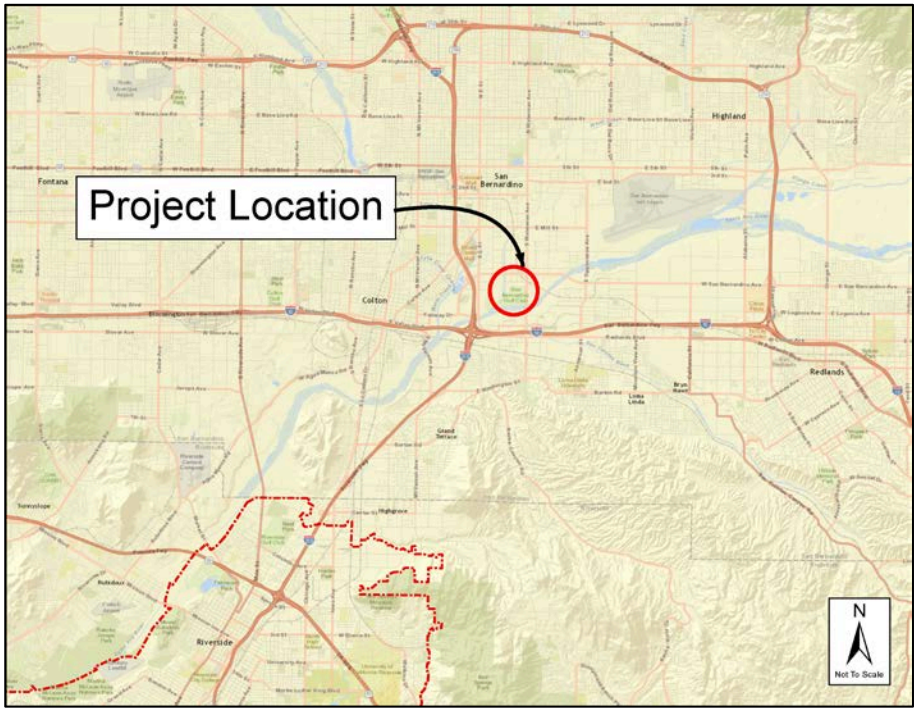
APPENDIX M

WRITTEN CORRESPONDENCE

Exhibit E

Warren 4R Well & Rice-Thorne Pipeline Replacement

(Final Planning and Water Resources Report)



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QUICK FACTS	
Ward:	N/A (Outside City Limits – City of San Bernardino)
Neighborhood:	N/A
Improvement Type:	Replacement of Warren 4 Well and Relocation of the Rice-Thorne Pipeline
Preliminary Cost Estimate:	Well & Waterline Replacement Cost: $3,600,000 Allocated Contingency: $500,000
Priority:	High
Work Order # :	WO# 1709464 (Warren 4R Well) WO# 1709465 (Rice-Thorne Pipeline)
Account # :	6230000-470803xx (Well Construction) 6230000-470735xx (Pipeline Relocation)
CEQA Action:	To be covered under the Developer's CEQA study

Background

The City of Riverside Public Utilities/Water Department (RPU) is proposing to abandon and replace the existing Warren 4 well and approximately 1,250 LF of the existing Rice-Thorne pipeline in the Warren Tract within the City of San Bernardino. A new well (Warren 4R) and re-aligned section of 24-inch Rice-Thorne pipeline will be constructed by the developer, Hillwood Enterprises, L.P. (Hillwood), to facilitate development of the site for a warehouse. The Warren 4 well is part of the Waterman System which produces potable water out of the Bunker Hill Basin. The existing 18-inch/30-inch diameter Rice-Thorne irrigation pipeline conveys non-potable groundwater from the Bunker Hill Basin to the Riverside Canal.

The existing Warren 4 well is located approximately 255 feet west of Waterman Avenue and was originally drilled by the City of Riverside in 1948. It was drilled to a depth of 1,102 feet below ground surface (bgs) and screened from 1,008 to 1,102 feet bgs. Warren 4 is a naturally developed 20-inch diameter well and discharges to the Waterman Transmission Main (TM). The well provides high water quality to the Waterman TM.

RPU is planning to locate the Warren 4R replacement well approximately 1,200 feet northwest of the existing well and approximately 840 feet southeast of the existing Thorne 12 well.

The existing Rice-Thorne pipeline conveys non-potable groundwater from the Bunker Hill Basin to the Riverside Canal via gravity flow. It is also used to convey blow-off water from Warren 1 well and serve as a drain for the Waterman TM when needed. The existing 18-inch/30-inch portion of the Rice-Thorne pipeline was installed in 1940. The ~1,250 LF portion to be relocated runs west by northwest across the property and is located within the proposed warehouse footprint and thus will need to be relocated. The replacement pipeline will consist of approximately 1,700 linear feet of 24-inch pipeline running along the southern and western property boundary and will lie outside of the footprint of the proposed warehouse.

The Warren and Thorne Tracts (site) are located in the City of San Bernardino, just north of Interstate 10 and west of Waterman Avenue. The Thorne Tract was originally acquired by the Riverside Water Company in 1887 and was used to supplement natural stream flow by developing artesian groundwater wells. The City of Riverside purchased the adjacent 52 acre Warren Tract from the Sylvia Warren estate in 1930. The site is currently leased to J.G. Golf Enterprise, who operates the San Bernardino Public Golf Course. Hillwood's proposed 1,064,880 square foot warehouse development will occupy most of the site and is scheduled for construction completion by the summer of 2018.

Project Location

The project is generally located within the City of San Bernardino northeast of the intersection of Interstate (I)-215 and I-10 Freeways, immediately north of the Santa Ana River. As shown in Figure 1, Warren 4R is proposed to be located approximately 1,200 feet northwest of the existing Warren 4 within the same City-owned property, approximately 2,000 feet southwest of the intersection of South Waterman Avenue and East Orange Show Road. The approximate GPS coordinates of the proposed Warren 4R well are: 34° 4'30.27" N longitude,117°16'59.41" W latitude (34.075075°,-117.283169°); Zone VI (Easting: 6248783.052, Northing: 2336377.030).

The proposed well site is within a paved entranceway to the San Bernardino Golf Course driving range parking lot. This site was appropriately located so as to not impact construction of the future warehouse and provides adequate separation from Thorne 12 to reduce the risk of groundwater pumping interference or influence.

Geologic Setting

The site is located upstream of the San Jacinto Fault. The San Jacinto Fault Zone is the most seismically active fault zone in Southern California and stretches from Imperial Valley to the Cajon Pass. The San Jacinto Fault zone does not have a continuous trace but rather consists of multiple sub-parallel fault strands. Numerous fault splays have been identified within the San Jacinto Fault Zone, some within the area of the Warren and Thorne Tract (Catchings et al, 2008 Open-File Report 2008-1197).

Geothermal temperatures commonly occur within certain areas of the Bunker Hill Basin with this site being one of the locations. The Paine Hot well, located east of the proposed replacement well and north of Warren 4 has continued to produce warm water since it was first drilled in the early 1900s. Historically, the Warren wells have also produced warm water - to the extent that a cooling tower was constructed and used for a time. Based on well log information and historical records, the geothermal groundwater seems to occur between 550 to 900 feet below ground surface. Currently, geothermal groundwater does not cause any problems at the existing Warren 1, Warren 4, or Thorne 12 wells.

Assets to Protect in Place

The existing Warren 1 is an active potable well located on San Bernardino County Flood Control (Flood Control) property, between the southern property boundary and the Santa Ana River. Warren 1 well discharges to the Waterman Transmission Main (TM) and blows-off to the Rice-Thorne pipeline. According to Water Operations staff, electricity to Warren 1 is provided by an electrical connection fed from the existing Warren 2 well. A new electrical service to Warren 1 must be established prior to abandonment of Warren 2. Warren 1 shall be protected in place and must remain active throughout the construction process.

Thorne 12 is an active potable well located within the northwest section of the property and provides high quality groundwater to the Waterman TM. Thorne 12 shall be protected in place and must remain active throughout the construction process. Thorne 12 currently discharges into the 24-inch Dumas Street pipeline via a 10-inch steel (STL) waterline. It is proposed to replace this 10-inch STL waterline with a new 24-inch waterline which will serve as a combined discharge pipeline for both the Thorne 12 and replacement Warren 4R wells. An existing blow-off pipeline runs south approximately 240 feet from Thorne 12 and heads west 190 feet along the property line and across the levee, discharging into the Flood Control Twin Creek Channel as shown in Figure 2.

Thorne 3 is an inactive irrigation well that is used for monitoring purposes. Thorne 3 is located along the Flood Control levee, outside of the southwest property corner. Thorne 3 shall be protected in place and continue to be used for monitoring purposes.

The existing 36-inch RCP segment of the Waterman Transmission Main was installed in 1946 and is a major water supply line to the City of Riverside. This transmission main must be kept in operation throughout the developer's construction. This waterline runs along S. Waterman Avenue and partially onto RPU property at the existing San Bernardino Golf Course. The developer will be responsible to protect this pipeline in place during construction work and minimize earthmoving equipment loading above the pipe. If the developer will be over-excavating above the pipeline, RPU will need to be notified and confirmatory pot-holing shall be performed by the developer to verify pipeline depth. RPU inspectors shall be on site for any potholing and excavation activities occurring over the pipeline.

Hydraulic Analysis

The estimated production of Warren 4R is 2,500 gallons per minute (GPM), which requires either a 14-inch or 16-inch discharge pipeline (see Table 1 below). Installation of a 16-inch diameter pipeline is proposed as this is a commonly available standard pipe size.

Table 1 - Velocity Analysis at 2,500 GPM

Pipe Diameter (in)	Velocity (ft/sec)
10	10.2
12	7.1
14	5.2
16	4.0
18	3.2

There is an existing 24-inch waterline along Dumas Street with a capacity of 8,460 GPM at a maximum velocity 6 feet per second (FPS). It is proposed to discharge both the existing Thorne 12 well and proposed Warren 4R well at a combined flow rate of 5,000 GPM into the Dumas Street waterline which connects to the Waterman TM.

Table 2 - Velocity Analysis at 5,000 GPM

Pipe Diameter (in)	Velocity (ft/sec)
16	8.0
18	6.3
20	5.1
24	3.5
30	2.3

The Dumas Street 24-inch waterline conveys groundwater pumped from Thorne 12 and Meeks & Daley 59 wells to the Waterman TM. (Meeks & Daley 59 well is a backup supply that would only pump into RPU's system in an emergency situation). Warren 4R will have an 8-inch well blow-off pipeline that will connect to the existing Thorne 12 blow-off pipeline as shown in Figure 2.

Rice-Thorne Pipeline Replacement

The existing 18-inch portion of the Rice-Thorne pipeline runs west by northwest across the property and is located in the proposed building footprint; and thus will need to be relocated. The replacement pipeline will consist of approximately 1,700 linear feet of 24-inch pipeline running along the southern and western property boundary. The pipeline will need to be designed to maintain a sufficient slope to facilitate a minimum flow of 3,000 gpm under gravity flow. Water Planning estimates a constant minimum slope of 0.07% to provide the minimum required flow rate within a 24-inch pipeline. The estimated cost for the relocation of this segment of pipe is $600,000.

Replacement Well Characteristics

Given the high construction cost and lifespan of groundwater wells, construction material has become an important factor in the construction and development of wells. High strength low alloy (HSLA) and 316L Stainless Steel (316L SS) are the preferred steel materials for well construction due to their high resistance to corrosion and bacterial growth compared to mild steel or copper-bearing steel. HSLA steel typically requires a rehabilitation interval of 5-7 years whereas stainless steel typically has a rehabilitation interval of 7-10 years[1]. Even though 316L SS has a greater initial construction cost, the overall life-cycle cost of a 316L SS well compared to an HSLA well tends to be lower over the course of 75-years due to the 316L SS well requiring less rehabilitation. For these reasons, it's recommended that the Warren 4R well be constructed of 316SS from the upper screened interval to the bottom of the well; to help reduce construction costs, it is recommended that HSLA steel be utilized for the section of well above the upper screened interval.

[1] Well Rehabilitation and Replacement Priority Ranking, Geoscience 2015

The static water level for Warren 4R is estimated to be about 130' and the pumping water level is estimated to be about 200'. The existing Warren 4 well's pumping water level is 230' however this pumping level was not used because it is representative of a deep screen interval and a less efficient well.

The Warren 4R well is anticipated to have relatively good water quality, and to be similar to Thorne 12. Thorne 12 well has always remained just north of the Crafton-Redlands Plume, and has generally been impacted by low concentrations of TCE from the Norton Plume (0.55 – 2.4ppb over last 10 years). Anticipated water quality for Warren 4R is as follows: DBCP <0.01ppb, arsenic 5ppb, hexavalent chromium 1.6ppb, nitrate (N) 3ppm, perchlorate 0.7ppb, TDS 420ppm, TCE 0.7ppb, gross alpha particle activity 9 pCi/L, and uranium 9 pCi/L.

Water Facility Abandonments

The Thorne 5, Thorne 6, Thorne 7, Thorne 8, Thorne 9, Thorne 10, Thorne 11, Warren 2, Warren 3, and Warren 4 wells located on the property will require proper well abandonment. Warren 4 is an active production well that provides high quality groundwater to the Waterman TM, and abandonment of this well must be coordinated with the construction of the proposed replacement Warren 4R well. Thorne 10 and Thorne 11 wells are actively used by the current tenant to irrigate the golf course; abandonment of these two wells will need to be coordinated with the current tenants. Appendix A presents a list of facilities and the necessary actions needed.

A 16-inch pipeline connecting Warren 4 and Warren 3 to the Waterman Pipeline will need to be properly abandoned, in addition to the existing 18- & 30-inch segment of the Rice-Thorne pipeline to be relocated. If the portion of Rice-Thorne pipeline to be abandoned is not removed during grading activities, it should be backfilled with appropriate material to prevent future pipeline collapse. Careful coordination with RPU will need to occur during the pipeline abandonment work to ensure that water is not introduced into the Rice-Thorne pipeline and the Warren 1 well remains active during abandonment work.

All abandonment and demolition work of the aforementioned water wells shall be performed as per State of California regulations and any applicable local regulations. The Developer will need to provide RPU with copies of the well destruction reports upon completion of the well abandonment work.

Well Design Criteria & Proposed Improvements with Basis of Design

The proposed location and preliminary design criteria for Warren 4R is based on the recommendations outlined by Water Resources staff.

Well Depth	Perforation Interval	Static Water Level	Pumping Water Level	Production Target
1,200' bgs	300' – 1,100' bgs, within water bearing zones	130' bgs	200' bgs	2,500 gpm

Based on well log information, it's estimated that the Warren 4R well should be drilled to a depth of 1,200' bgs and completed to a depth of about 1,130' bgs. The screen intervals and well completion depth will be dependent on observations and data collected during the drilling and geophysical process. Based on well completion records, the screen intervals are estimated to occur from about 300-400' bgs, 550-640' bgs, 740-810' bgs, 840-890' bgs, and 1010-1100' bgs. However, a few of these zone estimates may end up producing hot groundwater or may include clay layers, and will need to be adjusted based on collected data.

Final design shall be determined after completion of the pilot borehole, logging of the drill cuttings, review of the geophysical logs/lithologic samples, and isolated aquifer zone testing. Isolated aquifer zone testing subsequent to completion of the pilot boring will be completed to identify specific screening concentrations with depth prior to completing the final well design. Additional design/construction considerations outlined within the North Orange Well Field Evaluation Report (Appendix B)[2] and included by Water Planning and Resources staff that shall be completed are as follows:

1. The Consultant Design Team shall work closely with RPU Water Operations and Engineering staff for review and comment of preliminary design plans at the 30%, 60%, and 90% design levels. It is recommended that prior to design work, the Consultant Design Team provide a technical memorandum outlining the well design and equipment details, and proposed pipeline alignments for RPU review.
2. Installation of ~1,700 LF of 24-inch ML&C waterline to replace the ~1,250 LF of 18-inch RCP Rice-Thorne line to be abandoned. The waterline shall be installed with an adequate slope to facilitate a minimum of 3,000 GPM gravity flow rate and shall connect into the 18-in RCP and 30-in RCP portions of the Rice-Thorne line as presented in Figure 1.
3. The proposed 24-inch waterline shall be designed and constructed for eventual use as a pressurized pipeline, but will be utilized as a gravity flow drain line in the

[2] Appendix B obtained from North Orange Well Field Evaluation, Well Siting, and Non-Potable Water Supply Assessment, GEOSCIENCE, Finalized as of February 11, 2015.

immediate future. The existing 18-inch RCP waterline was originally constructed with a 3,000 GPM design capacity under gravity flow.

4. Installation of a manway and manhole junction structure at the East-West to South-North direction change of the proposed 24-inch waterline as seen in Figure 1.
5. Installation of a 24-inch butterfly valve on the immediate eastern side of the manway and installation of 24-inch butterfly valves at the eastern and western end connections to the existing 18- & 30-inch RCP portions, respectively.
6. Abandonment of existing 18-inch Rice-Thorne line shall be coordinated with Water Operations to ensure water is not introduced during abandonment work.
7. Installation of air/vacuum valves as necessary along new 24-inch waterline to maintain gravity flow and prevent vacuum conditions.
8. Installation of all Warren 4R well related facilities shall meet State of California and County of San Bernardino Department of Public Health requirements on utility separations.
9. Drill well to a depth of 1,200 ft bgs using reverse circulation rotary drilling, two-pass methodology (i.e., 17.5-in. pilot borehole and 32-in. reamed borehole).
10. Construct well with a 20-inch inside diameter (ID) HSLA steel blank casing above the upper screen interval and 316L SS blank casing and louvered well screen for the rest of the well. Allow for accommodation of pressure transducer, sounding tube, gravel tube, and camera tube. Aforementioned appurtenances shall be made of 316L SS.
11. Installation of a dielectric coupling between the HSLA steel blank casing and 316L SS casing.
12. Due to the long-term cost effectiveness of higher grade steel walls, it is recommended that the louvered section of the well be constructed of stainless steel material. It is further recommended that the higher grade, 316L, stainless steel be utilized, as it offers greater resistance to pitting from shock chlorination, longer well life, and reduced rehab and maintenance burden.
13. Installation of a gravel envelope to stabilize formation materials.
14. Installation of 14’ x 24’ (W x L) prefabricated Roll-Apart Well House.
15. Installation of new switchgear and transformer for electrical service from Southern California Edison (SCE) to Warren 4R. All related electrical wiring shall be made of copper.
16. Installation of a manual transfer switch for use with a portable backup generator.
17. Installation of intrusion alarm, electronic security system, and 8’ high security fence around the well building and above ground piping.

18. Provide all necessary SCADA programming and initial SCADA set up. Warren 4R shall be programmed to not blow-off while Thorne 12 blow-off is occurring and vice versa.
19. Conduct zone testing prior to the final reaming pass to collect depth-discrete water samples to help determine perforation intervals in final well design.
20. Provide inspection (by a consultant and RPU staff) on critical phases of well drilling and development, including formation logging, geophysical log observation, and casing installation. In order to ensure that the samples are representative of the formation, samples must be taken from an approved sample collection device and not from the shaker/sand separator assembly.
21. Grade project site to allow for proper drainage away from proposed Warren 4R.
22. Replace existing Thorne 12 well 10-inch STL discharge waterline with ~225 LF of 24-inch ML&C waterline (see Figure 2). The replacement 24-inch waterline shall be used as the common discharge for both Thorne 12 and proposed Warren 4R wells.
23. Installation of approximately 1,200 LF of 16-inch waterline from proposed Warren 4R well to connect to the proposed 24-inch waterline (see Figure 2).
24. Installation of a 16-inch butterfly valve immediately before connection of the 16-inch waterline to the 24-inch waterline, to allow isolation of Warren 4R well discharge waterline from Thorne 12.
25. Installation of approximately 950 LF of 8-inch blow-off piping from proposed Warren 4R to the existing 8-inch STL Thorne 12 well blow-off piping (see Figure 2).
26. Installation of a valve on the new 8-inch Warren 4R blow-off and a new valve on the existing Thorne 12 blow-off pipeline near the point of interconnection. Blow-off water from Warren 4R shall never be allowed to enter the blow-off pipeline of Thorne 12 and vice versa.
27. Installation of one (1) well pump with a 250-HP motor and variable frequency drive (VFD), at a design TDH of 310 feet. Discharge pressure at the interconnection point of the new 24-inch common well discharge line and the existing 24-inch ML&C pipelines is estimated to be 43 psi or 1100 feet HGL at a ground elevation of 1000 feet. Warren 4R pumping suction head is estimated to be approximately 800 ft HGL or 200 ft bgs, as predicted from historical water level data. Anticipated production rate is 2,500 GPM with a column and waterline friction loss of approximately 8 feet.
28. Provide a minimum of 2,500 GPM water production from the new Warren 4R well.
29. Abandonment and demolition existing water facilities as discussed under the Water Facility Abandonment section and as presented in Appendix A. All wells and underground piping not indicated to be protected in place

Warren 4R Site Assessment

A site visit was conducted on September 2, 2016. Photographs of the well site and the surrounding project area are shown in Appendix C. The following is a brief overview of the site assessment:

- The proposed well site is within an asphalt paved entranceway to the San Bernardino Golf Course driving range.
- There are electrical poles and overhead wiring near the well site, but they should not directly impact well construction.
- Construction of well and waterlines may require demolition of existing driving range netting and asphalt pavement.
- There is a large concrete water utility vault north of existing Thorne 12 well that should be avoided during design and construction of replacement 24-inch ML&C waterline to Dumas Street.

Cost Estimate

Presented in Table 3 is the anticipated total cost for the drilling, equipping, piping of Warren 4R and replacement of the portion of Rice-Thorne line. Total Warren 4 well and Rice-Thorne line replacement cost is estimated at $3,600,000. A contingency of $500,000 is allocated for any miscellaneous project expenses. The total project cost is not anticipated to exceed $4,100,000. Based on feedback from the Design Team, analyses of past bids, and recent well driller quotes, this is appropriate for a planning-level cost estimate.

Table 3 – Cost Estimate for Warren 4R & Rice-Thorne Line Replacement

	Item	Qty	Unit	Unit Cost	Cost
1	Drilling of Warren 4R Well	1	LS	$1,400,000	$1,400,000
2	Equipping Warren 4R (pre-fab building, electrical, SCADA, piping, pump unit, etc.)	1	LS	$750,000	$750,000
3	Furnish & Install 24-inch Pipe ($12/in/lf)	225	LF	$288	$64,800
4	Furnish & Install 16-inch Pipe ($13/in/lf)	1,200	LF	$208	$249,600
5	Furnish & Install 8-inch Pipe ($15/in/lf)	950	LF	$120	$114,000
6	Furnish & Install Rice-Thorne Line 24-inch	1,700	LF	$288	$489,600
				Construction Subtotal (rounded):	$3,100,000
7	Engineering[1]				$500,000
				Anticipated Total Project Cost:	$3,600,000
8	Contingency[2]				$500,000
				Total Project Cost Not to Exceed:	$4,100,000

Notes:

1. *Includes Design, Construction Management, Inspection, & Hydrogeologist services*
2. *Contingency includes funds for miscellaneous project expenses.*

Note: The standard unit cost for pipe installation including appurtenances, backfill, and paving is $25/diameter-inch/linear foot; however, due to the economy of scale in larger diameter pipe construction and construction within a vacant unpaved lot, a revised unit cost of $12 to $15/diameter-inch/linear foot was used.

Apart from the well drilling and development work, it is not anticipated that any other night-time construction will be required for this project.

Site Access

Existing Warren 1 and Thorne 3 wells are located on Flood Control easements and can be accessed through Flood Control access points. However, Warren 1 access through the Flood Control entry point is rather cumbersome, as it is located beneath the Waterman Avenue Bridge which limits vehicular access, especially for large vehicles such as maintenance trucks and drill rigs. Access through the San Bernardino Golf Course site to Warren 1 will be necessary and needed from the developer. Routine maintenance access to both Warren 1 and Thorne 3 shall also be made available during construction and occupancy in case of complications with Flood Control.

Access to Thorne 12 is located off of Dumas Street and will need to be maintained during construction and occupancy. The proposed Warren 4R well will also require access off of Dumas Street. Occasional site access may be necessary along the Rice-Thorne pipeline easement for pipeline maintenance work. Continuous access and

parking within leased properties for RPU employees to all aforementioned facilities throughout construction and occupancy will be necessary.

Paving and Right of Way Requirements

Warren 4R and associated waterlines will be installed within both paved and unpaved portions of City-owned property or public street right-of-way.

Environmental Impacts

It is recommended that the Developer include this scope of work (on-site utilities relocations, well relocation/abandonments) as part of their CEQA study for their proposed warehouse development. A copy of the filed Notice of Determination will need to be provided to RPU by the Developer.

Community Impacts and Public Outreach

This project will benefit the Riverside community and RPU's water customers by improving water supply reliability.

Impact on Other Projects

It is not anticipated that this project will impact any other RPU or City of Riverside Public Works projects. However, scheduling of water supply line shutdowns will need to be coordinated with Water Operations.

Project Funding

For this project, an agreement will be prepared between RPU and the real estate developer. The developer will fund and complete the design and construction of the proposed utility relocations/abandonments.

Gate 1 Meeting

A Gate 1 Meeting between RPU Water Engineering and Operations staff was held on October 12, 2016. Comments received were reviewed by Water Planning and incorporated in the planning report where appropriate.

Tentative Project Schedule

The preliminary project schedule has been set to allow for project construction to begin in Fiscal Year 2017. Design is anticipated to take approximately 25 weeks and construction is anticipated to take approximately 40 weeks. The project schedule is shown in the attached Appendix E.

FIGURE 1: PROJECT AREA OVERVIEW EXHIBIT

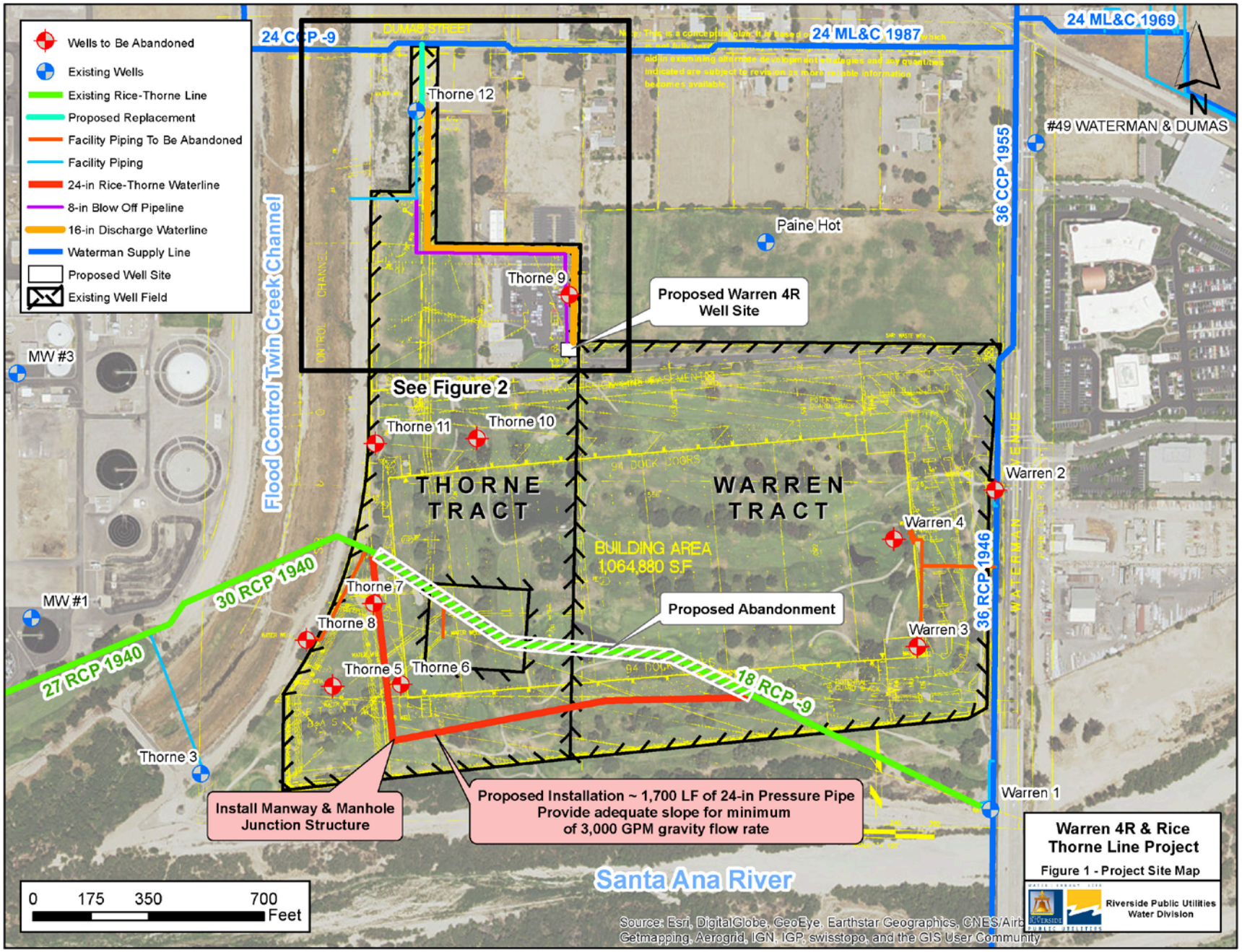
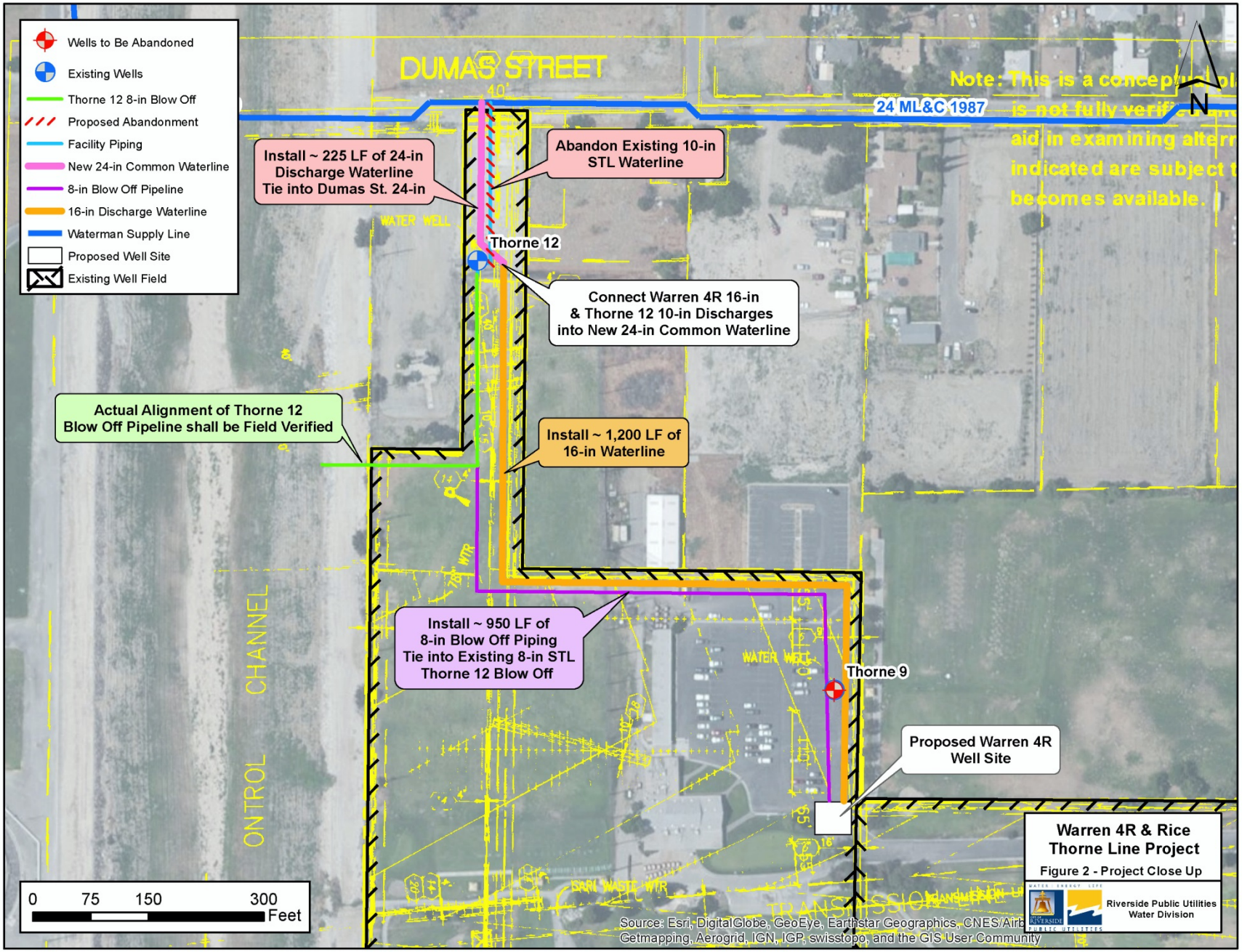


FIGURE 2: PROJECT SITE EXHIBIT



APPENDICES

APPENDIX A – RPU WATER FACILITY ACTION LIST

Facility	Use	Status	Impact	Action
Warren 1	Potable	Active	Indirect impact	Protect in place
Warren 2	Potable	Inactive	Direct impact	To be destroyed
Warren 3	Potable	Inactive	Direct impact	To be destroyed
Warren 4	Potable	Active	Direct impact	To be replaced
Thorn 12	Potable	Active	Direct impact	Protect in place
Thorn 3	Non-potable	Inactive	Indirect impact	Protect in place
Thorn 5	Non-potable	Inactive	Direct impact	To be destroyed
Thorn 6	Non-potable	Inactive	Direct impact	To be destroyed
Thorn 7	Non-potable	Inactive	Direct impact	To be destroyed
Thorn 8	Non-potable	Inactive	Indirect impact	To be destroyed
Thorn 9	Monitoring	Active	Direct impact	To be destroyed
Thorn 10	Non-potable	Active	Direct impact	To be destroyed
Thorn 11	Non-potable	Active	Direct impact	To be destroyed
Thorn 12 pipeline	Supply main	Active	No Impact	Protect in place
Warren 3 & 4 pipeline	Supply main	Active	Direct Impact	To be abandoned
Rice-Thorn Pipeline	Non-potable TM	Active	Direct Impact	To be relocated
Waterman Pipeline	Potable Supply TM	Active	No Impact	Protect in place

2.0 CONCEPTUAL WELL DESIGN

Based on an initial review of the local geohydrology and existing wells constructed in the North Orange area, a conceptual well design was prepared for the proposed potable and non-potable production wells (i.e., Wells A, B, NP1, and NP2). It is anticipated that the new wells will be constructed of 20-inch inside diameter (ID) stainless steel blank casing and louvered well screen with a wall thicknesses of 5/16-inch and an anticipated well screen consisting of 3/32-inch (0.094-inch) horizontal slots. It should be recognized that the recommended diameter and wall thickness of the well casing and screen is for preliminary design purposes only and would be modified based upon review of actual borehole lithologic samples, geophysical logs, and isolated aquifer zone testing results. The conceptual well design is shown on Figure 3 and summarized as follows.

North Orange Well
Conceptual Design of Casing and Screen

Interval [ft bgs]	Borehole Diameter [in.]	Casing Diameter [in.]	Wall Thickness [in.]	Screen Slot Size [in.]	Material Type
+0.5 – 50	48	36 OD	3/8	-	Conductor Casing (ASTM A139 Grade B Steel)
+1 – 120	Annulus	-	-	-	Sanitary Seal (10.3 Sack Sand-Cement Slurry)
+1 – 130	Annulus	3	Sch. 40	-	2 x Gravel Feed Pipes (Stainless Steel)
120 – 123	30	-	-	-	Fine Sand Layer
123 – 490	30	-	-	-	¼ in. x 16 Custom Blend Filter Pack Material
+1 – 198	30	2	Sch. 40	-	Sounding Tube (Stainless Steel)
+1 – 200	30	20 ID	5/16	-	Blank Casing (Stainless Steel)
200 – 450	30	20 ID	5/16	0.094 (3/32 in.)	Ful-Flo Louvered Screen (Stainless Steel)
450 – 470	30	20 ID	5/16	-	Blank Casing w/ Endplate (Stainless Steel)
470 - 490	30	-	-	-	Filter Pack Beneath Casing

The proposed wells would be drilled using reverse circulation rotary drilling, two-pass methodology (i.e., 17.5-in. pilot borehole and 30-in. reamed borehole), and installation of a gravel envelope to stabilize formation materials.

2.1 Well Construction Materials

The serviceable life expectancy of a well is greatly affected by the material from which it is constructed. Generally speaking, a well constructed of mild steel will have a 30 year service life and will require rehabilitation at least once every 3 years. Use of copper-bearing and high-strength low-alloy (HSLA) steel materials for well construction will result in service lives of 30 to 60 years and will require rehabilitation every 5 to 7 years. Wells constructed of 304L stainless steel will have service life expectancies of approximately 75 years or more and will require rehabilitation every 10 years. Wells constructed of 316L stainless steel will have service life expectancies of 90 years or more with a rehabilitation interval of greater than 10 years. For example, a copper-bearing steel well may require as many as eight rehabilitation events over its 45-year life while a stainless steel well may require as few as four over the same 45 year period. Over a 90-year evaluation period, one 316L stainless steel well would require approximately 8 rehabilitation events. Over that same 90-year evaluation period, a copper-bearing steel well would have to be replaced once and would require approximately 17 rehabilitation events. Consequently, wells constructed from more corrosion resistant materials exhibit greater reliability and experience longer periods of uninterrupted service.

Initial construction costs are lower for lower grade steel materials, however, over time, costs shift in favor of the more corrosion resistant materials (i.e., stainless steel). This is due to the additional costs required for more frequent well replacements and rehabilitation events for wells constructed of less corrosion resistant materials. Due to a history of declining yield in the area due to clogging of well screens, and the long-term cost effectiveness of higher grade steel wells, it is recommended that wells in this area be constructed of stainless steel materials. It is further recommended that higher grade 316L stainless steel be utilized as it offers greater resistance to pitting from shock chlorination, and offers greater well life.

2.2 Engineer's Estimates of Construction

Engineer's estimates of contractor costs for drilling, construction, development, and testing of a well as designed herein is provided in Table 1 and summarized below. Cost estimates for both 304L and 316L stainless steel well materials are included. These estimated costs are based on recent winning bids for similar construction projects in the Southern California area. It should be noted that these engineer's estimates may require revision should significant time (i.e., approximately 6 to 12 months) pass between the date of this report and initiation of the bidding process.

APPENDIX C - SITE PHOTOS

Photo 1 – Looking southeast at proposed Warren 4R well site towards Waterman Avenue.

Photo 2 – Looking northeast at existing Thorne 9 well towards Dumas Street.

Photo 3 – Looking west along property line towards Flood Control Twin Creek channel.

Photo 4 – Looking northwest at Thorne 12 well blow-off piping towards Flood Control Twin Creek channel and W Orange Show Road.

Photo 5 – Looking south at existing Thorne 12 well site towards Santa Ana River.

Photo 6 – Looking west along Dumas Street towards Flood Control Twin Creek channel.

APPENDIX D - GATE 1 SIGN-IN SHEET

Gate Sign-Off Sheet

Gate 1 Meeting: Planning - Warren 4R & Rice-Thorne Line **10/12/2016**

Team Function	Name	Signature	Comments	Date
Design Prinicipal Engineer	Oscar Khoury			10/12/16
Planning Senior Engineer	Blake Yamamoto			10-12-16
Design Prinicipal Engineer	John Farley			
Contract Admin. Principal Engineer	Eric Escobar			
Water Resources Engineering Manager	Arshad Syed			
Water Resources Interim Principal Engineer	Michael Plinski			
Water Superintendent Field Maintenance	Rick Small			
Water Quality Manager	David Garcia			
Chief Water Operator	Cliff Bellinghausen			
Water Resources Analyst	Greg Herzog			
Water Superintendent Field Construction	Andy Lindsay			
Real-Estate Assets	Irene Martinez	N/A	Project to occur within City-owned property	

APPENDIX E - PROJECT SCHEDULE

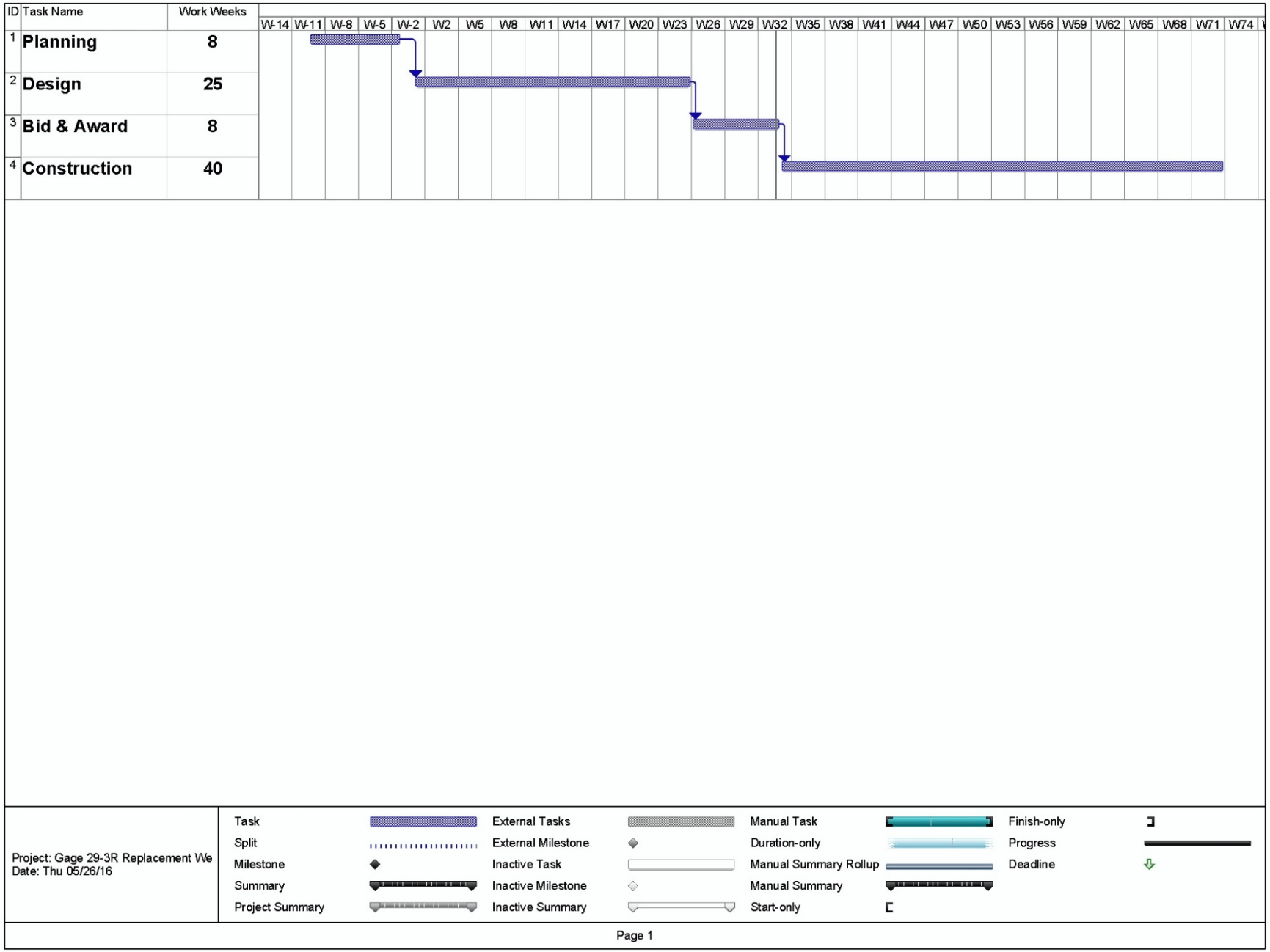


Exhibit D

WELL AREA

LEGAL DESCRIPTION

THAT PORTION OF PARCEL 2, AS DESCRIBED BELOW, IN THE CITY OF SAN BERNARDINO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, LYING NORTHERLY OF THE SOUTHERLY LINE OF THE LAND DESCRIBED IN THE EASEMENT DEEDS GRANTED TO CALIFORNIA ELECTRIC POWER COMPANY, RECORDED FEBRUARY 13, 1957 AS INSTRUMENT NO. 1019, IN BOOK 4155, PAGE 501, AND MAY 10, 1957 AS INSTRUMENT NO. 334, IN BOOK 4226, PAGE 588, BOTH OF OFFICIAL RECORDS OF SAID COUNTY.

EXCEPTING THEREFROM THAT PORTION WITHIN SAID PARCEL 2 DESCRIBED AS FOLLOWS:

BEGINNING AT THE NORTHWEST CORNER OF SAID PARCEL 2; THENCE NORTH 89° 28' 27" EAST , 239.00' ALONG THE NORTH LINE OF SAID PARCEL 2; THENCE AT A RIGHT ANGLE TO SAID NORTH LINE SOUTH 00° 31' 33" EAST, 83.50 FEET TO THE NORTHERLY LINE OF SAID DEEDS TO CALIFORNIA ELECTRIC POWER COMPANY; THENCE SOUTH 84° 21' 25" WEST, 239.75 FEET ALONG SAID SOUTH LINE TO THE WESTERLY LINE OF SAID PARCEL 2; THENCE NORTH 00° 38' 13" WEST, 104.89 FEET ALONG SAID WESTERLY LINE TO POINT OF BEGINNING.

PARCEL 2:

ALL OF LOT 12, BLOCK 54, OF THE FORTY ACRE SURVEY OF THE RANCHO SAN BERNARDINO, AS PER PLAT RECORDED IN BOOK 7 OF MAPS, PAGE 2, OFFICIAL RECORDS OF SAID COUNTY; AND ALSO THAT PORTION OF LOT 25, IN SAID BLOCK 54, OF SAID FORTY ACRE SURVEY OF THE SAID RANCHO SAN BERNARDINO, DESCRIBED AS FOLLOWS:

BEGINNING AT THE SOUTHEAST CORNER OF SAID LOT 25; THENCE NORTH ALONG THE EAST LINE OF SAID LOT 25, 26 RODS, MORE OR LESS, TO THE SOUTHEAST CORNER OF THE LAND DEEDED TO ERASZMUS C. BIGGS BY DEED DATED JUNE 21, 1865, AND RECORDED IN BOOK "F" OF DEEDS, PAGE 612, RECORDS OF SAID COUNTY; THENCE WEST ALONG THE SOUTH LINE OF THE LAND SO DEEDED, 80 RODS, MORE OR LESS, TO THE WEST LINE OF SAID LOT 25; THENCE SOUTH ALONG THE WEST LINE OF SAID LOT 25, 26 RODS, MORE OR LESS, TO THE SOUTHWEST CORNER OF SAID LOT 25, THENCE EAST ALONG THE SOUTH LINE OF SAID LOT 25, 80 RODS, MORE OR LESS TO THE POINT OF BEGINNING.

EXCEPTING THEREFROM THAT PORTION WITHIN THE SOUTH ONE-HALF OF SAID LOT 12.

ALSO EXCEPTING THEREFROM THE FOLLOWING DESCRIBED PARCELS:

PARCEL AA:

BEGINNING ON THE WESTERLY LINE OF WATERMAN AVENUE, 82.5 FEET WIDE, DISTANT ALONG SAID WESTERLY LINE AND ITS SOUTHERLY PROLONGATION, NORTH 2,954 FEET FROM ITS INTERSECTION WITH THE CENTER LINE OF COLTON AVENUE, 82.5 FEET WIDE; THENCE WEST AT RIGHT ANGLES TO SAID WESTERLY LINE OF WATERMAN AVENUE, A DISTANCE OF 570 FEET; THENCE IN A NORTHWESTERLY DIRECTION TO A POINT ON THE WESTERLY LINE OF SAID LOT 12; DISTANT ALONG SAID WESTERLY LINE, NORTH 500 FEET FROM THE SOUTHWEST CORNER OF SAID LOT 12; THENCE ALONG SAID WESTERLY LINE OF LOT 12, SOUTH 500 FEET TO SAID SOUTHWEST CORNER; THENCE ALONG THE SOUTHERLY LINE OF SAID LOT 12 EAST TO THE SOUTHEAST CORNER OF SAID LOT 12, SAID SOUTHEAST CORNER BEING ON THE WESTERLY LINE OF SAID WATERMAN AVENUE;

Exhibit D

WELL AREA

THENCE ALONG THE EASTERLY LINE OF SAID LOT 12; SAID EASTERLY LINE BEING ALSO SAID WESTERLY LINE OF WATERMAN AVENUE, NORTH TO THE POINT OF BEGINNING.

PARCEL BB:

BEGINNING AT A POINT IN THE CENTERLINE OF WATERMAN AVENUE, AN 82.5 FOOT STREET, DISTANT THEREON 646.58 FEET NORTHERLY OF THE INTERSECTION OF SAID CENTERLINE WITH THE EASTERLY PROLONGATION OF THE SOUTH LINE OF SAID LOT 12; THENCE SOUTH 84° 04' 36" WEST, 1326.92 FEET TO A POINT IN THE NORTH LINE OF THAT PROPERTY CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED OCTOBER 17, 1956, IN BOOK 4065, PAGE 513,OFFICIAL RECORDS OF SAN BERNARDINO COUNTY, SAID POINT BEING NORTH 84° 04' 36" EAST, 4.90 FEET FROM A POINT IN THE WEST LINE OF SAID LOT 12 WHICH IS 498.04 FEET NORTHERLY FROM THE SOUTHWEST CORNER OF SAID LOT 12; THENCE SOUTHEASTERLY AND EASTERLY ALONG THE SAID NORTH LINE OF THE STATE OF CALIFORNIA PROPERTY AND ITS EASTERLY PROLONGATION TO THE INTERSECTION THEREOF WITH THE CENTER LINE OF SAID WATERMAN AVENUE; THENCE NORTHERLY ALONG SAID CENTER LINE OF WATERMAN AVENUE, 352.16 FEET TO THE POINT OF BEGINNING.

PARCEL CC:

BEGINNING AT A POINT ON THE CENTERLINE OF WATERMAN AVENUE, DISTANT THEREON 646.58 FEET NORTH FROM THE INTERSECTION OF THE EASTERLY PROLONGATION OF THE SOUTH LINE OF SAID LOT 12 WITH THE SAID CENTERLINE OF WATERMAN AVENUE; THENCE SOUTH 83° 01" WEST, 150.65 FEET; THENCE NORTH 59° 13' 48" EAST, 61.72 FEET; THENCE NORTH 0° 50' 42" EAST, 636.60 FEET; THENCE NORTH 89° 33' 06" EAST, 13 FEET; THENCE NORTH 0° 26' 54" WEST, 38.18 FEET; THENCE SOUTH 89° 33' 06" WEST, 13 FEET; THENCE NORTH 3° 33' or EAST, 430.05 FEET, MORE OR LESS TO A POINT ON THE SOUTH PROPERTY LINE OF PARCEL OF LAND CONVEYED TO JOSEPH G. LAZAR, ET AL, BY DEED RECORDED SEPTEMBER 08, 1959 IN BOOK 4923, PAGE 75, OFFICIAL RECORDS OF SAN BERNARDINO COUNTY; THENCE EAST ALONG SAID PROPERTY LINE TO A POINT ON THE CENTER LINE OF SAID WATERMAN AVENUE; THENCE SOUTH 0° 26' 54" EAST, ALONG SAID CENTERLINE OF WATERMAN AVENUE TO THE POINT OF BEGINNING.

CONTAINING: *22,504 SQUARE FEET OR 0.517 ACRES MORE OR LESS.*

EXHIBIT "B" *ATTACHED HERETO AND BY THIS REFERENCE MADE A PART HEREOF.*

SUBJECT TO: *COVENANTS, CONDITIONS, RESTRICTIONS, RESERVATIONS, EASEMENTS AND RIGHTS-OF-WAY, IF ANY.*

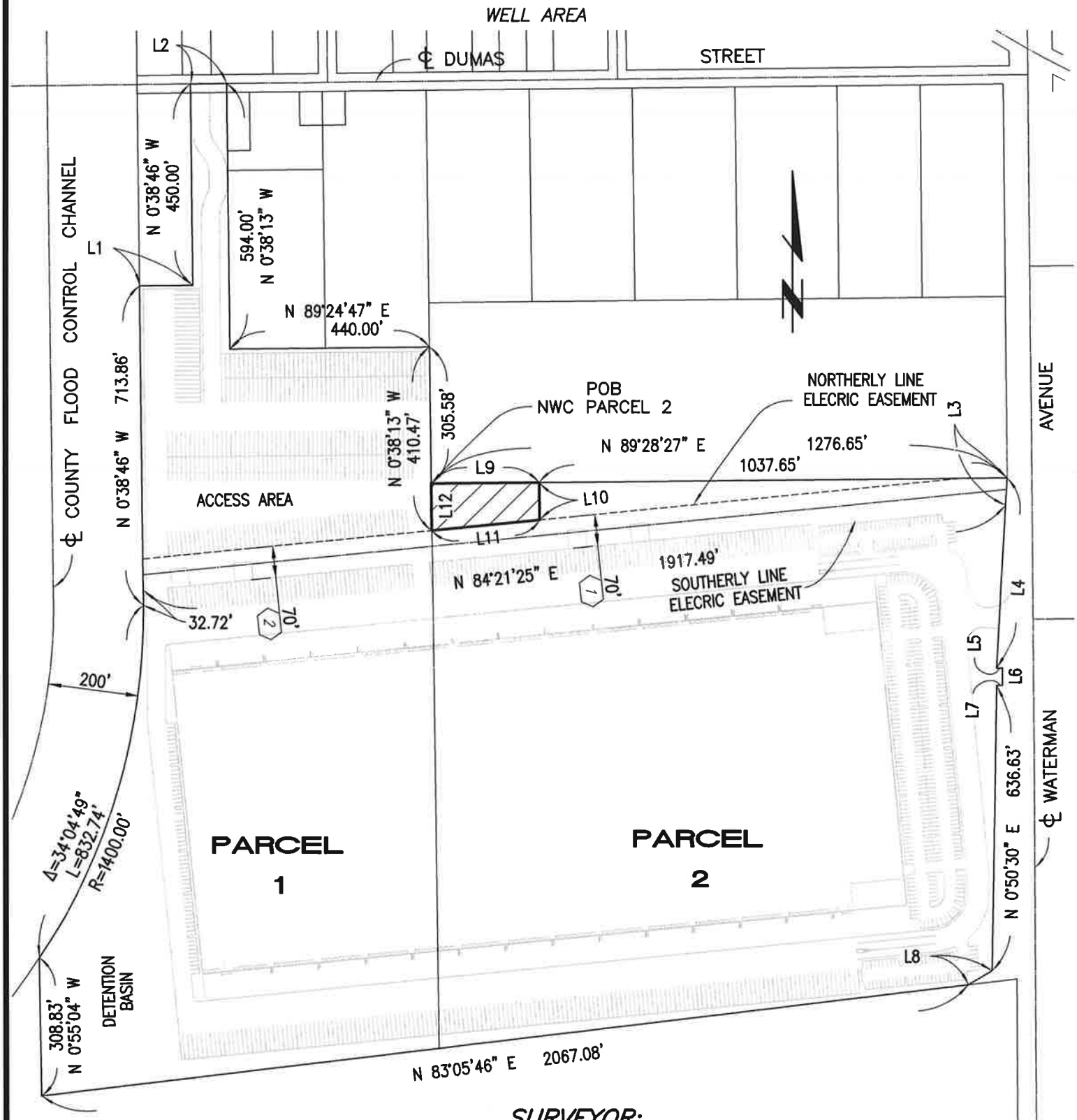
PREPARED UNDER THE DIRECTION OF:

_____ _____

BRIAN L. THIENES *DATE*
P.L.S. No. 5750
REG. EXP. 12/31/17

SCALE: 1" = 300'

Exhibit D



SEE SHEET 2 FOR
LINE TEBLE, EASEMENT NOTES, AND LEGEND

SURVEYOR:

PREPARED UNDER THE DIRECTION OF:

BRIAN L. THIENES
P.L.S. NO. 5750
REG. EXP. DEC. 31, 2017

DATE

PROFESSIONAL LAND SURVEYOR
BRIAN L. THIENES
NO. 5750
STATE OF CALIFORNIA

PREPARED BY:

Thienes Engineering, Inc.
CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH.(714)521-4811 FAX(714)521-4173

Exhibit D

WELL AREA

LINE TABLE		
LINE #	LENGTH	BEARING
L1	117.74'	N 25°23'40" E
L2	80.07'	N 89°24'47" E
L3	61.35'	N 03°11'49" E
L4	424.40'	N 03°11'49" E
L5	13.00'	N 89°32'54" E
L6	38.18'	N 00°27'06" W
L7	13.00'	N 89°32'54" E
L8	61.72'	N 59°18'06" E
L9	239.00'	N 89°28'27" E
L10	83.50'	N 00°31'33" W
L11	239.75'	N 84°21'25" E
L12	104.89'	N 00°38'13" W

(1) *GRANT OF EASEMENT RECORDED FEBRUARY 13, 1957 AS INSTR. NO. 1019 IN BOOK 4155, PAGE 501, O.R.*

(2) *GRANT OF EASEMENT RECORDED MAY 10, 1957 AS INSTR. NO. 334 IN BOOK 4226, PAGE 588, O.R.*

LEGEND:

INDICATES WELL AREA
CONTAINS: 22,504 SQ. FT.
0.517 AC. ±

Last Update: 10/25/16
O:\3400-3499\3412\ESMTS\3412 WELL AREA.dwg

Connie Anderson

Subject: FW: Hillwood

From: Plinski, Michael [mailto:MPlinski@riversideca.gov]
Sent: Friday, May 12, 2017 7:51 AM
To: Julianne Frabizio <Julianne@thieneseng.com>
Subject: Hillwood

Good Morning Julianne,

Per your request:

The San Bernardino Golf Course site which Hillwood plans to develop currently has a series of Riverside Public Utilities' potable, non-potable, and monitoring wells. Hillwood's project will require the abandonment on many of those wells. Hillwood has agreed to construct a replacement potable well, at a new location on-site, as part of the mitigation for their impacts. This project would not have a significant impact on recharge to the Bunker Hill Basin nor on Riverside's ability to extract their existing water rights.

Best Regards,

Michael L. Plinski, P.E.
Principal Engineer
Riverside Public Utilities – Water Resources & Planning
3750 University Ave.
Mission Square Bldg, 3rd Floor
Riverside, CA 92501
Office - 951.826.5766
mplinski@riversideca.gov