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COUNTY OF INYO
WATER DEPARTMENT

May 6, 2021

Mr. Adam Perez, Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, California 93514

Subject: ICWD concerns regarding well W076 replacement in the Bairs-George wellfield

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Dear Mr. Perez:

Thank you for providing the preconstruction report: *Well W076 Replacement (W076R) in Bairs-George Wellfield Preconstruction Evaluation*. Green Book Section IV.B and Water Agreement Section VI, provide that LADWP may replace existing wells and construct new wells in areas where hydrologic conditions are favorable, and where the operation of that well will not cause a change in vegetation that is inconsistent with the Water Agreement's goals and principles.

According to the draft preconstruction report, LADWP proposes to replace W076 with a well constructed at a nearby location, and limited to the same pumping capacity as W076 described in the 1991 EIR (approximately 2.6 cfs). The replacement well W076R presumably would be linked to monitoring site BG2 like the original well. Neither the original nor the proposed location of the replacement well allow for irrigation of Type E lands located up gradient to the west in dry years.

ICWD understands LADWP's need to update aging infrastructure and the Technical Group has considered preconstruction reports for several new and replacement wells in recent years. While the preconstruction report is technically sound, our assessment concludes that the W076 replacement has the potential to cause a change in vegetation and potentially impact Reinhackle Spring flows. Recent monitoring data as well as the preconstruction evaluation contains information that supports our conclusion. The principle concern is that the proposed location of this new well is surrounded by groundwater-dependent vegetation that includes shallow rooted perennial grasses, rose, and shrub willow. The modeled maximum simulated drawdown under this vegetation is large enough to likely cause negative effects unless the pumping from the well is managed carefully and constrained to avoid impacts.

Hydrologic Concerns.

The Bairs-Georges (BG) wellfield is different than other Owens Valley wellfields due to its structural and hydrologic features. Notable hydrologic properties include: 1) BG is structurally bonded by north-south trending fault zones including the Owens Valley fault on the eastern side; 2) BG is immediately north of the bedrock outcrop of the Alabama Hills and gravity studies indicated that shallow subsurface bedrock continues north of the surface outcrop; 3) unlike most other wellfields groundwater flow is primarily from west to east, and hydraulic head in numerous shallow, intermediate and deep wells in the area indicate an overall downward gradient. Based on historic pumping and groundwater level data, this wellfield has lower recharge and/or storage capabilities, and prevailing groundwater flow indicates that recharge from down-valley flow is unlikely. These hydrogeologic characteristics reduce the buffering effects of deeper Owens Valley groundwater flow and make BG potentially susceptible to greater impacts related to pumping.

The original W076 was located on the north side of George Creek just west of Highway 395 and the Los Angeles Aqueduct (LAA) (Figure 1). The well was drilled in 1925 to a total depth of 210 feet. The perforated interval was from 10-210 feet below ground surface (bgs). Well W076 had an original instantaneous capacity of approximately 3.8 cubic feet per second (cfs) before 1970, but slowly lost capacity and was approximately 2.6 cfs when described for the 1991 EIR. Notably, W076 was abandoned in the late 1990s after sitting idle since 1990 and was not pumped after implementation of the Water Agreement (LTWA) management procedures.

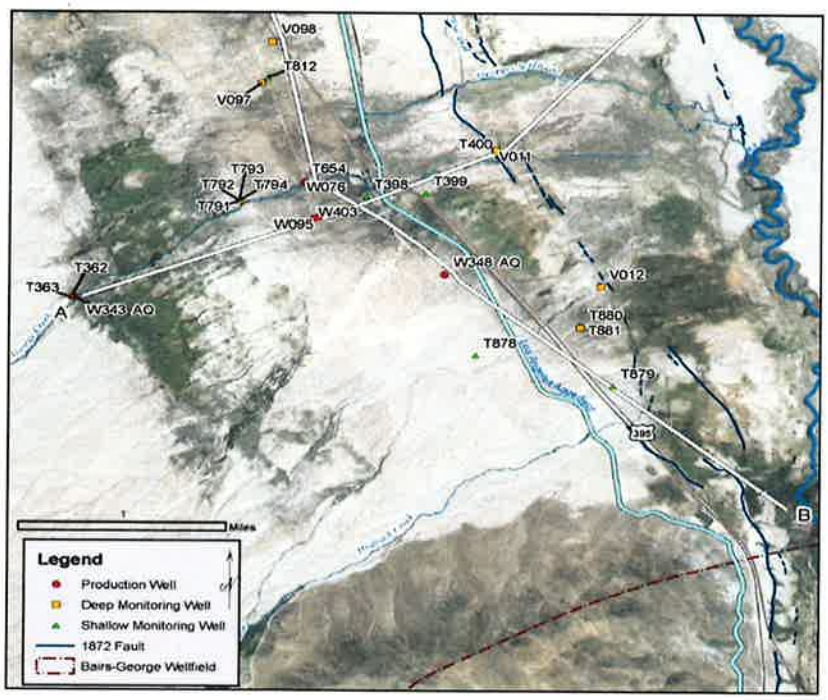

Figure.1 Bairs Georges monitoring well locations from the preconstruction evaluation. (LADWP 2021).

LADWP plans to drill the W076R replacement well approximately 0.25 miles to the east of the original W076. The well would be located adjacent to the George Creek sand-trap and the LAA. Total depth is planned to be approximately 400 feet with a screen interval from 50 to 400 feet.

The drill logs from wells near W076R show subsurface sediments consistent with layered alluvial fan deposits grading into the valley floor: interbedded sands, gravels, cobbles with alternating clay lenses. These clay lenses could provide localized, near-surface confined or semi-confined conditions, but that is not certain. The original W076 sourced groundwater primarily from shallow alluvial aquifers. Well logs combined with pump-test data indicate low transmissivity/production zones at increasing depths in the subsurface.

Groundwater levels in both shallow and deep aquifer zones in Bairs-George experienced declines during the 2012-2016 drought. The aquifers recovered in 2017 due to historically high runoff; however, groundwater levels in both aquifer zones have dropped in two of the past three years due to increased BG pumping. Since 2000, the largest groundwater declines occurred in years with greater wellfield pumping (Figures 2, 3, and 4). For example, in 2020-21, LADWP pumped 2,400 ac-ft of groundwater from BG, causing the notable water level declines since April 2020.

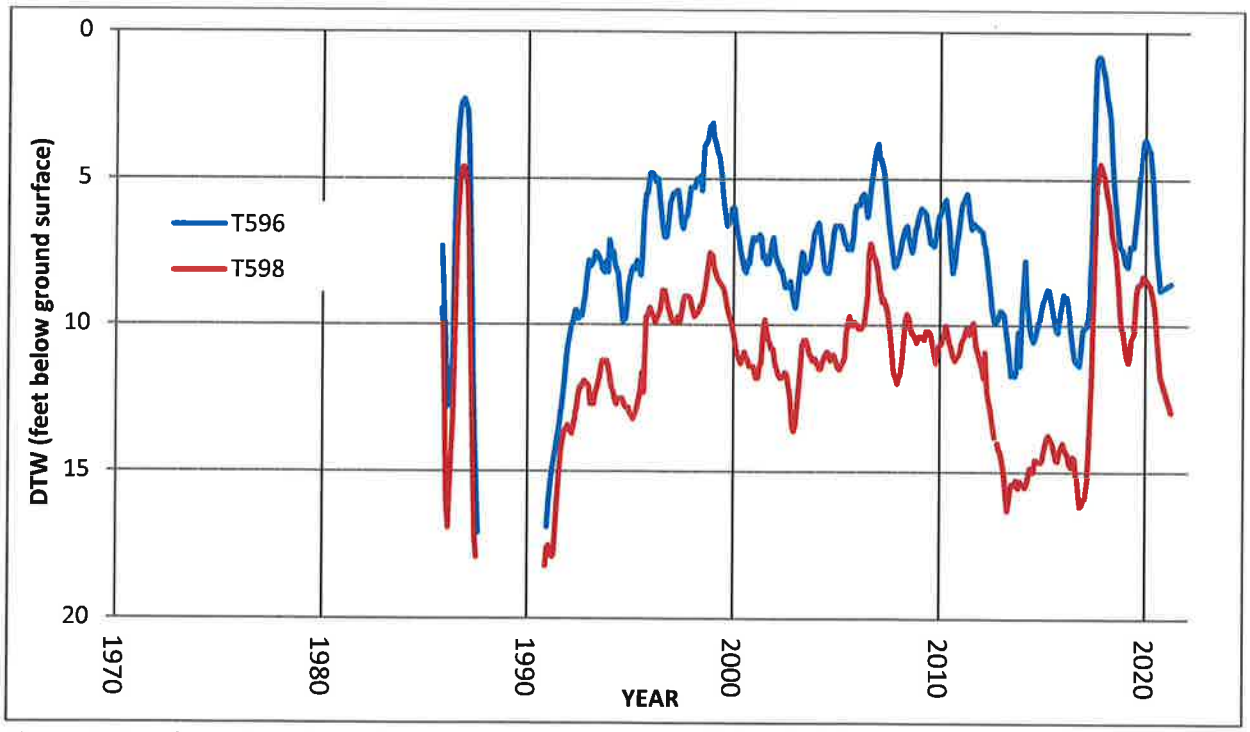

Figure 2. Depth to water in shallow BG monitoring wells T596 and T598.

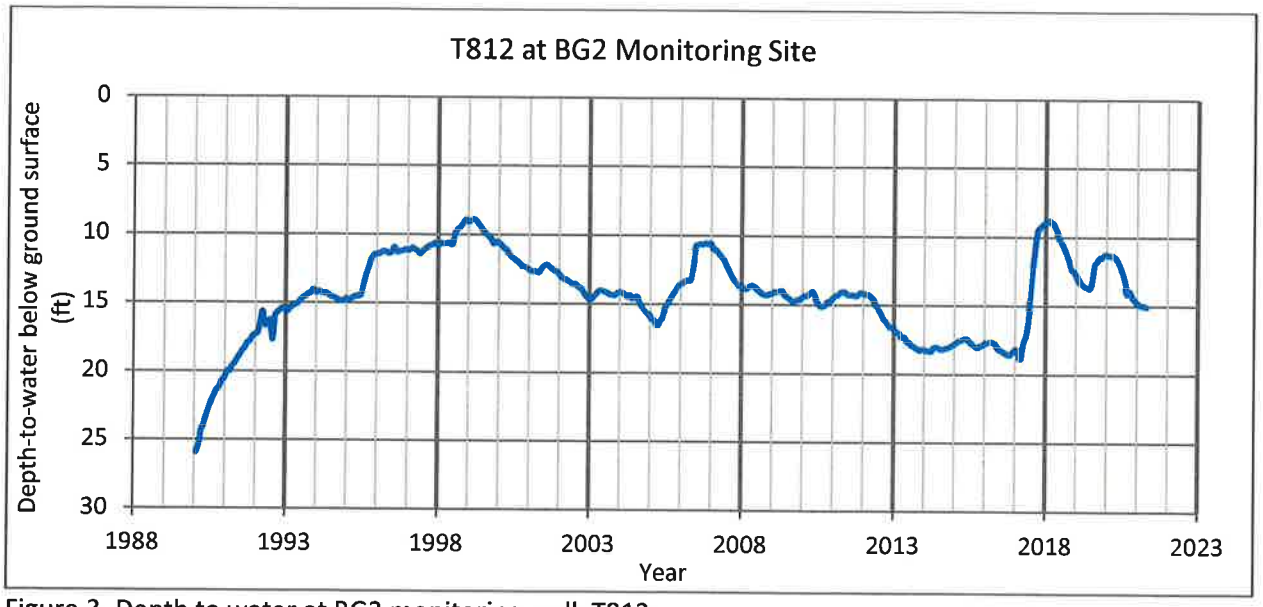

Figure 3. Depth to water at BG2 monitoring well, T812.

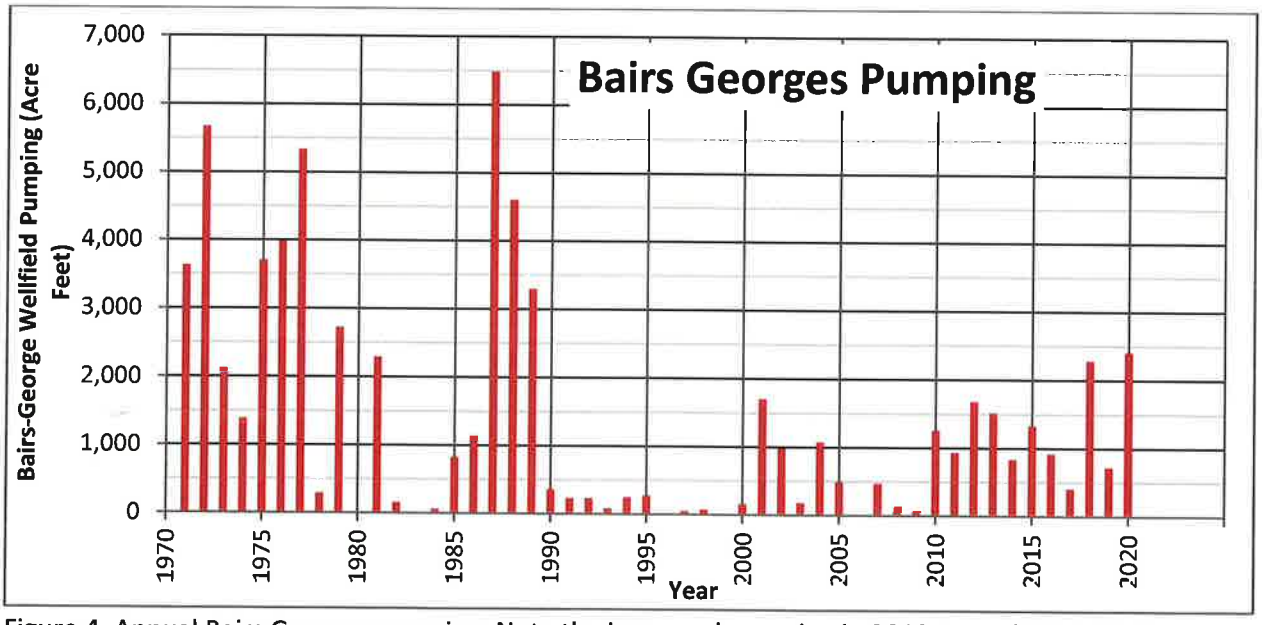

Figure 4. Annual Bairs Georges pumping. Note the increased pumping in 2018-19 and 2020-21 that correspond with recent DTW declines.

Water levels measured in select monitoring wells in the spring of 2020 and 2021 are shown in Table 1. Groundwater levels dropped several feet in the majority of BG wells. Note that monitoring wells V098, T793(d), V087, T880 (d), and V011N measure either shallow and deep aquifer or piezometric head in just the deeper aquifers.

Table 1. Depth-to-water below ground surface at monitoring wells in the vicinity of the proposed location of W076 replacement.

ID	Appx. distance from W076	Date	DTW ft-bgs	Date	DTW ft-bgs
T812	NNW 0.7 mi	3/31/21	15.76	4/2/20	12.32
V098	NNW 0.7 mi	3/31/21	10.65	4/2/20	7.93
T598	NW 0.3 mi	3/31/21	12.96	4/13/20	8.80
T654	W 0.6 mi	3/31/21	11.51	4/13/20	8.08
T791	W 0.6 mi	3/31/21	35.83	4/13/20	30.90
T793 (d)	W 0.6 mi	3/31/21	44.68	4/13/20	38.42
T362	WSW 1.5 mi	3/31/21	49.87	4/13/20	39.49
T398	SE 0.2 mi	3/31/21	4.38	4/2/20	2.36
T596	S 0.3 mi	3/31/21	8.55	4/2/20	4.25
T652	SE 0.5 mi	3/31/21	15.38	4/2/20	12.26
V087	SE 0.5 mi	3/31/21	14.58	4/2/20	10.46
T597	SE 0.8 mi	3/31/21	3.76	4/13/20	2.42
T880 (d)	SE 1.4 mi	3/31/21	-0.27	4/13/20	-0.29
T881	SE 1.4 mi	3/31/21	6.32	4/13/20	3.89
T856	E 0.4 mi	3/31/21	8.55	4/2/20	7.05
T400	E 0.7 mi	3/31/21	4.98	4/2/20	4.17
V011N	E 0.7 mi	3/31/21	13.50	3/30/20	13.01

LADWP's current instantaneous capacity in the BG wellfield is about 3.9 cfs which equates to 2,800 ac-ft/year of potential pumping. Groundwater declines of about 5 ft occur when pumping is between 2,000-2,500 ac-ft/year as was observed in 2018-19 and 2020-21 (Figure 4 and Table 1). Well W076R would increase the BG wellfield capacity by approximately 1,900 ac-ft/year (total capacity = 4,700 ac-ft/year). The preconstruction report compares current BG pumping capacities to historic pumping practices, noting that the pumping has decreased since implementation of the Water Agreement. However, pumping from 1987-1989, when the average annual amount was about 4,800 ac-ft year, led to water table declines of more than 10 ft. This drawdown caused substantial water table and vegetation declines (Figure 2 and 3 and vegetation changes discussed below).

Due to its hydrogeological complexities and relative isolation compared to other Owens Valley wellfields, a local-scale groundwater model updated specifically for BG is overdue. Since the regional-scale Southern Owens Valley model was produced in 2012 the range of environmental conditions and changes in the wellfield are sufficient justification for local-scale model recalibration. These include the 2012-16 drought, the drying of the LAA in summer 2015, the increased seepage from the LAA in 2016-17 once flow was reestablished, the conversion and subsequent pumping of W348 from deeper aquifer zones, and the recent increased pumping from BG since 2018. An updated model would take into account these observed factors in the impact of pumping W076R on Reinhackle Springs outflow.

To fully analyze W076R before operation, the ICWD requests the modeled outflow changes for Reinhackle springs during the 1-year continuous operation of W076R, and LADWP's Southern Owens Valley groundwater model itself. To properly monitor the effects of pumping W076R, a new monitoring well should also be established. Although there is an extensive monitoring network in the most of the BG wellfield with both shallow, deep, and flowing wells and metered surface water features, there is also a data gap northeast of the W076R. A dual-completion well (shallow and deep)

should be installed near MAN038/UNW033 area to allow measurements of drawdown in the fault-constrained wellfield.

Soil Moisture Conditions and Considerations

Permanent monitoring site BG2 is located in vegetation parcel MAN037, and the site has been On status since 2008. As of spring 2021, soils were moist at approximately 8.2 ft (2.5 meters) with groundwater recharge supplying this deeper soil water. Experience with the Green Book On/Off mechanism to manage pumping has shown that vegetation can decline substantially where the pumping capacity of linked wells is great enough to cause several feet of water table decline before the soil water trigger is reached. Operation of W076R would increase the wellfield capacity and the potential for a lengthy period necessary for water table to recover causing vegetation declines again. Despite the currently favorable soil water conditions, in this instance, reliance on the On/Off procedures alone will likely be insufficient to prevent impacts to vegetation.

Vegetation Concerns

Predicted groundwater drawdown contours produced using LADWP's Southern Owens Valley MODFLOW model, included in the evaluation, are generally consistent with recent BG pumping and observed drawdown. The modeled 10-ft drawdown contour for 1-year of operation of W076R extends into both MAN037 and MAN038, and the 6-ft drawdown contour extends into MAN050 and MAN083 as well (Figure 5).

Vegetation parcel MAN037 is a Type-B parcel and the current soil moisture is within the rooting zone for phreatophytic shrubs (13.1 ft). Cover in this parcel increased steadily following a fire in 2002 but declined during the 2012-2016 drought (Figure 6). Cover had been below baseline for more than 25 years but was not significantly below baseline in 2017, 2019, and 2020. MAN038 is a Type-C meadow parcel dominated by shallow-rooted perennial grasses, the cover of which has been significantly below baseline during the last two years (2019, 2020). Much of the southern portions of these two parcels are within a few hundred meters of the proposed well location and consist of high cover meadow or shrub willow/rose vegetation. Example photographs from transects in MAN 037 and 038 are provided at the end of the letter.

Both historic and groundwater model evidence of possible water table declines in the area of this shallow rooted and vulnerable vegetation type supports the concern that W076R would likely cause vegetation cover declines unless pumping is severely restricted to limit water table declines. Before operating the replacement well, the Technical Group should evaluate whether or not the deviation from baseline in MAN038 parcel is attributable to the current groundwater extraction practices from the BG wellfield before considering adding additional pumping stress to the ecosystem. Additional information about vegetation conditions in this wellfield are available in previous ICWD annual reports.

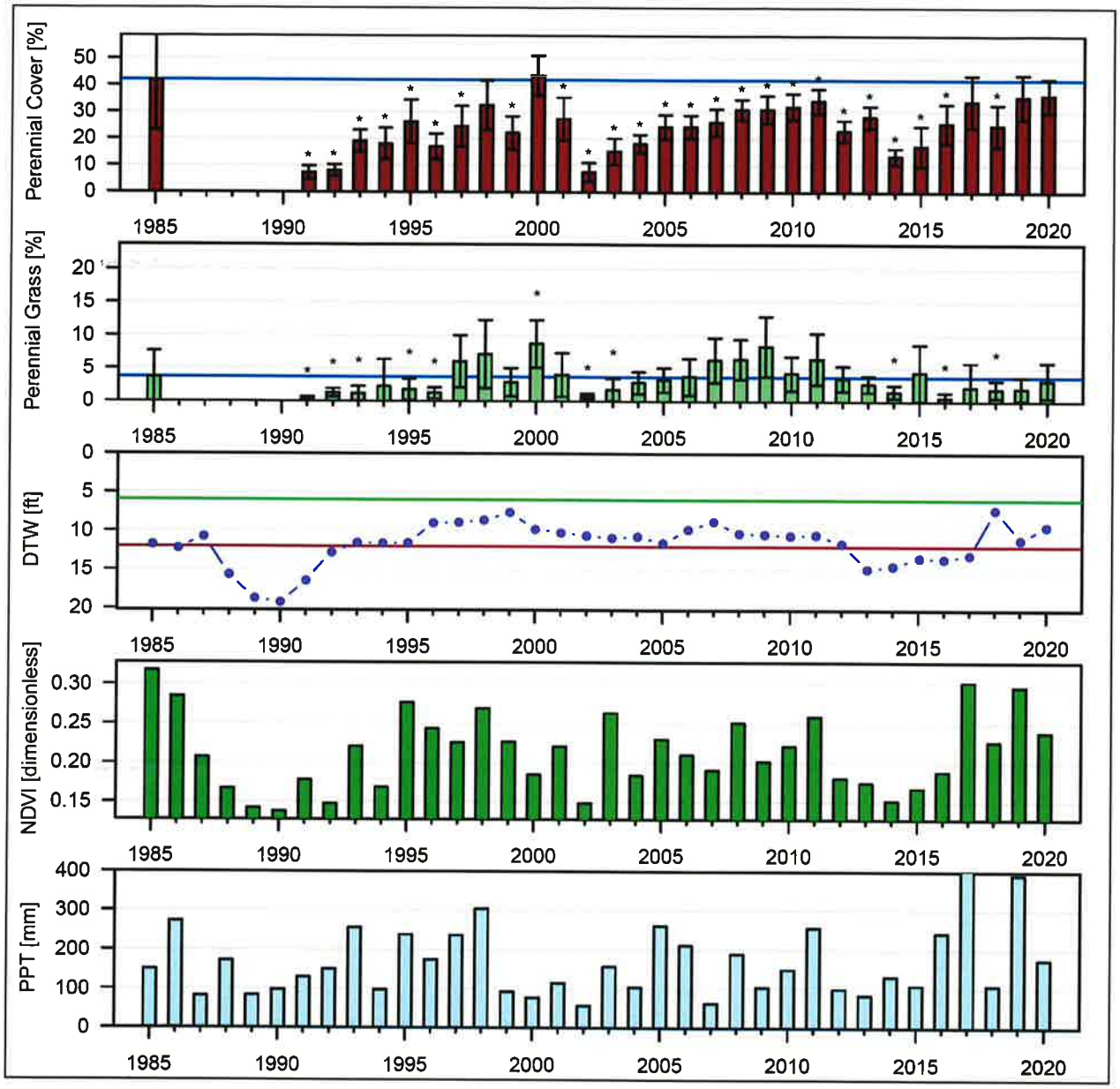

Figure 6. MAN037 Green Book monitoring aggregated to total perennial cover and shallow-rooted perennial grass cover as a parcel average. The average depth to water bgs was computed from a kriged DTW surface, but water level is generally shallower in the southern portion of the parcel which supports shallow rooted groundwater-dependent vegetation compared to the northern portion dominated more by deeper-rooted phreatophytic shrub species.

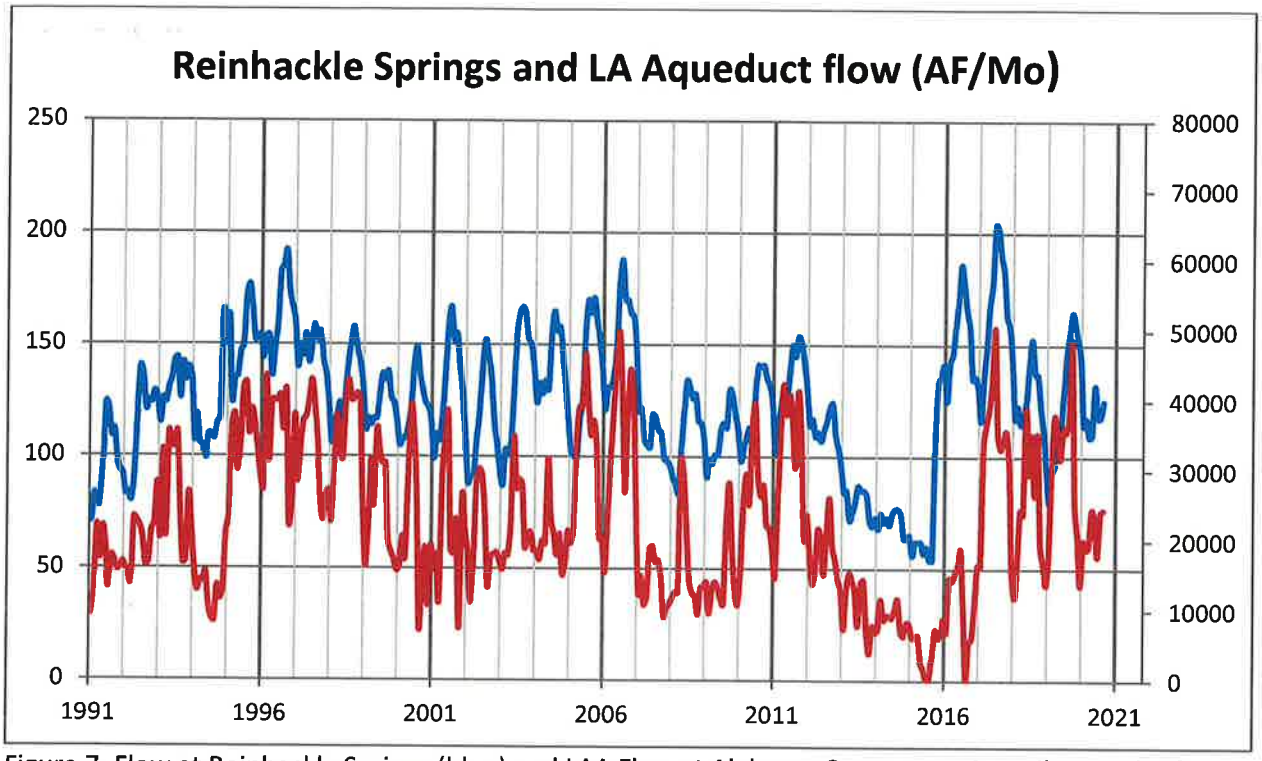

Figure 7. Flow at Reinhackle Springs (blue) and LAA Flow at Alabama Gates, appx 2.5 miles south of Reinhackle Springs.

Reinhackle Springs

North-south trending faults in Bairs-George create layers of low-conductivity materials which restrict natural groundwater flow paths causing groundwater upwell and discharge along the numerous fault traces including Reinhackle Springs. Both geochemical data from the Inyo/LA Geochemical Cooperative Study in 2004 along with long-term hydrologic data (spring discharge, LAA flows, monitoring well hydrographs) suggest Reinhackle spring/seep discharge is from recent recharge most likely related to shallow west-to-east groundwater flow and LAA seepage being impeded by Owens Valley Fault system. As is seen in Figure 7, increase and decrease in Reinhackle Spring discharge coincides with flow changes in the LAA. Note the persistent large decline during the 2012-2016 drought when flows in the aqueduct were at or near historic lows. In 2016 in Reinhackle flows increased quickly when near normal flow returned to the LAA and, as reported by LADWP staff, that after being dry for part of 2015, the unlined portion of the LAA in Bairs George was leaking at greater rates.

Based on LADWP's proposed construction for W076R with screened intervals in the shallow aquifer and W076R's more proximate location to Reinhackle spring/seep discharge; it is likely that pumping from W076R will either capture some of the aqueduct seepage or reduce the upwelling in shallow aquifer zones upgradient of the spring and, therefore, reduce discharge in the Reinhackle Springs area. The model results may support this hypothesis but were not included in the evaluation. Please provide the modeled spring flow results to the Water Department.

Pumping in the 1980's was shown by various analyses to affect the flow from Reinhackle Spring. The 1991 DEIR states *"Increased groundwater pumping has periodically reduced the flow from Reinhackle Spring."* Furthermore, the Technical Group is required to monitor conditions at Reinhackle spring:

"Under the provisions of the Agreement and Green Book, spring flows and vegetation dependent upon such flows will be carefully monitored by the Technical Group." Finally, groundwater pumping will be managed *"...so that flows from the spring will not be significantly reduced compared to flows under prevailing natural conditions."* Because the replacement of W076 constitutes a significant increase in pumping capacity of the wellfield since before the adoption of the Agreement and 1991 EIR, ICWD recommends the Technical Group adopt a monitoring plan and management plan for pumping in the Bairs George wellfield. The plan should rely on existing monitoring programs as much as possible for continuity but the management provisions would be in addition to the On/Off provisions which were not designed to protect springs. Vegetation inventory at Reinhackle springs prepared by Ecosystem Sciences in the 1998-1999 Spring and Seep Inventory should be reassessed and updated. Permanent vegetation transects and/or plots would be established within each community type within the spring as necessary prior to operating W076R.

A draft Reinhackle Springs Monitoring Plan has been prepared and presumably implemented by LADWP (LA staff report 2011). Key recommendations in that plan included updating the Southern Owens Valley Model, screening a potential W076 replacement well to the deep aquifer only, and using groundwater level triggers in nearby monitoring wells to limit pumping to protect outflow at Reinhackle springs/seeps. The Technical Group has not adopted that plan nor assessed whether the water level and spring flow relationships developed in the early 2000's were effective and are still valid. The management procedures in that plan relied on data largely from the period after W076 ceased operation (1990) and it is not certain the empirical models will accurately capture the effects of W076R. The Technical Group should re-evaluate and update that monitoring plan.

Conclusion

The replacement well W076 potentially could negatively affect water levels, vegetation, and Reinhackle Spring outflow based on the evaluation of existing monitoring data and the information contained in the preconstruction evaluation. Additional modeling information not provided in the preconstruction evaluation and requested in this letter should be provided to the Water Department. While we have serious reservations about the feasibility of operating W076R at the proposed location, the contents of the preconstruction evaluation fulfills the basic requirements of the Green Book, Section IV and Water Agreement Section VI. However, construction and/or operation of W076R should not proceed until; 1) the requested groundwater model updates are completed, 2) the Reinhackle plan is updated and re-evaluated by the Technical Group, 3) the requested additional vegetation monitoring at Reinhackle is developed and the monitoring wells are installed, 4) the initial period of operation is conducted in accordance with a jointly developed monitoring plan that includes triggers to shut off the well to avoid impacts.

Sincerely,

S. Piper for Aaron Steinwand

Aaron Steinwand, Ph.D
Water Director
Inyo County Water Department

Cc: Dr. Saeed Jorat, Eric Tillemans, Dr. Dave Martin

MAN037 Green Book Transect 13 is dominated by Alkali Sacaton (*Sporobolis airoides*) and Narrow-leaf/Coyote Willow (*Salix exigua*) approximately 100 meters from the proposed location of W078R where drawdown was modeled at 16 feet, a scenario that would likely kill the groundwater-dependent vegetation necessitating significant mitigation requirements under Green Book Section I.C.2.

MAN037 Green Book Transect 7 is dominated by Wood's Rose (*Rosa Woodsii*) and Nevada/Torrey's Saltbush (*Atriplex torreyi)* approximately 700 meters from the proposed location of W078R where drawdown was modeled at 6-8 feet, a scenario that could likely kill the Wood's Rose and significantly reduce the health and cover of Torrey's Saltbush, necessitating significant mitigation requirements under Green Book Section I.C.2.

MAN038 Green Book Transect 1 is dominated by Saltgrass (*Distichlis spicata),* Baltic Rush (*Juncus balticus*), and Alkali Sacaton (*Sporobolis airoides*) approximately 400 meters from the proposed location of W078R where drawdown was modeled at 6-8 feet, a scenario that could impact the perennial grasses.

MAN038 Green Book Transect 13 is dominated by Saltgrass (*Distichlis spicata),* and Coyote Willow (*Salix exigua*) approximately 384 meters from the proposed location of W078R where drawdown was modeled at 6-8 feet, a scenario that could likely kill the grasses and willow, necessitating significant mitigation requirements under Green Book Section I.C.2.

MAN038 Green Book Transect 11 is dominated by Coyote Willow (*Salix exigua*) and Nevada/Torrey's Saltbush (*Atriplex torreyi)* approximately 536 meters from the proposed location of W078R where drawdown was modeled at 6-8 feet, a scenario that could likely kill the Coyote Willow and significantly reduce the health and cover of Torrey's Saltbush, necessitating significant mitigation requirements under Green Book Section I.C.2.