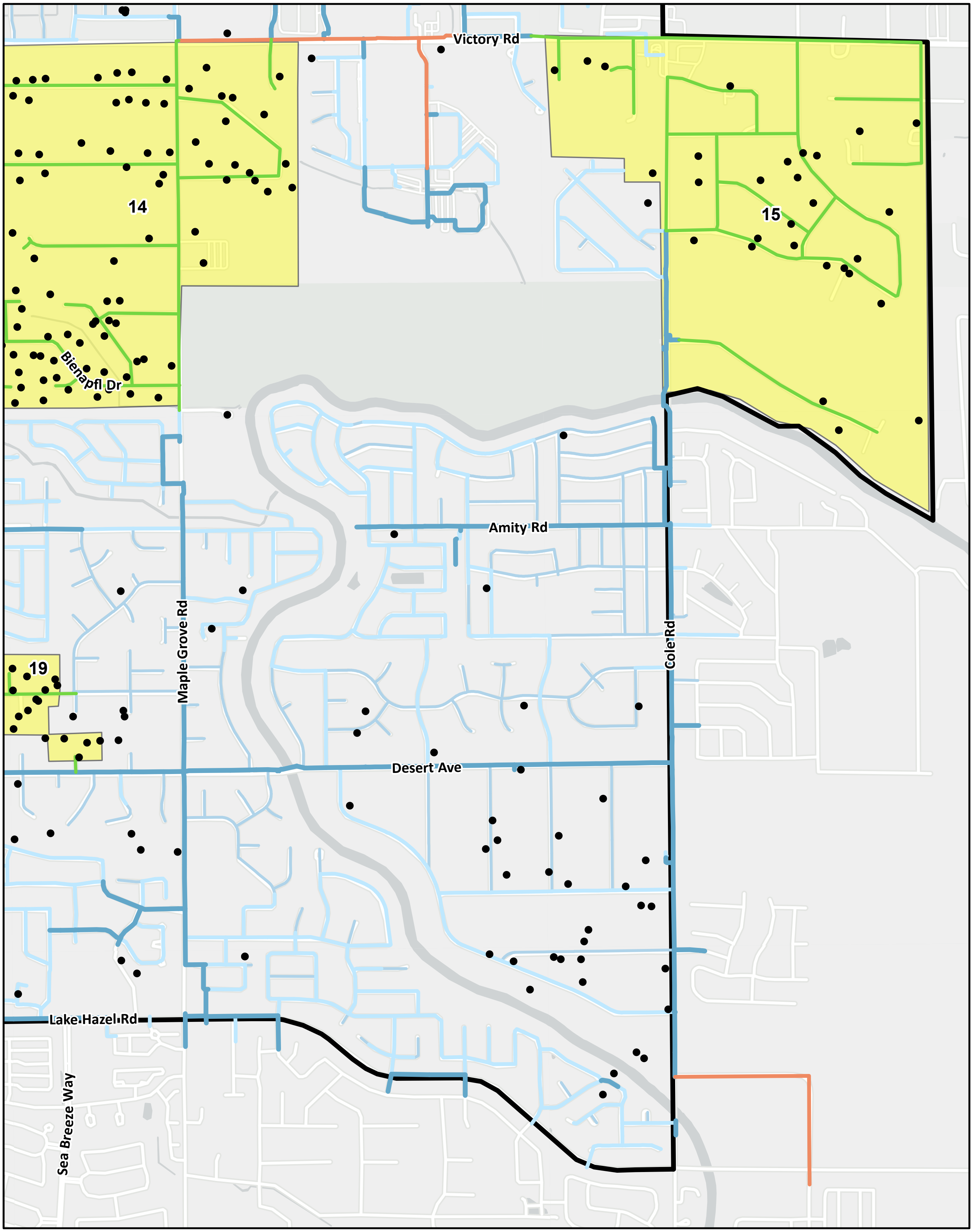
AREAS OF INTEREST AND PROPOSED PIPELINE

Figure 18b-2



AREAS OF INTEREST AND PROPOSED PIPELINE

Figure 18b-3



Well
Proposed Pipeline
Area of Interest
Project Area

Diameter (in)
0.0 - 6.0
8.0 - 10.0
12.0
16.0

0 500 Feet

AREAS OF INTEREST AND PROPOSED PIPELINE

Figure 18b-4

Table 9. Breakdown of Wells by Area Identified for Veolia Upgrades

Area	Number of Properties	Number of Wells Verified	Risk Year	High	Moderate	Low	Risk Ranking[1]
1	152	0	2022	N/A			14
			2027				
			2032				
			2037				
2	224	48	2022	0	2	46	10
			2027	0	3	45	
			2032	0	5	43	
			2037	1	5	42	
3	181	19	2022	1	1	17	8
			2027	1	1	17	
			2032	1	1	17	
			2037	1	2	16	
4	65	12	2022	1	4	7	2
			2027	2	7	3	
			2032	2	8	2	
			2037	5	5	2	
5	11	7	2022	0	0	7	12
			2027	0	1	6	
			2032	0	1	6	
			2037	0	1	6	
6	116	23	2022	0	0	23	14
			2027	0	0	23	
			2032	0	0	23	
			2037	0	0	23	
7	65	10	2022	0	0	10	6
			2027	0	4	6	
			2032	0	6	4	
			2037	0	6	4	
8	175	64	2022	0	10	54	3
			2027	1	12	51	
			2032	7	10	47	
			2037	10	8	46	
9	14	5	2022	1	2	2	1
			2027	1	2	2	
			2032	2	1	2	
			2037	3	1	1	

Area	Number of Properties	Number of Wells Verified	Risk Year	High	Moderate	Low	Risk Ranking[1]
10	49	30	2022	1	2	27	4
			2027	1	5	24	
			2032	2	6	22	
			2037	3	9	18	
11	78	28	2022	0	0	28	11
			2027	0	2	26	
			2032	0	2	26	
			2037	0	5	23	
12	80	42	2022	1	3	38	8
			2027	1	6	35	
			2032	2	5	35	
			2037	4	3	35	
13	23	13	2022	0	0	13	13
			2027	0	1	12	
			2032	0	1	12	
			2037	0	1	12	
14	272	136	2022	7	15	114	3
			2027	11	17	108	
			2032	14	23	99	
			2037	21	19	96	
15	179	29	2022	1	1	27	9
			2027	2	1	26	
			2032	2	1	26	
			2037	2	2	25	
16	87	57	2022	4	4	49	5
			2027	4	5	48	
			2032	7	4	46	
			2037	8	4	45	
17	49	21	2022	2	0	19	7
			2027	2	0	19	
			2032	2	1	18	
			2037	2	3	16	
18	157	128	2022	14	4	110	6
			2027	14	5	109	
			2032	18	3	107	
			2037	18	6	104	

Area	Number of Properties	Number of Wells Verified	Risk Year	High	Moderate	Low	Risk Ranking[1]
19	48	30	2022	2	1	27	8
			2027	2	1	27	
			2032	2	2	26	
			2037	3	2	25	

[1]Ranking based on weighted percent of high/moderate wells in each area in 2022 and 2037 (2022 weighted higher than 2037; weighted at 0.75 and 0.25 respectively). Ranking of 1 is the highest risk.

Based on the results of the risk analysis, it is recommended that the primary areas of concern be those with increasing numbers of moderate and high-risk wells. Ideally, service from Veolia occurs before most of the wells are at risk. The number of wells at risk in each area may be higher than reported as not all properties have identified wells onsite and there are many wells remaining the study area without verified locations. Due to the limitations in the accuracy of well locations and projected surfaces, a more accurate field survey would need to be completed in order to determine exactly how many wells in each area are at risk and what areas may need more emphasis.

Table 10 shows the breakdown of new Veolia lines and connections for each house in each area as well as estimates for the installation of new domestic wells at each property if not connected to Veolia lines The Veolia cost breakdown is based on an estimated cost of $300 per foot of new water line and $3,600 per service connection. The cost breakdown for new well installation is based on an estimated $100 per foot cost for a new well (assuming a depth of 200 feet), as well as an estimated cost for a new pump in each well at $5,000 each. These costs are based on recent public works projects in Idaho.

Table 10. Cost Breakdown for New Veolia Connections or New Domestic Wells

Area	Number of Properties	New Veolia Connections				New Domestic Well	
		Length of new line	Cost of new line	Cost of new connections	Total Cost Per Area	Cost for New Wells (no new pump)	Cost for New Wells (with new pump)
1	152	8,850.74	$2,655,000	$547,000	$3,202,000	$3,040,000	$3,800,000
2	224	19,830.78	$5,949,000	$806,000	$6,755,000	$4,480,000	$5,600,000
3	181	9,949.67	$2,985,000	$652,000	$3,637,000	$3,620,000	$4,525,000
4	65	3,231.14	$969,000	$234,000	$1,203,000	$1,300,000	$1,625,000
5	11	1,700.46	$510,000	$40,000	$550,000	$220,000	$275,000
6	116	10,568.89	$3,171,000	$418,000	$3,589,000	$2,320,000	$2,900,000
7	65	6,558.70	$1,968,000	$234,000	$2,202,000	$1,300,000	$1,625,000
8	175	14,817.71	$4,445,000	$630,000	$5,075,000	$3,500,000	$4,375,000
9	14	805.42	$242,000	$50,000	$292,000	$280,000	$350,000
10	49	4,046.18	$1,214,000	$176,000	$1,390,000	$980,000	$1,225,000
11	78	5,623.00	$1,687,000	$281,000	$1,968,000	$1,560,000	$1,950,000
12	80	6,694.97	$2,008,000	$288,000	$2,296,000	$1,600,000	$2,000,000
13	23	1,394.44	$418,000	$83,000	$501,000	$460,000	$575,000
14	272	26,879.12	$8,064,000	$979,000	$9,043,000	$5,440,000	$6,800,000
15	179	24,522.54	$7,357,000	$644,000	$8,001,000	$3,580,000	$4,475,000
16	87	6,593.18	$1,978,000	$313,000	$2,291,000	$1,740,000	$2,175,000
17	49	4,345.10	$1,304,000	$176,000	$1,480,000	$980,000	$1,225,000
18	157	9,805.91	$2,942,000	$565,000	$3,507,000	$3,140,000	$3,925,000
19	48	4,569.04	$1,371,000	$173,000	$1,544,000	$960,000	$1,200,000
Totals	**2025**	**170,787**	**$51,237,000**	**$7,289,000**	**$58,526,000**	**$40,500,000**	**$50,625,000**

7 Groundwater Management District Evaluation

Groundwater management districts (GWMDs) are “special districts to provide for financing of repair or abandonment of wells in aquifers which have experienced or are experiencing declines in water level or water pressures because of flow, leakage, and waste from improper construction, maintenance and operation of wells drilled into the aquifer” (IDWR 2023c). The districts are described under Idaho Code 42 Chapter 51 and can be formed by the IDWR Director following receipt of a petition signed by no less than 50 percent (measured by water right quantities) of the water users (water right holders) in the district.

GWMDs can be formed only within the boundaries of a CGWA or GWMA. Because the focus of this study is on cold-water aquifers utilized for domestic and municipal purposes, a new CGWA or GWMA must be declared prior to petitioning to form a groundwater management district. A CGWA is a “groundwater basin, or designated part thereof, not having sufficient groundwater to provide a reasonably safe supply for irrigation of cultivated lands, or other uses in the basin at the then-current rates of withdrawal, or rates of withdrawal projected by consideration of valid and outstanding applications and permits” (Idaho Code 42-233a) and a GWMA is “a groundwater basin or designated part thereof which the director of the department of water resources has determined may be approaching the conditions of a critical groundwater area” (Idaho Code 42-233b) (IDWR 2023b). The cold-water aquifer in the southwest Boise vicinity might be considered for designation as a GWMA if it can be shown that chronic water level declines indicate that the aquifer is approaching critical conditions.

The only active GWMD in Idaho is in Bruneau and was put into place on May 19, 2000 (IDWR 2000). This was put into place due to declining water levels and pressures in both the shallow lower-temperature aquifer and in the geothermal aquifer. Prior to its designation as a GWMD, the Grand View-Bruneau GWMA was designated in October 1989 due to increasing groundwater withdrawal and declines in spring flows from the geothermal aquifer (IDWR 1989). No other GWMDs have been designated in Idaho, although two GWMAs have been designated in the Treasure Valley, as described in Section 5.1.

The applicability of a GWMD and a GWMA can be determined based in part of the willingness of the water right holders to form such a district or area. Ada County can discuss with water right holders their willingness to try to form a GWMA and possible subsequent GWMD.

8 Recommended Next Steps

Future work that should be considered to verify and update accuracy of data in the study area includes:

- On-the-ground well surveys to verify the number, location, static water levels, and depth of wells within the study area, primarily focused on domestic wells. This would more accurately depict the current groundwater surface and the number of wells at risk.
- Groundwater sampling throughout the area to identify current groundwater quality.
- Discuss with water rights holders what their willingness is to form a Groundwater Management District (can be done during the public outreach stage).

- Consider or look into potential aquifer recharge options.

Finally, USGS released the Treasure Valley Groundwater Flow Model in January 2023 following 6 years of development. It has potential to be a valuable tool to test hypotheses regarding future water-level responses to activities (residential development, canal lining, municipal pumping, etc.) that are believed to influence groundwater levels. As it is currently composed, the model is in its early stages and is considered to be a large-scale regional model. Site specific data collection and integration would be required to adapt a smaller, study-area-specific model that pulls from the main model. Thus, HDR was unable to run specific model scenarios as part of the current project, but does propose potential scenarios that can be run if a more specific model is created for the study area using the Treasure Valley Groundwater Model.

- Model groundwater declines in the area and influences from recharge of the shallow aquifer from the New York Canal and irrigation by using the Treasure Valley Groundwater Flow Model.
- Run scenarios to model groundwater declines over time.
- Run scenarios to model changes to the New York Canal and influences on groundwater levels.
- Run scenarios to model groundwater impacts and changes due to increasing or changing pumping rates.

9 References

Bittmann. B., Kaiser, K.E., Poulos, M.J., and Flores, A.N. 2022. *Modeling the Impacts of Urbanization and Climate on Surface Water diversions in A Semi-Arid Basin to Support Water Management.* Masters Thesis, Boise State University. Bridget Bittmann - Graduate Student Success Center (boisestate.edu)

Berenbrock, C. 1999. *Streamflow Gains and Losses in the Lower Boise River Basin, Idaho, 1996-97.* Water Resources Investigations Report 99-4105, prepared in cooperation with the Idaho Department of Water Resources.

Carlson and Petrich. 1999. *New York Canal Geologic Cross-Section, Seepage Gain/Loss Data, and Ground Water Hydrographs: Compilation and Interim Findings.* Treasure Valley Hydrologic Project Open File Report. 6. p.

Hutchings and Petrich. 2002a. *Ground Water Recharge and Flow in the Regional Treasure Valley Aquifer System, Geochemistry and Isotope Study. Idaho Water Resources Research Institute Research Report IWRRI-2002-08.* December 2002.

Hutchings and Petrich. 2002b. *Influence of Canal Seepage on Aquifer Recharge Near the New York Canal. Idaho Water Resources Research Report IWRRI-2002-09*. December 2002.

Idaho Department of Water Resources (IDWR). 2023a. Wells: IDWR GIS data set. Wells | Idaho Department of Water Resources GIS Data Hub (arcgis.com)

IDWR. 2023b. Groundwater Management Areas. Groundwater Management Areas | Idaho Department of Water Resources (Serve Idaho)

IDWR. 2023c. Groundwater Management Districts. Groundwater Management Districts | Idaho Department of Water Resources (Serve Idaho)

IDWR. 2020. 2015 Irrigated Lands for the Treasure Valley. Last updated June 5, 2020. IDWR GIS Data Hub. Search for '*' | Idaho Department of Water Resources GIS Data Hub (arcgis.com)

IDWR. 2016. Preliminary Order Regarding West Ada Area of Drilling Concern. September 30, 2016. Preliminary Order Regarding the Proposed Creation of a West Ada Area of Drilling Concern | September 30, 2016 | idwr.idaho.gov

IDWR. 2001a. *Domestic, Commercial, Municipal, and Industrial Water Demand Assessment and Forecast in Ada and Canyon Counties, Idaho.*

IDWR. 2001b. Order Designating the West Boise ADC. May 21, 2001. Order Designating the West Boise Area of Drilling Concern | May 21, 2001 | idwr.idaho.gov

IDWR. 2000. Amended Preliminary Order Creating Bruneau GWMD. Active Groundwater Management Districts | Idaho Department of Water Resources (Serve Idaho)

IDWR. 1993. *Ground-Water Conditions in the Area Northeast of Kuna, West-Central Ada County, Idaho.* May 1993 (Steve Baker with IDWR)

Treasure Valley Advisory Committee (TVAC). 2012. *Proposed Treasure Valley Comprehensive Aquifer Management Plan.* April 2012.

U.S. Geological Survey (USGS). 2023. EarthExplorer. EarthExplorer (usgs.gov)

USGS. 2020. *Simulating the New York Canal*. PowerPoint Slide Deck. Stephen Hundt. September 3, 2020.

Womeldorph. L. A. 2019. *The Spatial Distribution of Elevated Uranium in the Treasure Valley Aquifer System, Southwest Idaho. Year 3, 2019.* Boise State University and IDWR, October 2019.

A

Ada County Provided Map

8-8-2022

Boise City · Dry Wells Reported · Wells (100' Deep or Less) · Specific Location · Approximate Location