Replacement for Production Well W243 in Laws Wellfield

Pre-Construction Evaluation Report

1. Purpose

Well W243 is located on the east side of the Laws Wellfield and is used for Los Angeles Aqueduct supply and to supply water to irrigated fields located east and west of the McNally Canals. This well is currently out of service because it has lost much of its pumping capacity over the past many years. The City of Los Angeles Department of Water and Power (LADWP) plans to replace Well W243. The purpose of this report is to satisfy the requirement of Section IV.B of the Green Book (Technical Appendix to the Inyo/Los Angeles Agreement) Guidelines for Drilling and Activating New Production Wells.

2. Background

2.1 Introduction

LADWP owns and operates over 100 production wells in Owens Valley. As wells age, some begin to fail. These failures occur for a variety of reasons including; casing misalignment, damage, and sanding. LADWP replaces failed wells to maintain operational flexibility and to meet water demands that were historically supplied by the wells. Replacement wells are drilled using the current industry standards and with the goal of maximizing efficiency and minimizing possible impact to nearby resources.

The City of Los Angeles and Inyo County entered into an agreement for the long-term management of groundwater in the Owens Valley in 1991 (Water Agreement). Section VI of the Agreement describes the process that allows LADWP to replace existing wells and construct new wells in areas where hydrologic conditions are favorable. Since the implementation of the Agreement, LADWP has replaced a number of wells that had failed for a variety of reasons throughout the Owens Valley.

LADWP is planning to replace well W243 because the pumping capacity is not adequate to meet the obligations required of the well. The replacement for well W243 will be installed approximately 100 feet north of the current location.

2.2 Location

Figure 1 shows a map of the Laws Wellfield in the vicinity of well W243. The Laws Wellfield is the northern most LADWP wellfield in the Owens Valley and is located northeast of Bishop and the Owens River. The main landmarks near the Laws Wellfield include Highway 6, from Bishop to Chalfant Valley, the Owens River, and the McNally Canals.

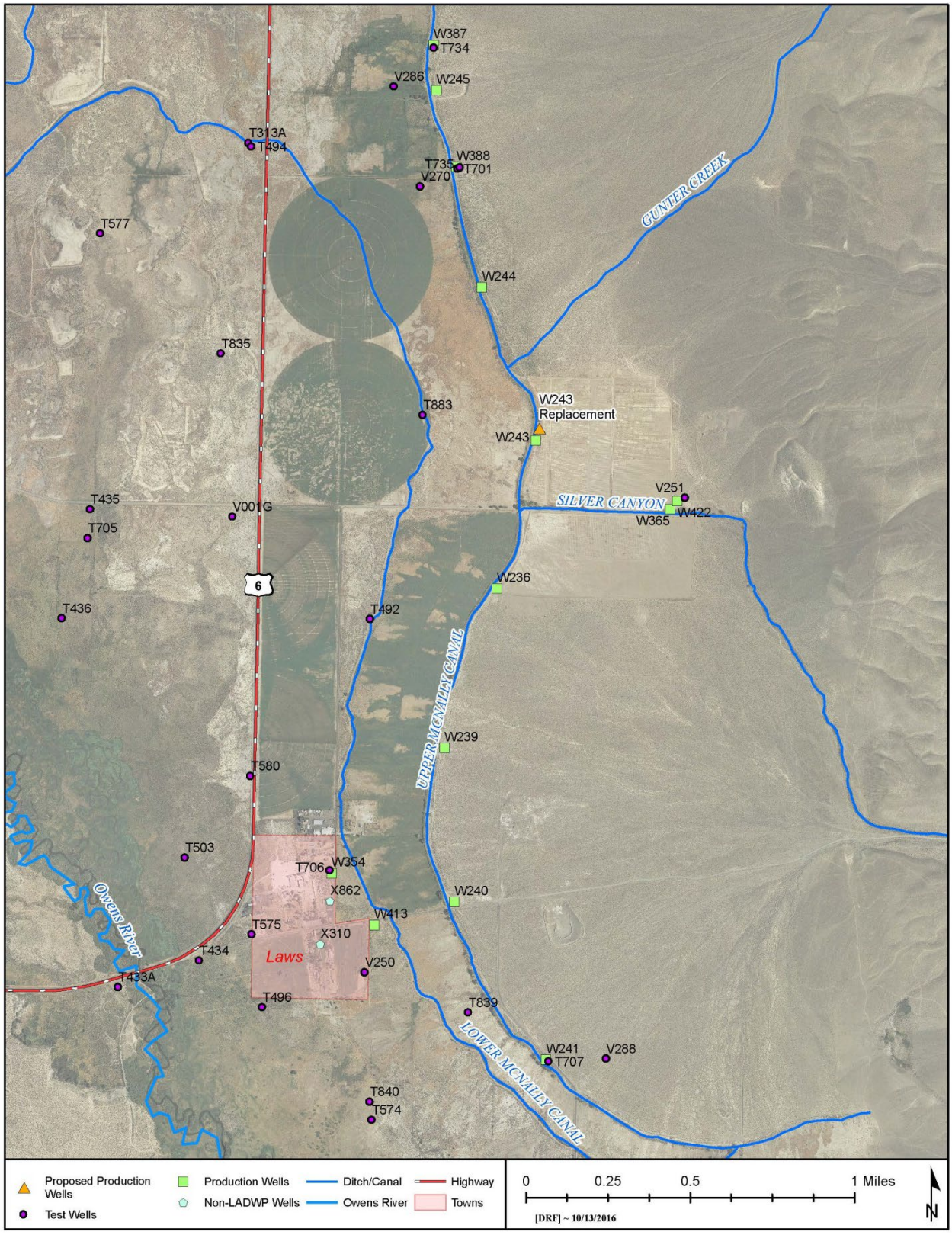

Figure 1 – Select Wells in the Laws Wellfield in the Vicinity of Well W243

3. Geo-Hydrologic Condition

3.1 Geology

The conceptual geological framework of the Owens Valley was presented in a U.S. Geological Survey (USGS) report in 1991 (Hollett, et. al., 1991). The Owens valley was formed by a graben that was filled by debris eroded from the White/Inyo Mountains to the east and the Sierra Nevada Mountains to the west. The Laws Wellfield is located at the base of the White Mountains, at the southern edge of the Volcanic Tablelands, and the confluence of the Owens and Chalfant valleys. The sediments underlying the Laws Wellfield are the combination of alluvial deposits originating from the White Mountains, periodic volcanic eruptions that resulted in Bishop Tuff formations north of the wellfield, and fluvial/lacustrine deposits stemming from the ancestral Owens River and associated lake environment in the Bishop Basin.

3.2 Hydrology

3.2.1 Groundwater

Groundwater in the Laws Wellfield flows generally southward, from both the Chalfant Valley and Volcanic Tableland to the north and Round Valley in the west. Percolation from the Owens River, and the McNally canals (when operated), along with mountain front recharge from the White Mountains are among inflows to the groundwater aquifer in Laws Wellfield.

The Laws Wellfield has historically been one of LADWP's larger wellfields. There are 23 production wells located in the Laws Wellfield. The majority of the wells are located along the Upper and Lower McNally Canals. Figure 1 shows the location of production wells in the vicinity of W243. Table 1 lists annual pumping since the 1972 runoff year from these wells. As illustrated, pumping of well W243 has diminished over time.

There are over 50 shallow and deep monitoring wells in the Laws Wellfield (Figure 1). Table 2 lists total depth and recent average depth to water in each well. As shown in Table 2, the average water level decreases from north to south and toward the Owens River, indicating a draining of groundwater in the shallow aquifer to Owens River.

3.2.2 Surface Water

The main water features in the Laws Wellfield are the Upper and Lower McNally Canals, the Owens River, and two creeks. The Upper and Lowers McNally Canals divert water from the Owens River and runs through the wellfield and recharges the aquifer. The Owens River runs from the northwest and forms the western boundary of the wellfield. Silver Canyon and Coldwater Creek are two small creeks that run off White Mountain and supply water to the wellfield. Figure 2 shows the location of various surface water flow gauges and measuring stations in the vicinity of W243. Table 3 lists flow measurements of the measuring stations.

Table 1 – Annual Groundwater Pumping from Selected Wells near Well W243 Replacement in Laws Wellfield (AF/year)

Ruoff Yr.	W365	W236	W239	W240	W241	W243	W244	W245	W354	W387	W388	W413	W422	Laws
1972-73		2,802	2,325	2,277	1,668	1,810	2,111	2,156						15,149
1973-74		1,762	1,487	626	483	989	1,349	1,532	93					8,321
1974-75		680	379	80	413	548	499	636	101					3,336
1975-76		1,322	1,060	1,217	1,365	1,337	415	1,946	50					8,712
1976-77		2,688	2,439	2,262	1,550	1,521	1,868	2,297	37					14,662
1977-78	1,311	2,312	2,008	1,582	1,204	1,946	2,001	1,804	20					14,188
1978-79	907	0	0	0	0	0	0	0	38					945
1979-80	1,726	1,796	1,639	1,488	1,186	1,649	1,482	1,374	35					12,375
1980-81	1,218	0	0	0	0	0	0	0	23					1,241
1981-82	1,775	2,015	1,888	1,807	1,448	2,020	1,878	1,723	30					14,584
1982-83	946	0	0	27	21	54	54	84	32					1,218
1983-84	1,085	0	1	0	1	0	0	0	24					1,111
1984-85	1,265	969	836	713	569	662	984	847	26					6,871
1985-86	1,030	2,134	2,052	1,745	1,036	1,957	1,847	1,693	30					13,524
1986-87	1,343	712	618	532	404	592	407	431	27					5,066
1987-88	1,360	2,506	2,218	1,940	1,307	2,009	552	1,256	24					13,172
1988-89	1,245	2,542	2,377	1,969	1,054	2,044	937	1,172	17	2,675	2,105			18,137
1989-90	1,172	1,969	2,255	1,710	762	1,814	1,995	915	15	3,686	3,945			20,238
1990-91	581	726	751	1,032	546	567	634	687	11	3,416	3,696			12,647
1991-92	739	1	0	882	500	0	0	602	35	3,304	2,341			8,404
1992-93	502	31	0	886	435	18	0	433	22	2,946	1,146			6,419
1993-94	2	1	1	705	646	0	0	312	27	1,212	0			2,906
1994-95	1	1	2	1,487	725	1	1	818	27	2,886	2,070			8,019
1995-96	87	244	171	0	0	152	11	74	27	1,654	2,181			4,601
1996-97	0	0	0	0	0	0	0	0	34	2,970	3,240			6,244
1997-98	0	0	0	0	0	0	0	0	45	581	682			1,308
1998-99	0	0	0	0	0	0	0	0	34	0	23			57
1999-00	0	0	0	0	0	0	0	133	33	506	521			1,193
2000-01	597	0	0	0	0	0	0	487	37	1,263	1,273			3,657
2001-02	236	0	0	0	2	0	0	290	38	814	480			1,860
2002-03	1,624	0	0	0	0	0	0	413	40	1,114	785			3,976
2003-04	836	1,626	959	0	0	0	869	120	32	473	1			4,916
2004-05	512	1,293	732	0	0	0	1,019	389	33	1,339	1,604			6,921
2005-06	449	1,021	50	0	0	0	135	81	21	1,013	670			3,440
2006-07	466	1,293	0	0	0	0	0	130	41	743	422			3,095
2007-08	543	1,107	0	0	0	0	0	622	65	1,432	1,323	193		5,285
2008-09	732	962	0	0	0	0	7	668	19	2,398	1,635	110		6,531
2009-10	609	1,066	0	0	0	0	432	442	21	1,534	381	136		4,621
2010-11	673	993	197	0	0	0	579	687	19	1,681	797	152		5,778
2011-12	350	2,175	1,321	503	0	0	1,526	562	18	1,460	1,408	105		9,428
2012-13	199	1,371	917	51	57	0	418	521	17	1,404	1,398	138		6,491
2013-14	496	1,315	547	0	0	0	551	508	16	988	1,539	138		6,098
2014-15	287	1,158	493	0	0	0	579	255	17	1,412	1,523	127	432	6,282
2015-16	0	1,024	747	0	0	0	369	330	20	1,055	1,249	123	800	5,717
5-Year Average	**266**	**1,409**	**805**	**111**	**11**	**0**	**689**	**435**	**18**	**1,264**	**1,423**	**126**	**616**	**6,803**

Table 2 – Monitoring Well Measurements in the Vicinity of W243 Replacement Well

Well #	RP Elevation	Average DTW *	Water Table Elevation *
	(ft)	(ft)	(ft)
T313 A	4136.38	23.00	4113.38
T433 A	4083.98	6.01	4077.97
T434	4090.56	9.48	4081.08
T435	4113.91	16.26	4097.65
T436	4107.49	12.84	4094.65
T492	4130.06	35.81	4094.25
T494	4135.55	19.46**	4116.09
T496	4091.83	13.74	4078.09
T503	4099.6	13.74	4085.86
T574	4087.02	16.70	4070.32
T575	4100.62	17.49	4083.13
T577	4130.23	24.37**	4105.86
T580	4113.99	20.74**	4093.25
T701	4150.83	31.49**	4119.34
T705	4113.93	15.52	4098.41
T706	4122.51	33.99	4088.52
T707	4147.39	53.08**	4094.31
T734	4153.22	97.82	4055.40
T735	4151.6	83.63	4067.97
T835	4127.77	27.85	4099.92
T839	4135.92	44.60	4091.32
T840	4090.73	19.29	4071.44
T883	4134.25	29.98	4104.27
V001 G	4123.09	26.28	4096.81
V250	4118.58	35.83	4082.75
V251	4174.6	81.34	4093.26
V270	4141.58	36.64	4104.94
V271	4128.19	28.22	4099.97
V286	4142.2	23.80	4118.40
V288	4168.55	78.18	4090.37

** Average April measurement for 2012-2016 runoff year*
*** Well is Dry*

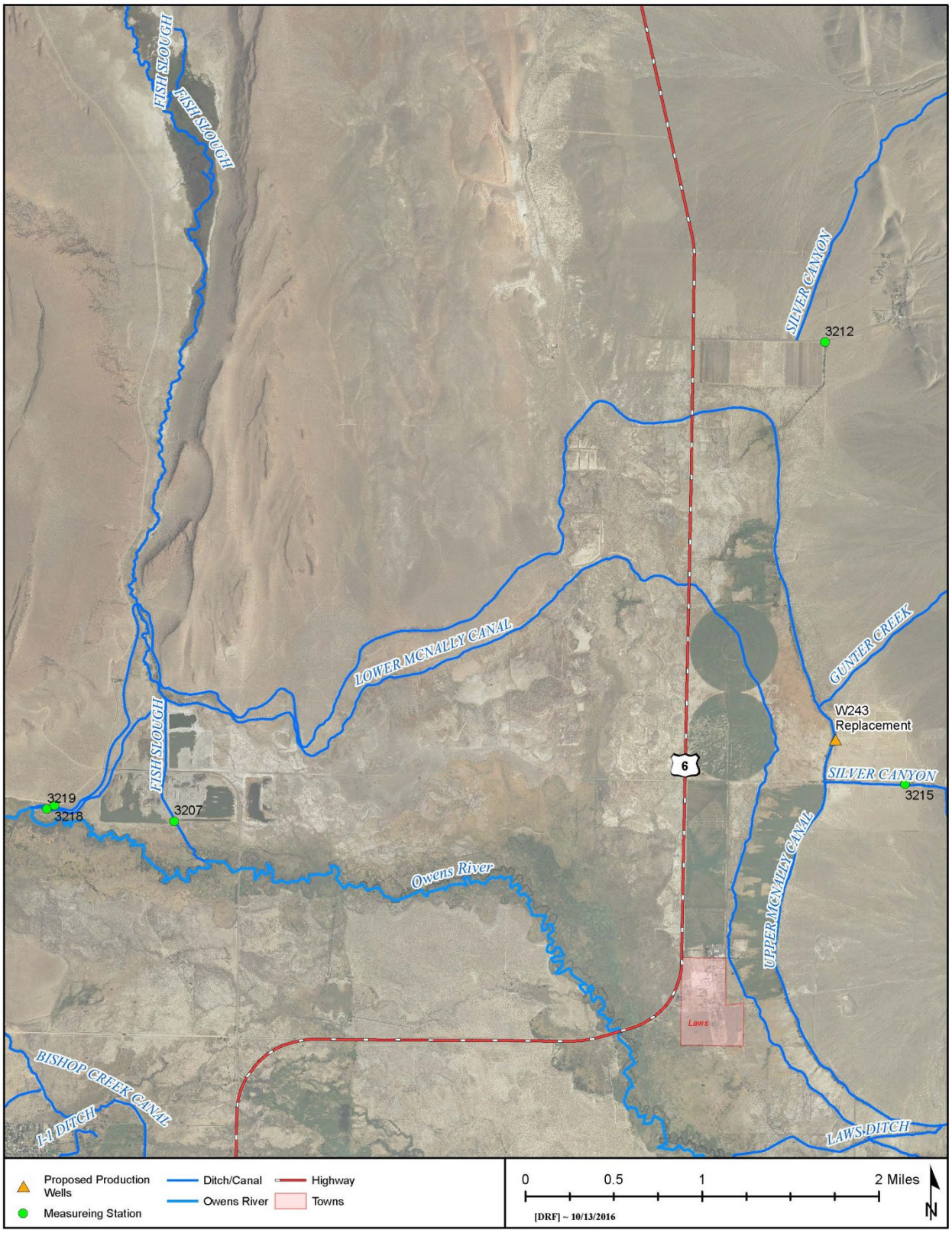

Figure 2 – Selected Flow Measuring Gauges in the Laws Wellfield in the Vicinity of Well W243

Table 3 – Surface Water Flow Gauges in the Vicinity of Well W243 Replacement in AF/YR

Ronuff Year	Silver Canyon	Coldwater Canyon	Upper McNally Canal	Lower McNally Canal	Fish Slough
Station ID	3215	3212	3218	3219	3207
1972-73		827	0	0	6,670
1973-74		1,018	4,990	244	6,032
1974-75		893	9,652	4,971	5,284
1975-76		720	5,743	1,499	5,809
1976-77		600	0	0	5,669
1977-78		606	679	0	5,638
1978-79		1,051	13,135	5,232	4,075
1979-80		835	6,505	356	5,196
1980-81		925	16,122	13,010	2,612
1981-82		884	3,273	17	3,310
1982-83		871	23,179	18,391	2,050
1983-84		1,353	21,317	11,175	2,391
1984-85		1,204	5,513	1,076	4,629
1985-86		1,003	1,870	2,247	4,857
1986-87		1,088	16,420	11,784	3,231
1987-88		977	0	0	7,585
1988-89		905	0	3,743	9,544
1989-90		819	0	173	4,934
1990-91		595	0	0	4,892
1991-92	586	602	0	0	4,263
1992-93	532	584	0	0	4,660
1993-94	395	559	14,999	3,083	5,371
1994-95	281	468	18	8	4,380
1995-96	347	652	10,667	12,130	3,679
1996-97	373	699	0	0	4,143
1997-98	414	495	3,614	1,278	3,937
1998-99	858	673	15,413	13,997	2,249
1999-00	781	259	0	0	3,684
2000-01	635	739	0	2,439	3,766
2001-02	528	636	0	351	3,809
2002-03	372	628	0	0	3,828
2003-04	275	522	0	0	3,418
2004-05	270	342	304	258	3,502
2005-06	390	260	16,879	8,959	2,274
2006-07	288	342	11,353	9,125	3,642
2007-08	254	120	0	0	3,348
2008-09	257	97	0	0	3,073
2009-10	296	131	0	0	3,144
2010-11	327	173	399	2,952	3,832
2011-12	537	295	3,310	1,955	3,031
2012-13	473	352	0	0	2,770
2013-14	374	212	0	0	2,905
2014-15	329	338	0	0	2,633
2015-16	246	305	0	0	2,885

The weather station at Bishop Airport is the closest station to the Bishop Wellfield with a long-term average precipitation (from 1960 to 2010 runoff year) of 6.4 inches per year.

4. Environmental Resources

4.1 Vegetation in the vicinity of the Replacement Well

Figure 3 shows the vegetation parcels in the area near W243 that were inventoried for baseline conditions in 1987. These parcels were classified according to the Agreement based on water use with designations of Type A to Type E (Table 4).

Table 4 – Information on Vegetation Parcels Located in the Vicinity of W243

Parcel Number	Vegetation Type	Community
LAW050	E	Irrigated Agriculture
LAW051	E	Irrigated Agriculture
LAW082	C	Rabbitbrush Meadow
LAW083	C	Alkali Meadow
LAW085	C	Alkali Meadow
LAW086	C	Alkali Meadow
LAW087	A	Desert Sink
LAW088	E	Irrigated Agriculture
LAW089	A	Abandoned Agriculture
LAW090	A	Abandoned Agriculture
LAW094	A	Abandoned Agriculture
LAW095	A	Abandoned Agriculture
LAW096	E	Irrigated Agriculture
LAW097	A	Desert Greasewood Scrub
LAW098	C	Alkali Meadow
LAW099	E	Irrigated Agriculture
LAW100	E	Irrigated Agriculture

4.2 Springs, Seeps, Flowing Wells

The closest spring to Well W243 is located approximately 2 miles southeast of well site. This spring appears to be the result of mountain front runoff from White Mountains being intersected by the White Mountain fault zone and moving up to the surface. Vegetation at this spring is classified as Riparian Shrubs and Trees. These features are denoted as vegetation parcel LAW132 (Figure 3). .

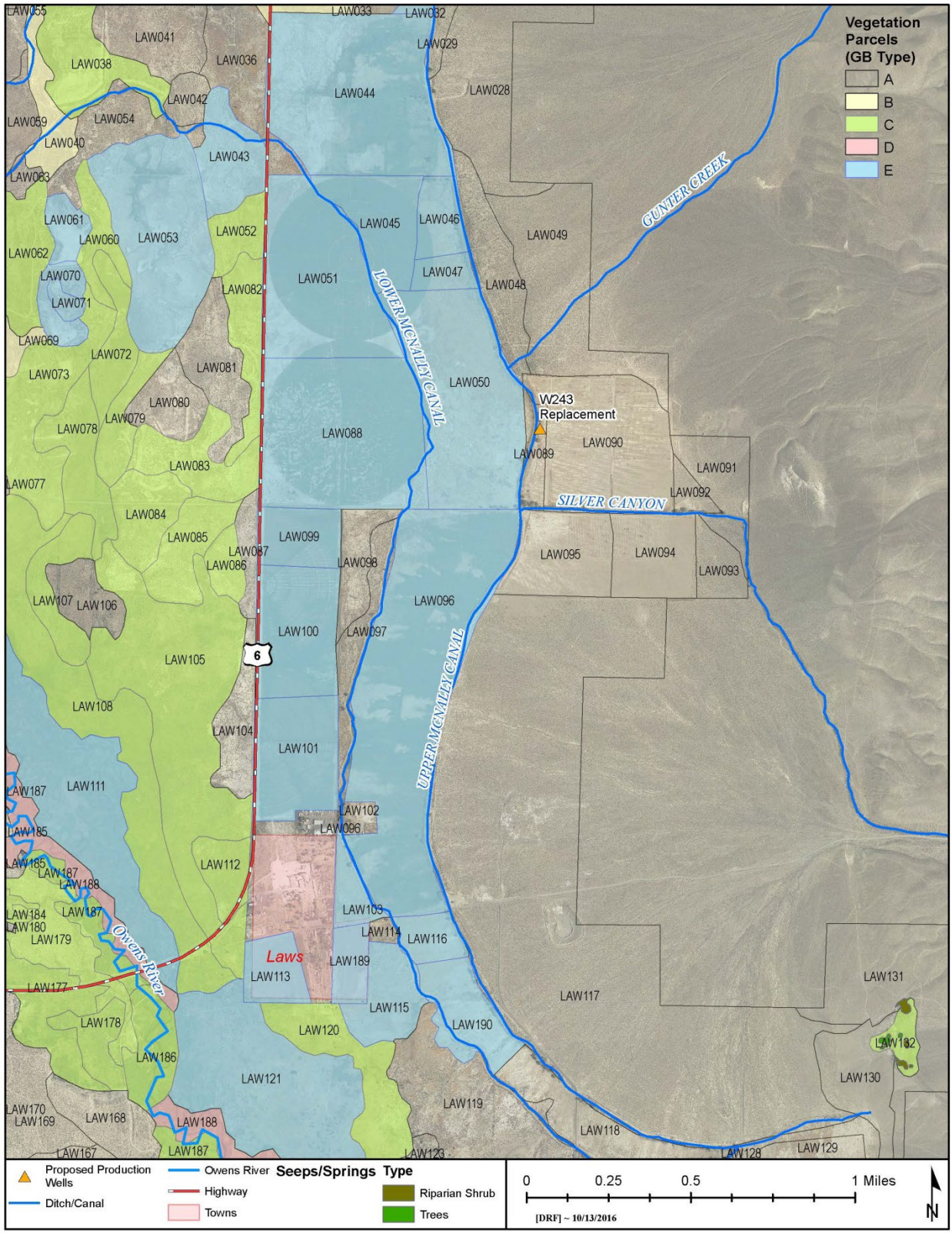

Figure 3 – Vegetation Parcels in the Vicinity of Well W243

4.3 Private Wells

Private (or Non-LADWP) wells are typically of small diameter and shallow depth and used for domestic purposes. These wells typically draw water from shallow aquifers and are susceptible to changes in the depth to water in the shallow aquifer. There are two private wells in the vicinity of W243; both are located within the town limits of Laws (Figure 1)

5. Potential Impacts on Environmental Resources

5.1 Area of Influence (AOI) Analysis

A groundwater model, developed for the Bishop-Laws wellfields by MWH Americas, Inc.in 2005, was utilized to estimate the AOI of the replacement well for W243. This model covers both Laws and Bishop Wellfields because the Owens River does not act as a real boundary between the aquifers under these wellfields. This MODFLOW based groundwater model includes three layers simulating the shallow, intermediate, and deep aquifers as Layer 1, Layer 2 and Layer 3 respectively. The uniform cell size in this model is 500 feet by 500 feet.

While the actual pumping capacity will not be known until a well is drilled, data collected from a 24-hr pumping test is analyzed, the pumping rate modeled for developing the AOI was based on the 1991 EIR analyzed rate of 2.3 cfs (1,665 acre-feet per year) . As this well is expected to be screened in the deeper section of the aquifer, the pumping is assigned to Layer 3 of the model. A one-year pumping scenario was simulated during normal year runoff conditions similar to 1985-86 runoff year. Figure 4 shows the resulting drawdown in the shallow aquifer due to the simulation of pumping.

Once the proposed replacement well is drilled and the pumping test data is analyzed, the calculated aquifer characteristics from the test will be used to update and re-calibrate the model in the area near the site. This updated model should produce a more realistic result of pumping effects on shallow aquifer water levels. The updated model will then be used to simulate pumping for the replacement well to develop an updated AOI for the proposed well.

Figure 4 shows modeled drawdown contour map resulting from the one-year pumping scenario at Well W243 at a rate of 2.3 cfs.

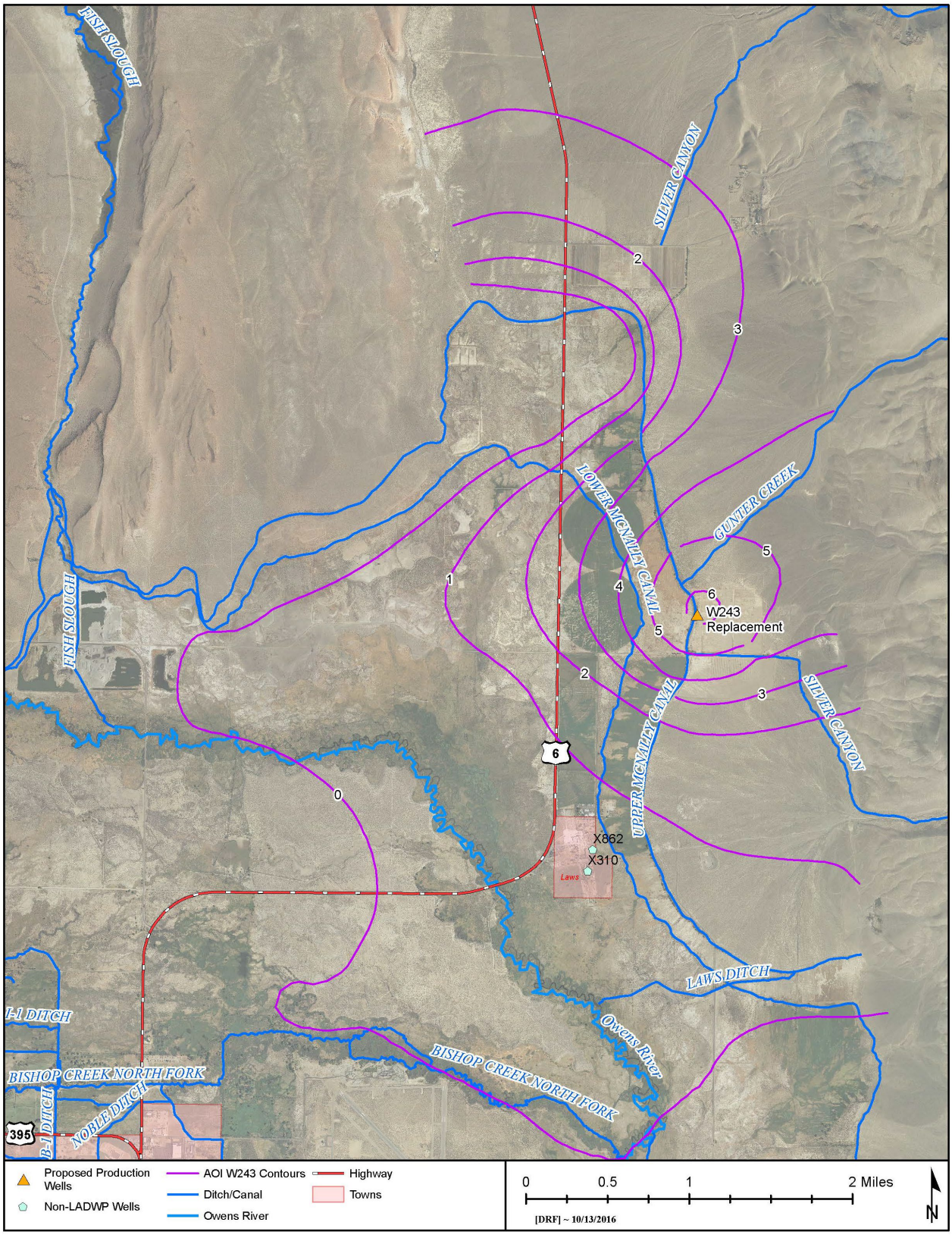

Figure 4 – Contour Map of Drawdown in the Shallow Aquifer due to the Simulation of Pumping W243

5.2 Potential Drawdown Effect on Resources within the AOI

Well W243 replacement will be located within a vegetation parcel LAW089 near the western edge of the parcel bordering with LAW050. LAW089 is listed as Barren Lands – abandoned agriculture while LAW050 is listed as Type E or irrigated agriculture (Table 4). Adjacent vegetation parcels include LAW048, LAW049, LAW090, LAW094, LAW095, and LAW96, are listed as Type A (LAW048 and LAW049), Type E (LAW096) or Barren Lands – abandoned agriculture (LAW090, LAW094, and LAW095). The latter three parcels are subject to the Laws Type E Transfer mitigation effort. Because DTW under these parcels are too deep to influence vegetation cover, there will be little or no impact on vegetation condition of the surrounding parcels.

L2 (Laws 2 Permanent Transect) is designated as a vegetation monitoring site for Well W243 by the Green Book (Table I.A, page 6). Vegetation cover at L2 is closely related to water spreading through the diversion gate (STAID 3151) from Lower McNally Canal.. DTW at V001G, an observation well associated with L2, shows a strong correlation with water spreading from Lower McNally Canal; DTW becomes shallower when more water is spread from Lower McNally Canal. L2 falls in between 1ft and 2ft drawdown contours, but very deep DTW readings at V001G (mostly >20ft except periods of high water spreading) (Figure 5). Consequently, an impact on L2 from pumping at Well W243 will most likely be very little. Permanent transect monitoring at L2 will continue as a part of permanent transect monitoring linked to production wells throughout the Owens Valley.

A Type C parcel closest to Well W243 with vegetation monitoring record based on the line-point methodology is LAW082, approximately 0.8 miles to the southeastern border of the parcel. LAW082 was classified as Rabbitbrush Meadow during the initial inventory (Table 4). Since the beginning of LADWP's line-point monitoring program in 2004, vegetation cover at this parcel has been low and dominated by shrub species. A monitoring well T835, closest to LAW082 shows DTW readings deeper than 15 ft., too deep for many plant species, except during a period of increased water spreading. DTW readings at T835 are highly correlated to spreading through the diversion gate (STAID 3151) from the Lower McNally Canal. Further, the estimated drawdown under LAW082 will fall in between 2ft and 3ft (Figure 5). When considering these findings, it is expected that an impact on LAW082 from pumping at Well W243 will be most likely very little. Vegetation monitoring based on the line-point methodology will continue in future.

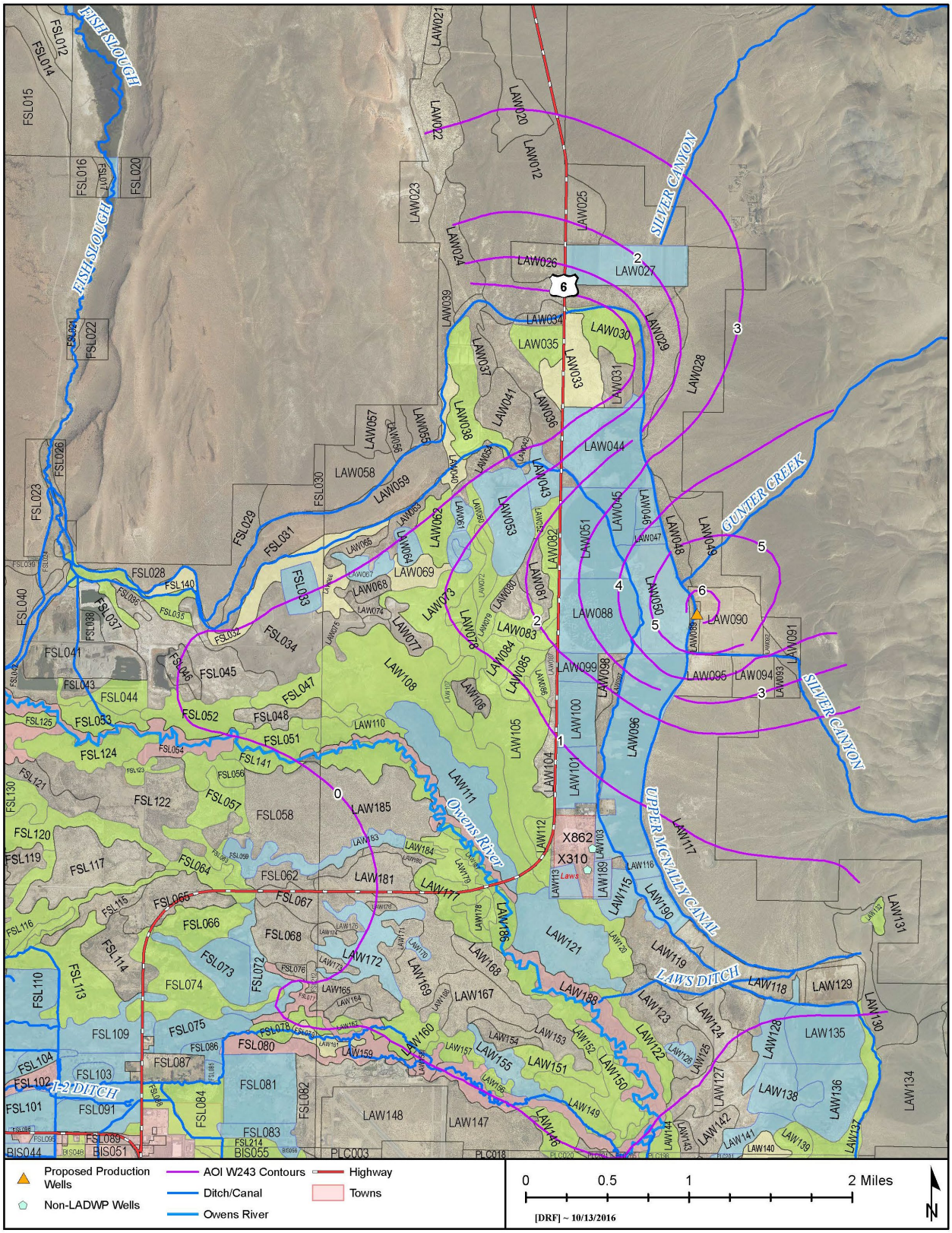

Figure 5 – Resulting Drawdown, Vegetation, and Private Wells near W243 Replacement

6. Construction and Testing

6.1 New Well Design

The planned location of the replacement for Well W243 is approximately 100 feet north of the current location. The proposed location is highly disturbed by farming activity and therefore, no archeological or biological survey is planned at this location.

A review of the driller's log for Well W243 shows that the borehole encountered multiple clay layers (0 to 55, 58 to 67, 122 to 162, 198 to 205, 220 to 276, 365 to 408, and below 479 feet depth). When compared to the descriptive logs from other nearby wells, these clay zones are expected to extend to the west. As shown on Figure 6, sandy zones appear at depths of 276 feet to 320 and from 354 to 365 feet. To improve the chance of encountering productive aquifer material with less impact to the shallow aquifer, the borehole for the replacement well will be drilled to 700 feet depth and descriptive and geophysical logs will be collected. Based on the interpretation of the collected logs, the replacement well will be screened within the more productive, deeper zone of the formation. The replacement well will be pumping from deep aquifer and the screen length will be approximately 350 feet. Figure 7 shows the preliminary design of the replacement well subject to the review of the borehole's driller's and geophysical logs.

Current industry standards for well drilling and design will be incorporated into plans for the replacement for Well W243. These plans include using a mud rotary method for drilling and using a pre-fabricated casing and screen, along with placing a properly sized gravel pack in the annular space between the screen and borehole wall. The diameter of the casing and screen in the replacement well will be 18 inch.

The pumping capacity of the replacement well is expected to be approximately the same as the documented capacity of W243 from the 1991 EIR. In the event that the initial testing shows that the replacement well has more than the documented capacity of the W243, LADWP will either adjust the pump size to the documented capacity or will treat the additional capacity as a new well.

6.2 Aquifer Test

Following the installation of the replacement for Well W243, the contractor will perform a step-drawdown test with up to four steps and a 24-hour constant rate pumping test of the new well while collecting water level data from nearby shallow and deep monitoring wells. Data from the pumping test will be used to calculate aquifer characteristics at that location. This information will be utilized to calculate the capacity of the replacement well.

FORM 1452

WELL LOG

Cenath 10511-5

DEPARTMENT OF WATER & POWER
CITY OF LOS ANGELES

Well Number or Name 243

LOCATION 1325' N and 850' W of theSE Cor. Sec. 15 - T 6 S - R 33 E

MAP No. Base

WORK STARTED June 6, 1928 WORK COMPLETED August 1, 1928

504 ft. of 16 in. 8 lb./ga. casing 504 left in well
" " " " " " " " "
" " " " " " " " "
" " " " " " " " "

Type of perforator used Mills

Perforated	62	ft. to 230	ft.	8	holes per ft.
"	272	" 325	"	8	" " "
"	350	" 370	"	8	" " "
"	400	" 482	"	8	" " "
"		"			" " "
"		"			" " "
"		"			" " "
"		"			" " "
"		"			" " "
"		"			" " "

Diameter of perforations 1/2 in., length 3 1/2 in.
Depth at which water was first found 35 ft.
Standing level before perforating 35 ft.
Standing level after perforating 35 ft.
Note your observation of any change in water level while drilling

Date tested , 19
Water level when first started test 35 ft.
Draw down from standing level 20 ft.
G. P. M. at beginning of test 1800
G. P. M. at completion of test 1800
Draw down at completion of test 20 ft.
If reducing strings of casing were cut off, state how cut

Depth from surface cut ft.
Size of casing cut in.
Lap in larger casing ft.
Was adapter or cement used?
If casing was swedged or repaired, state depth, describe repairs and condition in which casing was left and probable future effect:

Is well straight top to bottom, if not, what is the variation?

Will there be any detrimental effect on pump, and if so, what?

Give any additional data which may be of future value:

Casing parted at 62 Ft. Liner put in to 70 Ft.

Total depth of well 504 ft.
Formation: Mention size of water gravel—

0	ft. to	55	ft.	Clay
55	"	58	"	Sand - gravel
58	"	67	"	Clay - gravel
67	"	122	"	Gravel
122	"	162	"	Clay
162	"	198	"	Gravel
198	"	203	"	Clay
203	"	220	"	Fine sand
220	"	276	"	Clay
276	"	320	"	Sand tufa
320	"	354	"	Tufa clay
354	"	365	"	Sand tufa white
365	"	408	"	Clay
408	"	479	"	Fine sand
479	"	504	"	Clay - rocks
	"		"	
	"		"	

1-16-61 L & B. 10 FHM (3 Stg.)
8-16-61 Sounded = 504'
8-15-64 Repaired pump - Sand worn
4-23-64 Liner collapsed at
" 60' & 70'. Liner replaced
" with new liner.
3-22-65 Pump overhauled
12-29-71 New bowls, spider &
" col. - old worn out
" Photo well.
5-3-77 New bowls, shafts,
" spiders, 20' col. &
" 1 column col. 20'.
Jun. 73 (?) " Slab.

Date of Report , 19

Lawrence
Driller.

In charge

SHOW LOCATION ON BACK

Figure 6 – Well W243 Driller's Log

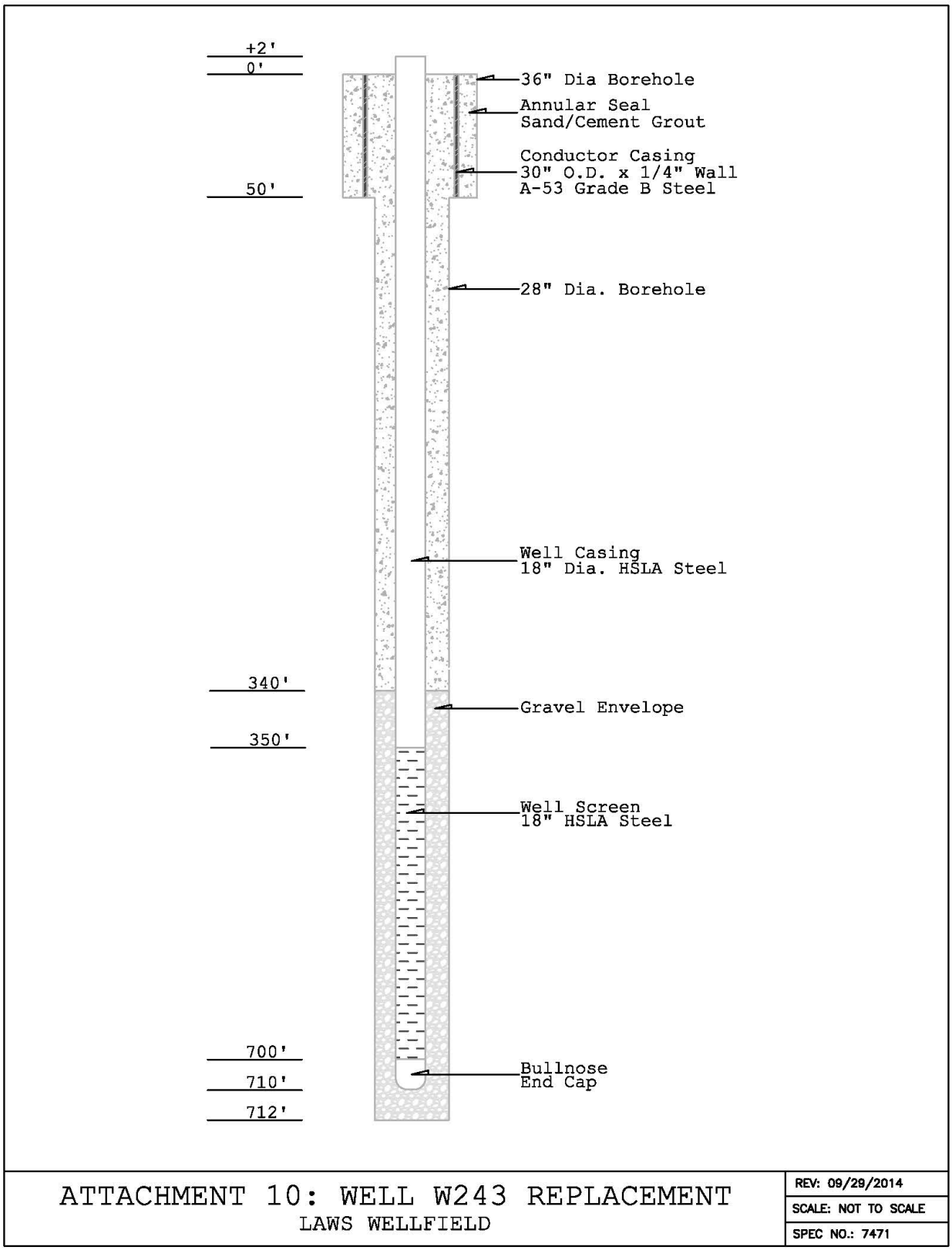

Figure 7 – Preliminary Design of Well W243 Replacement

6.3 Initial Operation

Well W243 replacement is one of the existing production wells in Owens Valley that is linked to the permanent vegetation monitoring site L2 according to Table 2 of the Green Book. Water pumped from replacement for Well W243 will be used to supply water the nearby irrigation fields or to flow to Owens River via the upper McNally Canal. During the first season of operations, LADWP will monitor water level in nearby monitoring wells.

6.4 Operation Plan Development

The replacement for the existing production Well W243 will be linked to the permanent vegetation monitoring site L2 and subject to the ON/OFF provision of the Water Agreement.

7.0 Environment Assessment

The replacement for Well W243 will be located adjacent to the existing well, pump from the deeper aquifer, with the capacity limited to that of the existing well, and water will be used for the same purposes as the well it is replacing. Therefore, no further impact to vegetation is expected from the operation this well. Additional assessment will not be conducted for the replacement well and LADWP has filed a Notice of Exemption under the California Environmental Quality Act with Inyo County Recorder's Office.

References

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