Inyo/Los Angeles Technical Group

Evaluation of McNally Ponds E/M Project

March 15, 2022 Draft

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Background

The McNally Ponds and Native Pasture Project was one of 26 Enhancement/Mitigation (E/M) Projects developed in the 1980s and included in the Long Term Water Agreement (Agreement). The McNally Project was evaluated as a mitigation project in June 1985 and ultimately incorporated as a mitigation measure in the 1991 EIR for the Agreement. The project mitigates for significant adverse vegetation decreases and changes in Laws due to a combination of factors. The project description was provided in the Laws/Poleta Area E/M Projects CEQA Initial Study:

> *Approximately 60 acres of ponds located south of the Lower McNally Canal and west of U.S. Highway 6, will be provided water annually during the waterfowl season September through January. Water will be diverted through existing ditches and headgates from the Lower McNally Canal*. (Section 17, T6S, R33E).
>
> *Approximately 300 acres of native pasture will be provided water from existing diversion from the Lower McNally Canal within Sections 16 and 35, T6S, R33E, and MDB&M during the growing season April through September*.

Water was to be diverted into four basins in the autumn to form seasonal ponds in the Laws wellfield (Figure 1). The anticipated water supply to the ponds was Owens River water conveyed along the Lower McNally Canal and/or groundwater pumping wells. Two wells located along the canal can directly supply the ponds, and another two wells near the Laws return ditch can replace the water supplied from the river. The project also includes a 100-acre native grass pasture adjacent to the ponds and another 250 acre field four miles southeast of the ponds at the base of the White Mountains. These pastures were not the subject of this evaluation and will continue to be irrigated at the current locations. Pumping and irrigation for the pasture adjacent to McNally Ponds was included in the hydrologic analysis to distinguish those effects from wells that supply the ponds. It was assumed the McNally Ponds will continue to be used for water spreading as part of aqueduct operations.

The primary challenges implementing the McNally Ponds have been reliable water supply, sporadic habitat creation, and pumping to supply the project in an area of Laws with vegetation that is often below baseline conditions. The ponds have been partially or fully supplied with water in the fall in approximately 13 of the last 31 years (Table 1, see discussion below describing 2004-5 and 2007-8). Given the questionable habitat value and lack of reliable water supply, the Standing Committee has often agreed not to supply the ponds or pasture in drought years in accordance with Section IV.A of the Agreement. Given the long standing difficulty implementing the McNally Ponds at the present location, at its October 2020 meeting, the Standing Committee concurred with the staff recommendation:

> *Staff recommends that the Technical Group prepare a report to the Standing Committee evaluating the McNally Ponds portion of the E/M project including possible improvements or alternatives to the project.*

This report was prepared to fulfill that request of the Standing Committee.

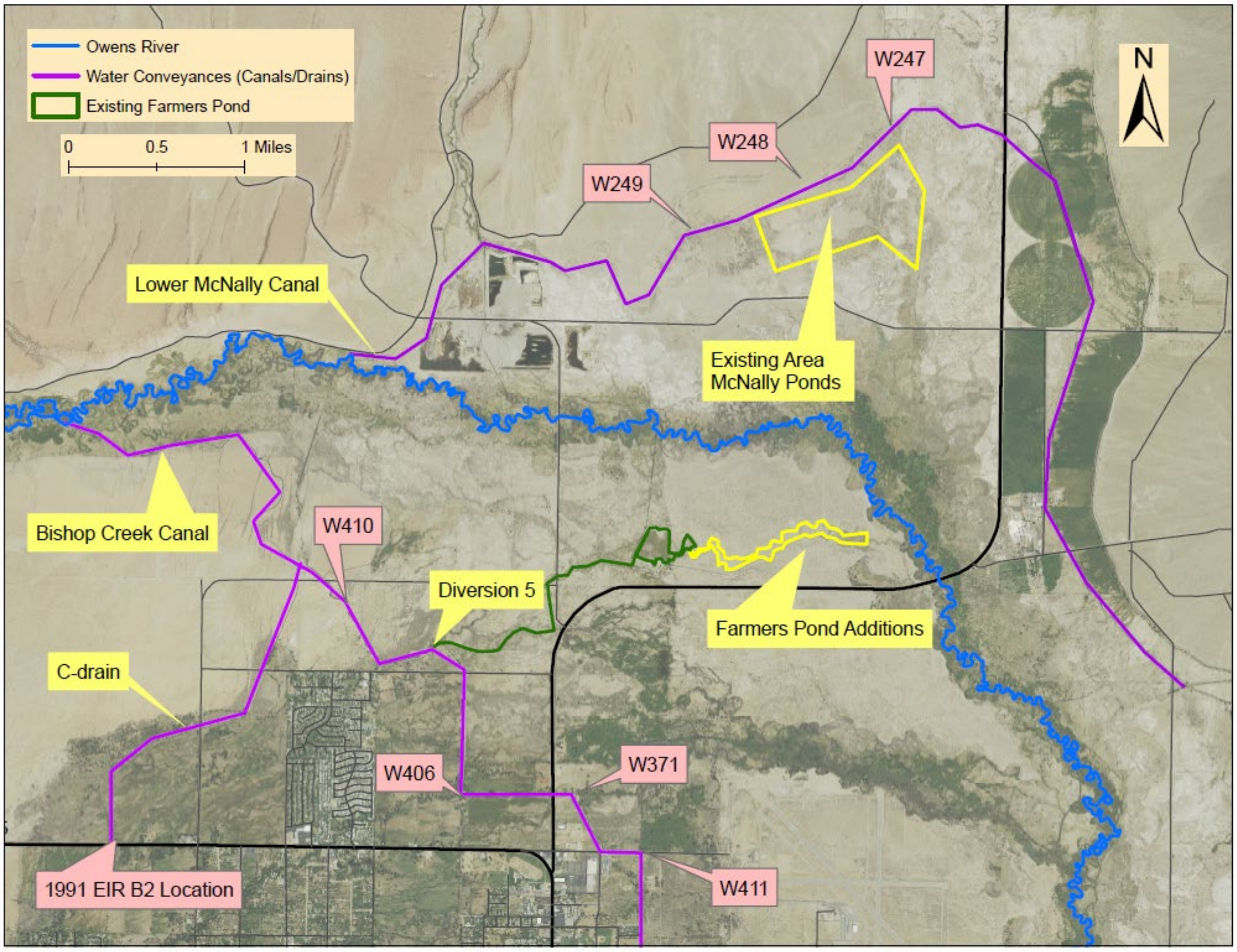


Figure 1. *McNally Ponds and Farmer's Pond locations and associated water delivery infrastructure and pumping wells.*

In 2016, staff scouted the Bishop/Laws area for alternative locations near the original project site and near the original impact described in the 1991 EIR that could potentially provide better habitat and recreation value with fewer water supply difficulties. Two alternatives for seasonal waterfowl ponds were suggested. The first would use surface water from the Bishop Creek Canal to increase ponded acreage in basins located east of Farmer's Pond. Based on initial inspection of the capacity of water conveyances and existing irrigation water uses and pumping, it seems feasible to deliver additional water to this location. A second alternative to seasonally flood an existing shallow spreading basin near Bishop Creek Canal north of Riverside Road was not compatible with available capacity in the Bishop Creek Canal, irrigation demands downstream, and pumping management requirements of the Hillside Decree. It was dropped from further evaluation.

Table 1. *Water delivery history to the McNally Ponds in the months October-March when the project is required to be implemented. Red text was primarily supplied using groundwater wells. In the years with black text, the ponds were primarily filled using water from the Owens River.*

Runoff year	Water delivered†	NDWI flooding evident
	Acre-feet	
1991-92	0	no
1992-93	0	no
1993-94	1385	yes
1994-95	0	no
1995-96	1258	yes
1996-97	495	yes
1997-98	0	no
1998-99	1753	yes
1999-2000	0	no
2000-01	0	no
2001-02	0	no
2002-03	0	no
2003-04	0	no
2004-05	73	no
2005-06	2530	yes
2006-07	904	yes
2007-08	57	no
2008-09	0	no
2009-10	0	no
2010-11	365	yes
2011-12	0	no
2012-13	0	no
2013-14	0	no
2014-15	0	no
2015-16	0	no
2016-17	1626	yes
2017-18	753	yes
2018-19	1147	yes
2019-20	1083	yes
2020-21	650	yes
2021-22	Ponds filled with well water, total not available yet.	yes

† -sum of Lower McNally Diversions 5, 7, and 8.

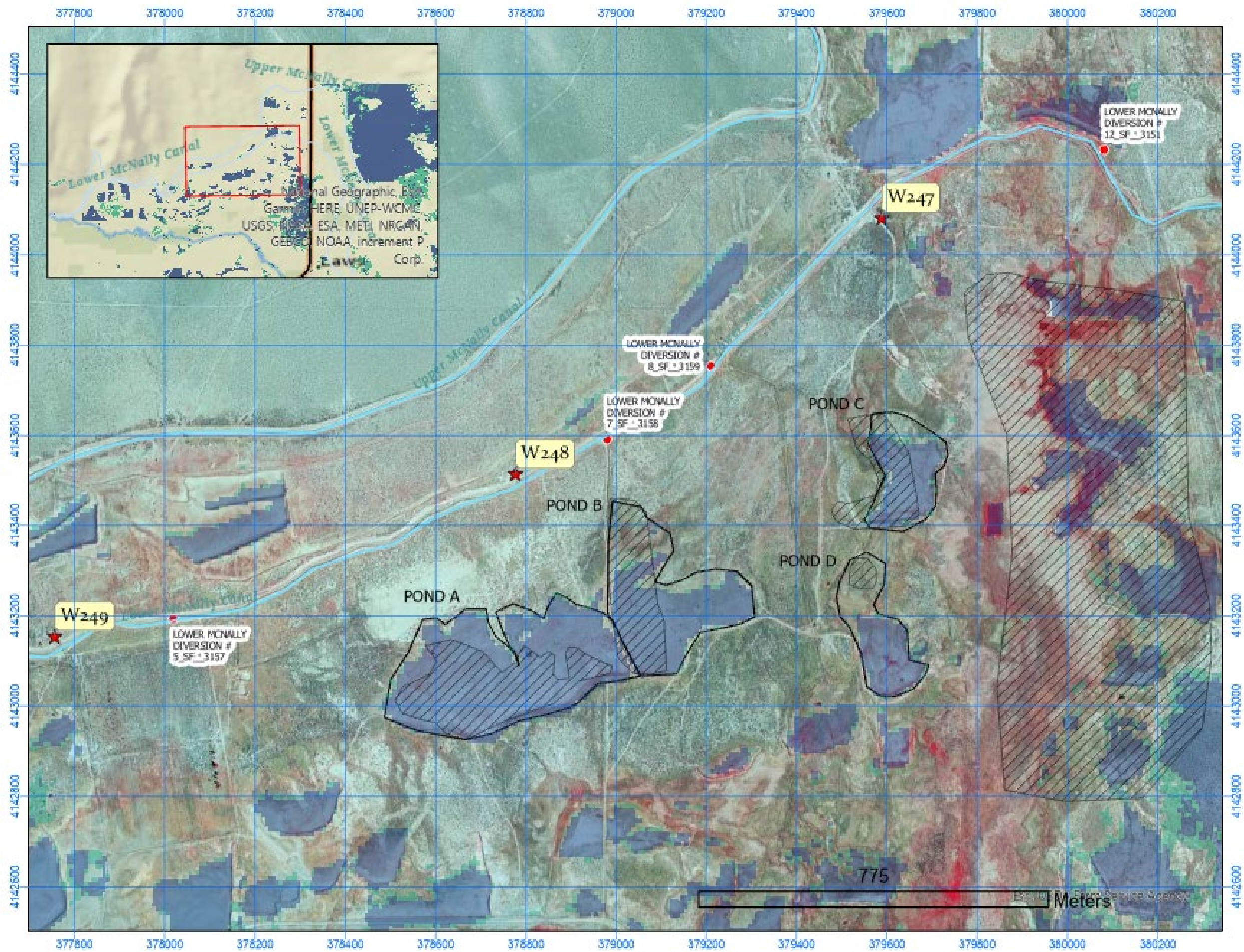


Figure 2. *McNally Ponds (A, B, C, D). Ponded extent shown in blue as NDWI > 0 for the 2017 water year representing approximate maximum actual flooding extent. The hashed polygons correspond to an imperfect digitization of the original project EIR mitigation project maps. The dark black polygons encompass the digitized polygons and a more accurate flooded extent classified from Sentinel 2 Green and near infrared bands (Mcfeeters NDWI).*

The alternative area evaluated in this report is near the existing Farmer's Pond Environmental Project described in the 1991 EIR as:

> *Water provided in fall of each year to offer increased habitat for migrating waterfowl two miles north of Bishop.*

Farmer's Pond is located 1.75 mile to the south of the existing project. (Figure 1), and infrastructure exists to supply water to a series of three cascading basins below the existing Farmer's Pond (pond 1). Pond 1 has been filled annually since 1970 with small overflow into adjacent pond 2. In some wet years, the lower ponds 3 and 4 have been used as spreading areas as part of aqueduct operations. The three spreading basins below Farmer's Pond comprise approximately 32 acres.

The site conditions and feasibility of regularly supplying water to the McNally and Farmer's Ponds were evaluated in this report. Assessing the relative potential value of the two project areas was based on three considerations: 1) reliability of water supply and potential effects on the hydrology near wells that could supply the projects, 2) potential habitat quality created at the locations including the primary goal of water-fowl habitat and also associated benefits to other ecosystem components such as tree persistence and recruitment, 3) whether or not the presence of weedy species will create additional or new management problems or lessen the mitigation value of created habitat.

The scope of this report was limited to evaluating the existing McNally Ponds Project and suggesting one common-sense alternative: potentially moving the project to the Farmer's Pond area. Based on the hydrologic data collected, it appears more feasible to consistently supply water to the Farmer's Pond area. The Technical Group presents this finding to the Standing Committee to decide whether further investigation is warranted.

Biological Conditions

This section describes the vegetation condition in and around the existing McNally Ponds (labeled A, B, C, and D; Figure 2) and the Farmer's Pond as related to historic timing and frequency of pond filling. The Farmer's pond alternative would consist of activating basins 2, 3 and 4 in the fall and winter similar to what has been implemented in Farmer's pond 1. The present vegetation condition at both the McNally and Farmer's locations reflect surface water management both for purposes of the environmental and E/M projects as well as operational water-spreading by LADWP in years of above normal runoff. Vegetation at the McNally Ponds location also responds to groundwater pumping to supply the project in the fall in some years of lower runoff.

Data from a variety of existing monitoring programs were compiled to assess conditions in and near the two locations. In August and September 2021, ICWD staff conducted additional field surveys to document dominant vegetation cover types throughout the basins of McNally Ponds and Farmer's Pond, including a characterization of annual grass and forb dominance versus perennial grass, forb, and shrub cover. Distributions of mature cottonwood (*Populus fremontii*, POFR) and red willow (*Salix laevigata*, SALA6) and recent tree recruitment of both species at Farmer's Pond were mapped. Groundwater-dependent vegetation adjacent to the McNally Ponds (parcels Laws63, 65, 62, 70) were evaluated with the line point intercept method implemented as part of the Technical Group's vegetation monitoring, or with Landsat-based normalized difference vegetation index (NDVI) time series (parcels Laws 60, 73) when Greenbook monitoring data were unavailable (Figure 3).

Point-based mapping of invasive species including perennial pepperweed and saltcedar (*Tamarix ramosissima*) was conducted at Farmer's Pond 1 and lower basins to evaluate the risk of future spread under the proposed fall-winter flooding. There have been many visits to the McNally Ponds area for purposes of line point transects in surrounding parcels, saltcedar control in surrounding basins and visits to the project during activation. Perennial pepperweed is unfortunately ubiquitous throughout the McNally Ponds, present in each of the ponds and prevalent along all roads and ditches in the area including the McNally canals themselves. Saltcedar is removed by the Inyo/Los Angeles programs as needed. Because the weeds were widespread in the McNally Ponds, the 2021 mapping of perennial pepperweed was limited to Farmer's Pond since the extent of colonization had not been documented previously.

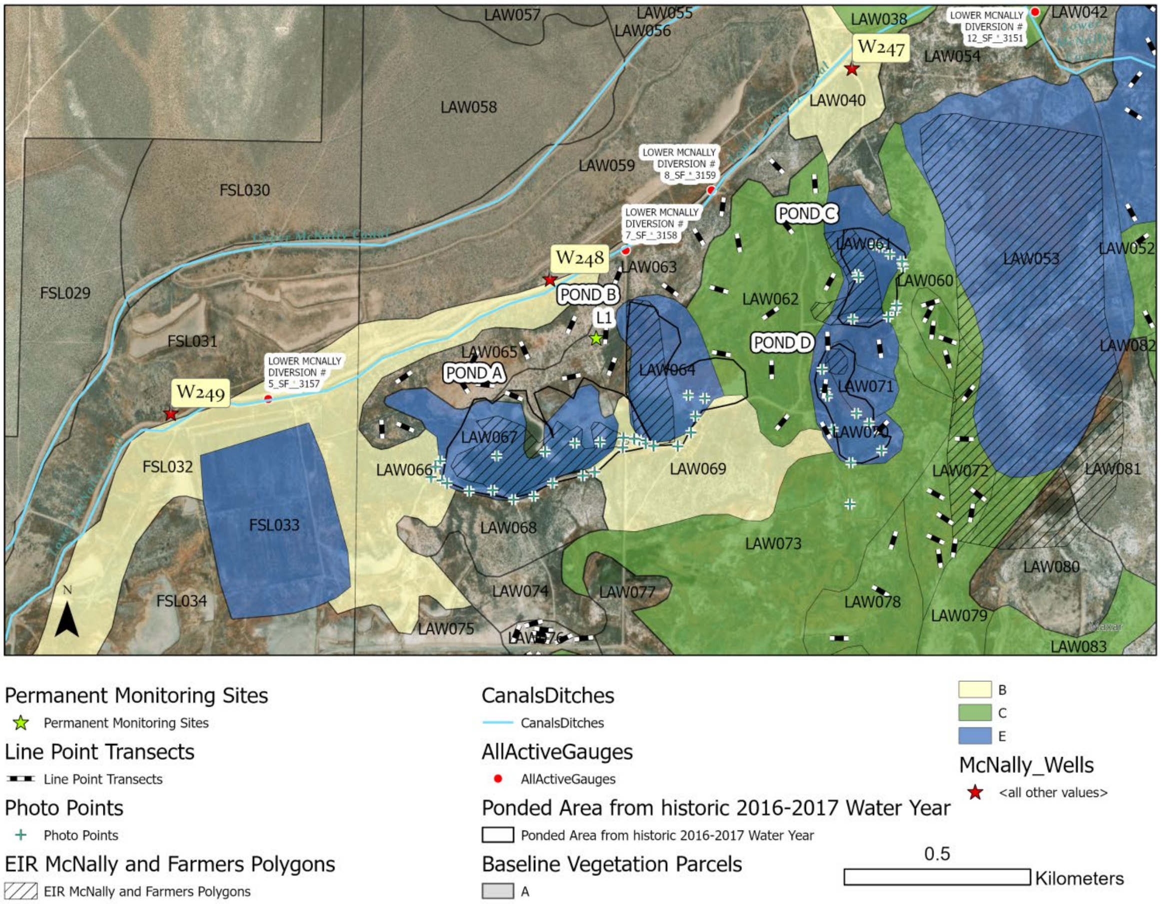


Figure 3. *McNally Ponds and Pasture Area south of Lower McNally Canal. Locations shown include vegetation parcels, line point transects, permanent monitoring site (Laws #1), diversions from the Lower McNally Canal, pumping wells, and 2021 photo points.*

Three transects within Farmer's pond 4 were established using methods consistent with the riparian monitoring program the Water Department is developing. These data include basic characterization of tree stature and condition, tree size class distribution, understory cover, and tree cores which will be analyzed to estimate establishment dates.

The satellite record from Landsat 5, 7, and 8 (1984-present) was queried from Climate Engine (2021) to provide the normalized difference water index (NDWI) proposed by McFeeters (1996) (Eq. 1) to detect open water (using the Green to Near Infrared ratio) and the normalized difference vegetation index (Eq. 2, using Red to Near Infrared ratio) to evaluate the 35-year association between the timing of ponded water (NDWI) and vegetation changes (NDVI). The overview and details of using the javascript and python APIs to query Google Earth Engine can be found in Huntington *et al.* (2017).

$$NDWI = GREEN\text{-}NIR/GREEN+NIR \quad (1)$$

$$NDVI = RED\text{-}NIR/RED+NIR \quad (2)$$

A maximum flooded extent GIS layer was created to show the distribution of water in spreading basins derived from the NDWI greater than zero over the historic 2016-2017 water year when the spreading basins off of the McNally canals were flooded for much of the spring and summer. Though outside the fall-winter flooding season of the project, these high runoff years dictate when most spreading basins were activited and influenced the existing vegetation assemblage. Using NDWI can also clearly show which basins have been activated recently and the approximate flooded extent.

Aerial imagery services from ESRI (ESRI map service) and Google Earth (Google Earth Imagery Historical Archive) providers include some growing season images in years when Farmer's ponds 3 and 4 were flooded and the ponded extent were used to interpret vegetation distribution in the project area.

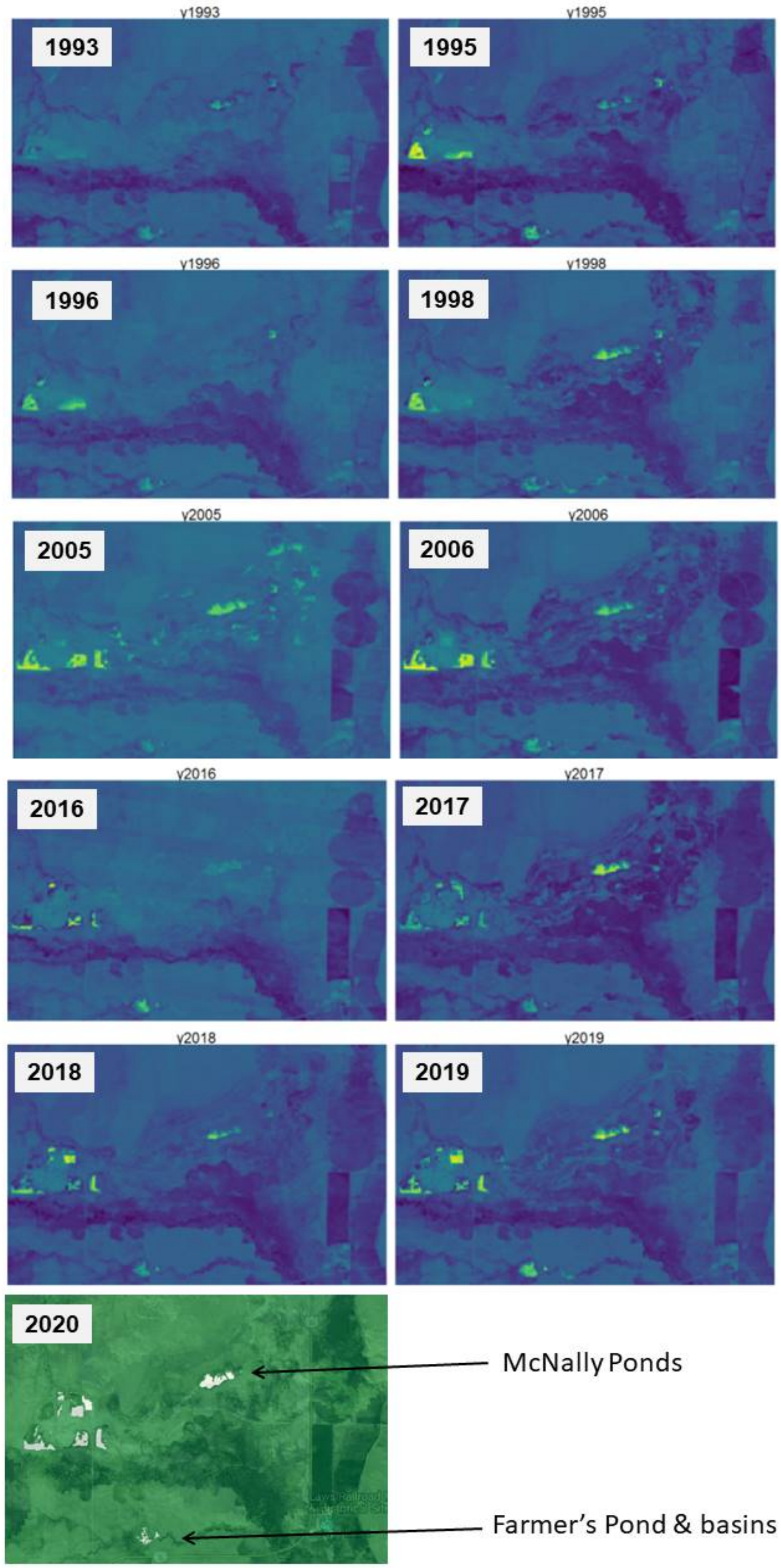
Maps are shown with National Agricultural Imagery Program NAIP (2018) false color near infrared, or 2020 Maxar Vivid imagery (2020) from ESRI map services. Plant species present in both project areas and the species codes displayed on maps are presented in Appendix A.

Biological Assessment Results

McNally Ponds

Monitoring data from the Greenbook vegetation parcels adjacent to the Mc Nally Ponds project area provide information regarding site conditions. Parcels classified as Intermittent Water include pond A (Laws67), pond B (Laws64), and pond C (Laws61) (Figures 2 & 3). Parcel Laws 70, mapped as rush/sedge meadow, includes pond D. Over the past 30 years, and first evident in 1993, McNally Ponds received a supply of either pumped and/or surface water in approximately 13 out of 31 years during the fall-winter period, based on diversion data and verified by remote sensing (Table 1, Figure 4). Water diverted to the ponds in 2004-5 or 2007-8 was not detected by remote sensing probably due to the relatively small total amount of water diverted and only during a single month at the beginning or end of the wetting period in those years. While the original scope of the McNally Ponds project anticipated 60 acres of ponded water, preliminary imagery analysis found that 60 acres of open water has rarely been achieved.

Figure 4. (below) *Landsat 5/7/8 NDWI (1991-2019) and Sentinel 2 (2020) show fall and winter flooding (light colors) occurred at McNally Ponds in 1993, 1995, 1996 (Pond C), 1998, 2005-2006 and 2017-2019 and 2020 (McFeeter's NDWI > zero highlighted). Farmer's pond 1 was flooded and Farmer's pond 2 received some overflow every year; ponds3 and 4 have been flooded occasionally.*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McNally Ponds
Farmer's Pond & basins

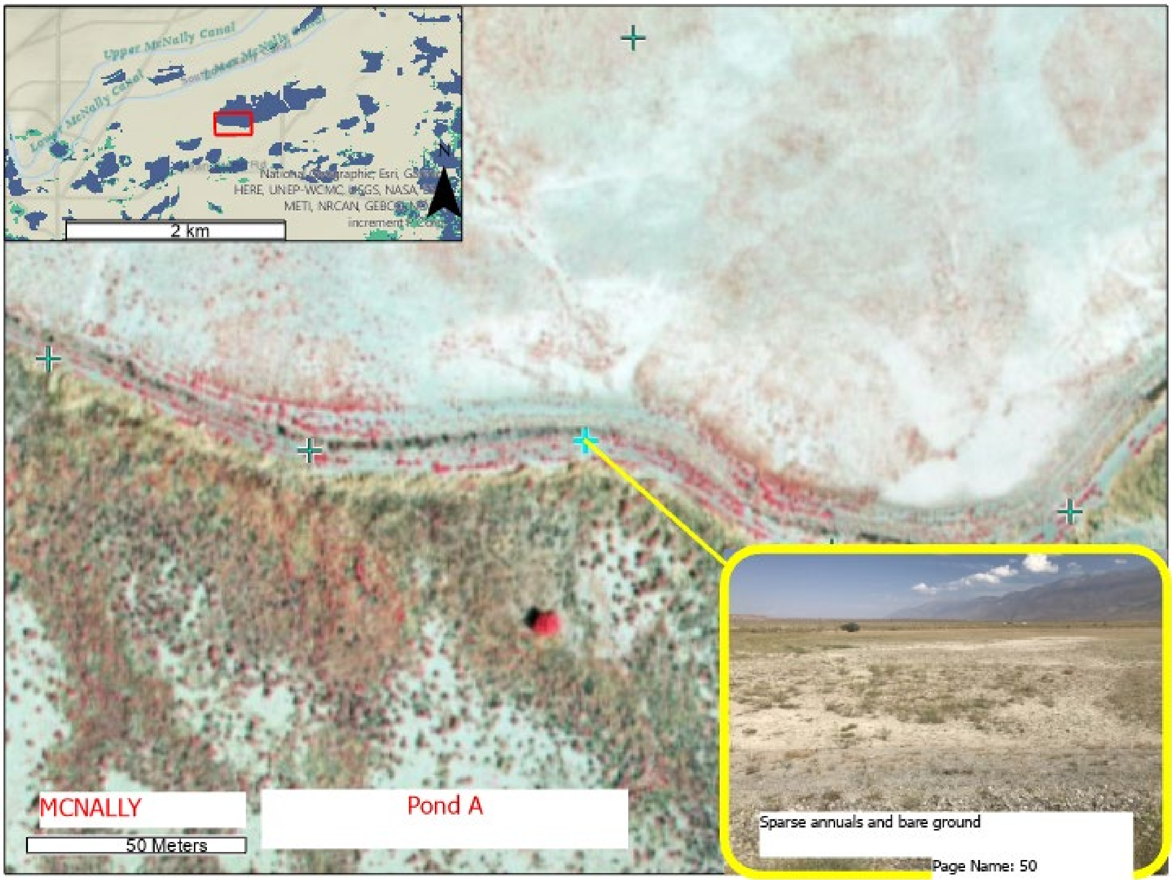


Figure 5. *McNally Pond A sparsely vegetated by annual weedy species (i.e. Salsola tragus and Melilotus alba) with some native Mavella leprosa. The pond most recently flooded in 2020 with drawdown in winter 2021.*

Presumably in part owing to the infrequent water delivery, including consistent inactivity from 1999-2004 and 2007-2015, the McNally Ponds project hasn't created a robust annual plant community to provide waterfowl food resources when the basins are flooded. Ponds A (Figures 5 & 6) and B (Figure 7) are sparsely vegetated with native perennial and exotic annual species including *Malvella leprosa*, *Melilotus albus*, *Laennecia coulteri*, *Lepidium latifolium*, *Salsola tragus*. Pond C has been thoroughly colonized by saltcedar and has been actively treated in recent years; ongoing removal will be needed to reduce its prevalence (Figure 8). Deactivating this unit until the saltcedar is removed again could alleviate future costs associated with weed control.

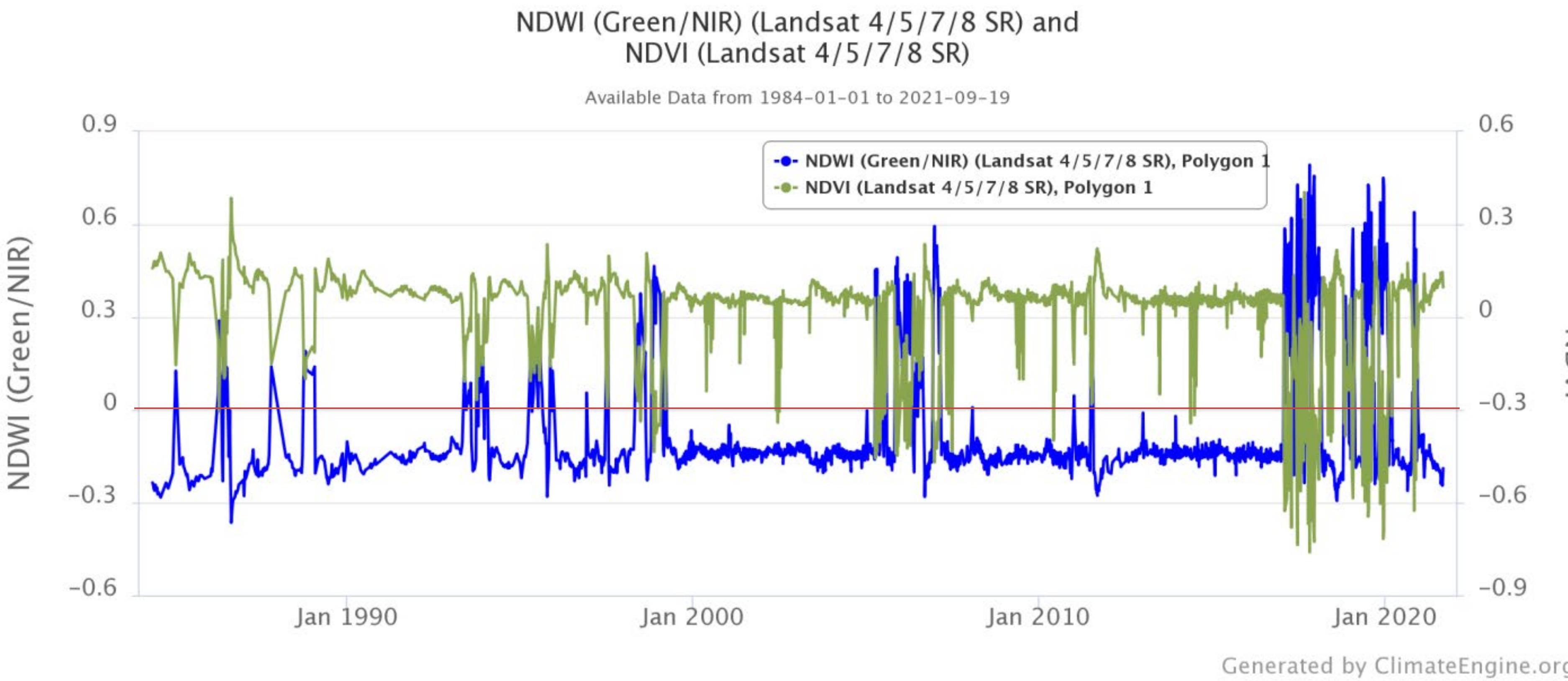


Figure 6. *NDWI above zero indicates open water in McNally Pond A. The annual growing season NDVI signal from annual herbaceous species increases very marginally after flooding relative to years with no antecedent flooding, but not to the degree that Farmer's Ponds NDVI increases after flooding (compare Figure 19, Farmer's Pond 1).*

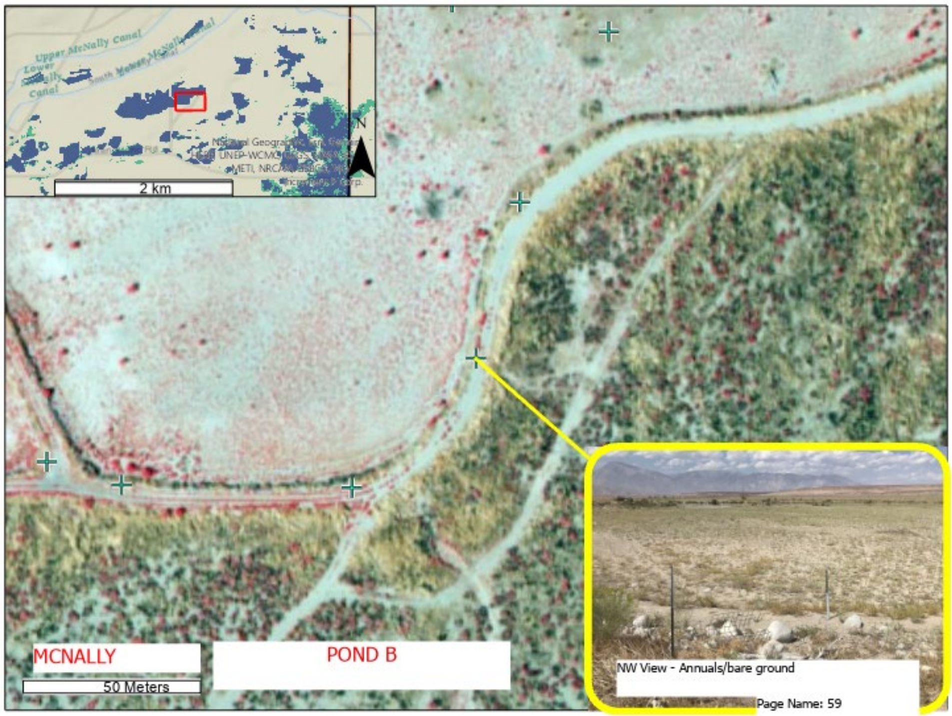


Figure 7. *Pond B, similar to A, has low vegetative cover and is dominated by annual weedy species. The northwest corner of Pond B supports some Typha Domingensis and Tamarix ramosissima.*

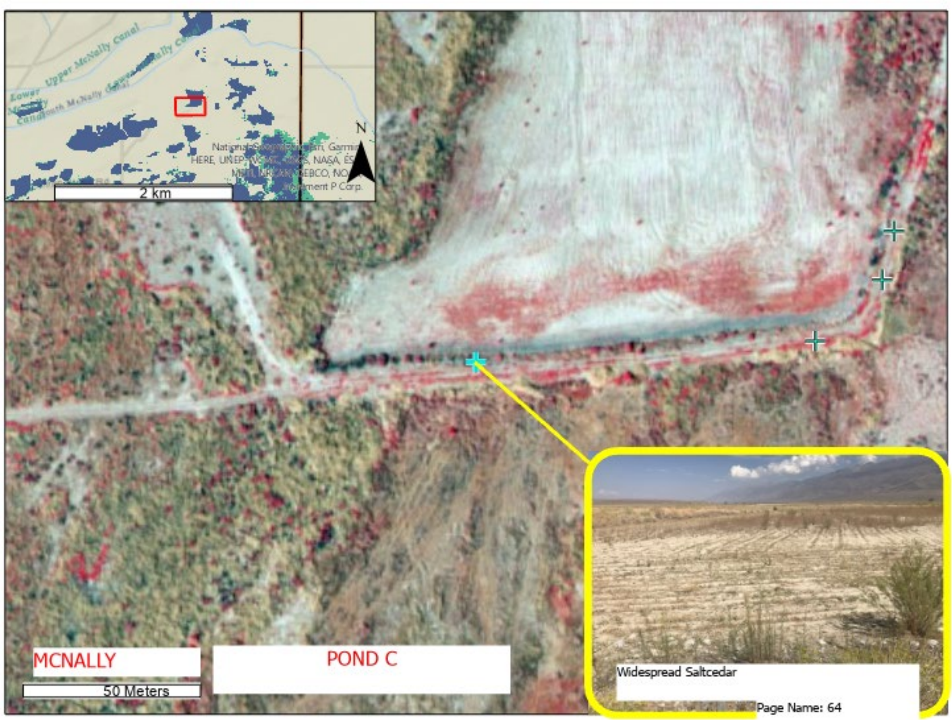


Figure 8. *McNally pond C has widespread saltcedar (Tamarix ramissisima) throughout the basin.*

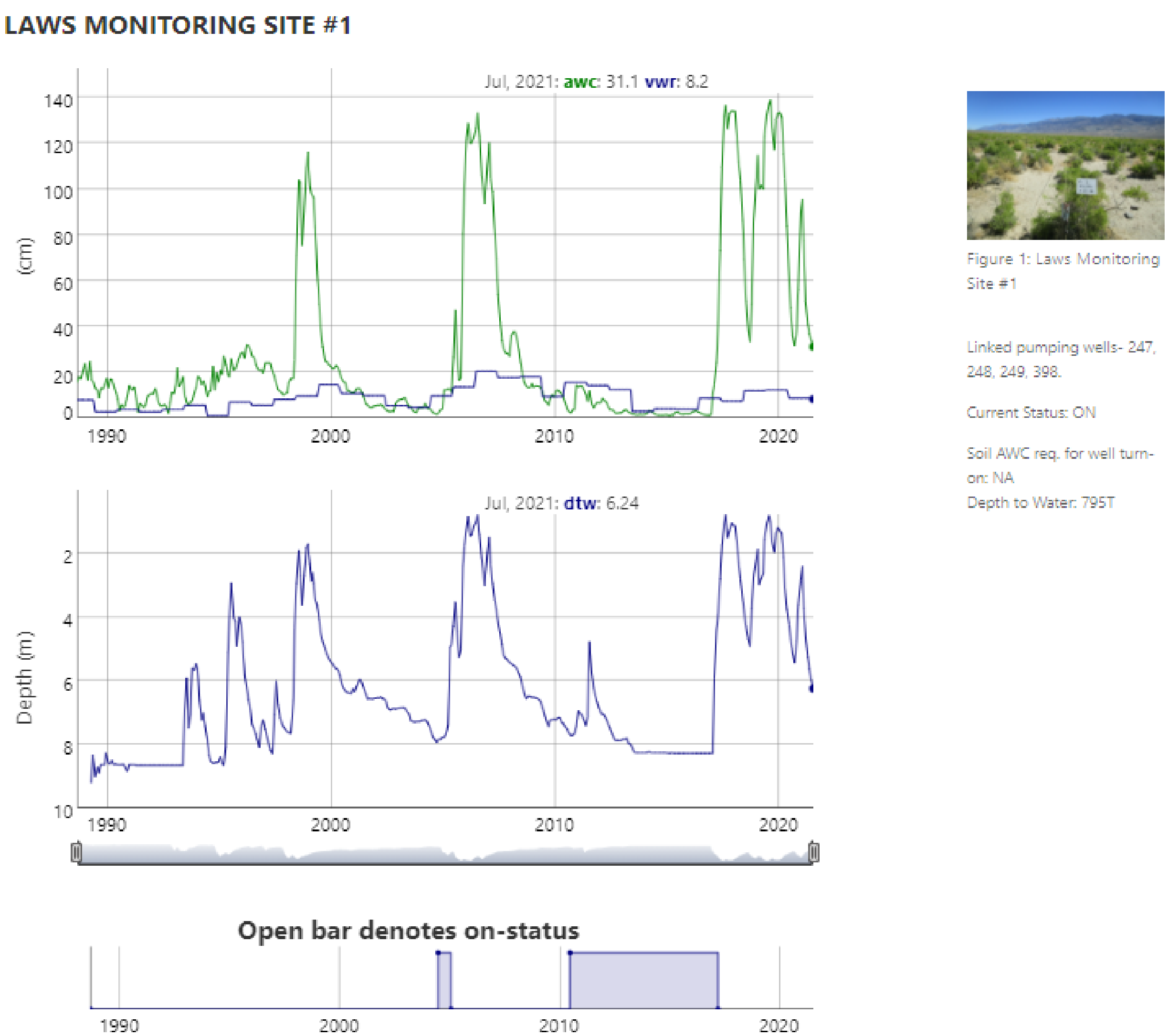


Figure 9. *Vegetation water requirement and available water content at Laws monitoring site #1 linked to wells 247, 248, 249, and 398. Depth to water is shown for 795T (https://www.inyowater.org/wp-content/uploads/2021/09/soilwaterOct2021b_LW_BP.html).*

Water levels and soil water levels increase rapidly when Owens River water is delivered to the McNally Ponds for spreading operations (Figure 9). Typically, the pond surfaces are prepared using tillage before spreading to enhance infiltration.

Laws 65 (classified as Alkali Meadow, Figure 11) and Laws 63 (Desert Greasewood Scrub, Figure 12), are both Green Book Type A parcels directly north of pond A, between the pond and the lower McNally Canal. Laws 63 includes Laws monitoring site #1 (Figure 10) which is linked to pumping wells W249 and W248 that have been pumped in the past to fill the ponds. Laws 65 is classified as alkali meadow, maintains less than 5% perennial grass cover and has responded positively when groundwater level rises and wets the root zone.

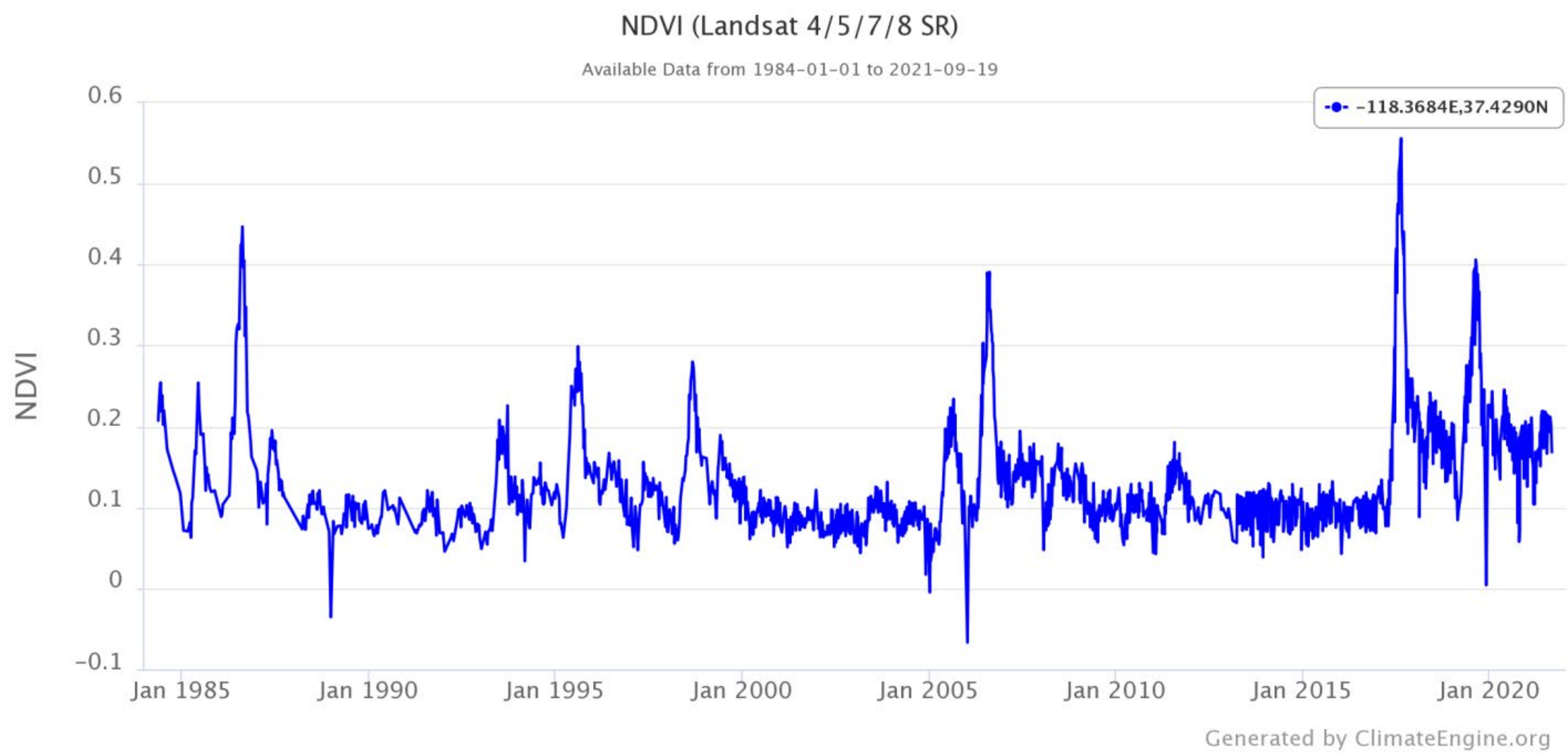


Figure 10. *NDVI measure of vegetation cover at Laws Monitoring site #1 responds to changes in groundwater level (compare 795T; Figure 9).*

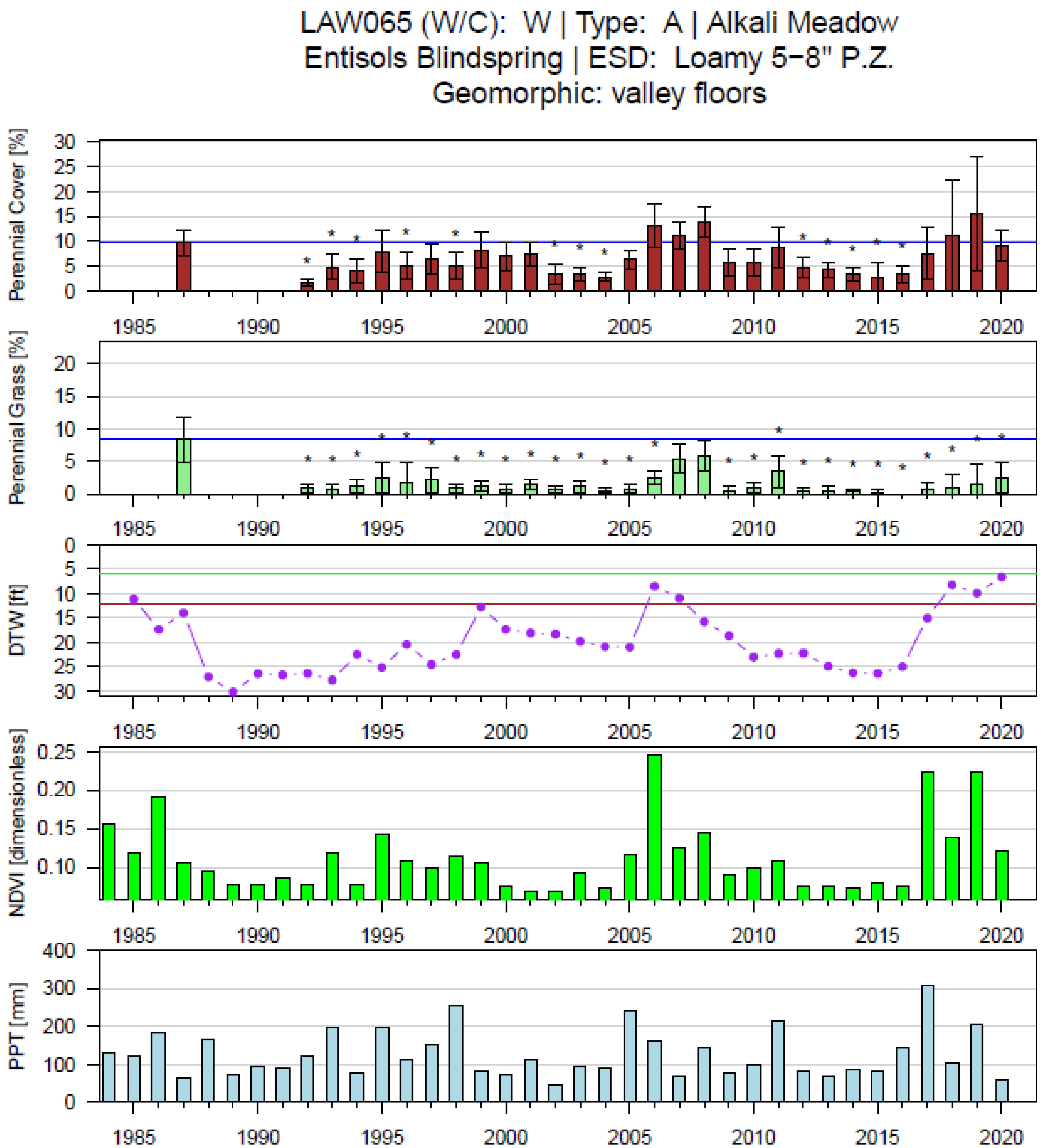


Figure 89: Two−Sample t−Test: Baseline (lpt) vs. reinventory (* p < 0.05).
Baseline sample size (n = 6). Current year sample size (n = 8). Error bars = 95% CI.

Figure 11. *Laws 65 Type A Alkali Meadow lies directly between the McNally canal and Pond A. Line Point Cover (total perennial and perennial grass cover) in the first and second panels; depth to water table (DTW), Normalized Difference Vegetation Index (NDVI), and precipitation (PPT) in the last three panels respectively.*

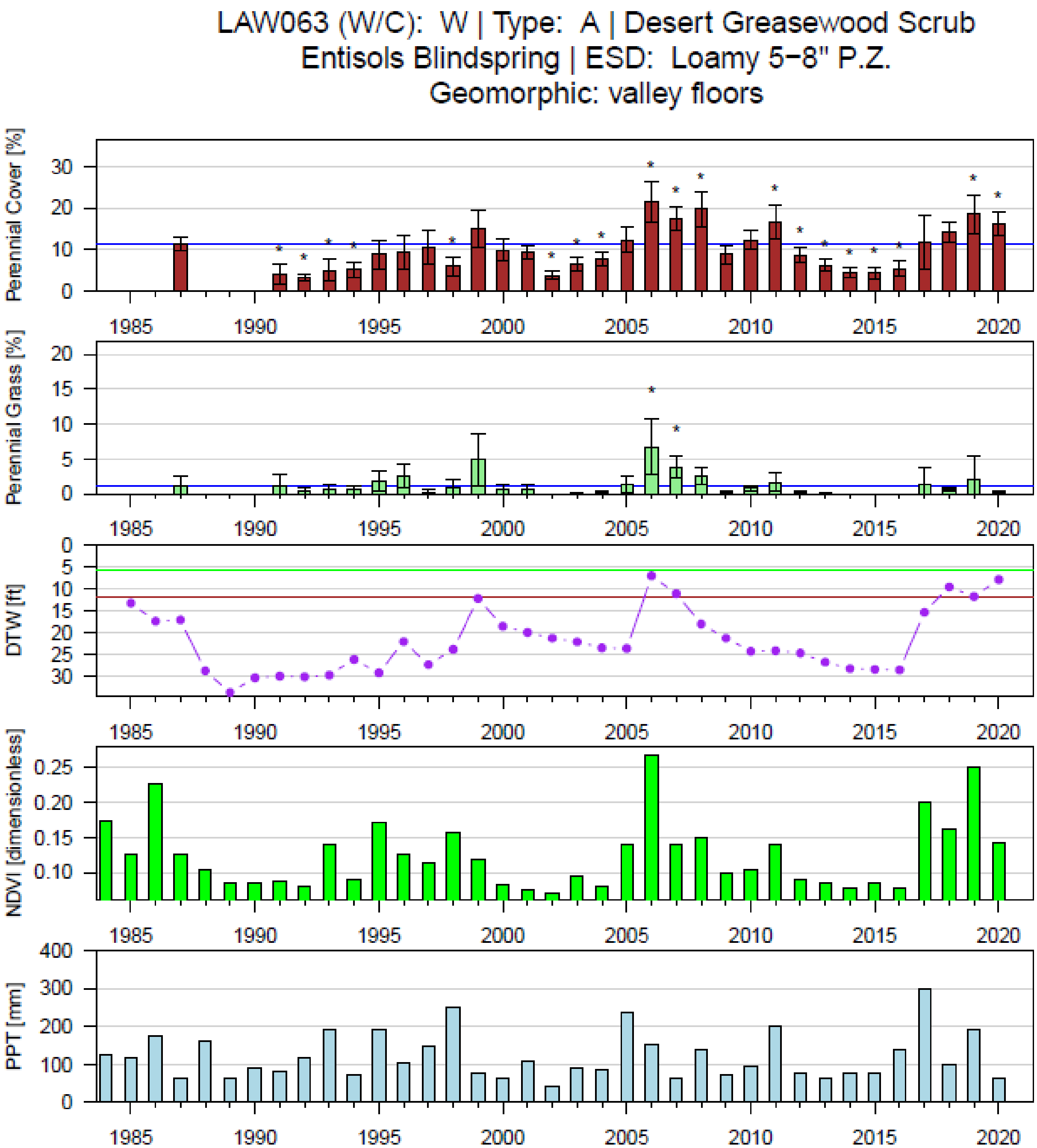


Figure 88: Two−Sample t−Test: Baseline (lpt) vs. reinventory (* $p < 0.05$).
Baseline sample size ($n = 8$). Current year sample size ($n = 9$). Error bars = 95% CI.

Figure 12. *Laws 63: Line Point Cover, NDVI, depth to water, and precipitation.*

Laws 63 and Laws #1 have a similar setting as Laws 65 and similar response of increased grass and shrub cover with rising groundwater level (see 2006, 2017-19 in Figures 11 & 12).

Laws 62, a Type C Rabbitbrush Meadow parcel lies between ponds B and C. The parcel is dominated by *Ericameria nauseosus* and ranges between 10-20% shrub and 5% perennial grass cover. Vegetation cover increases in association with: years of above-average precipitation (runoff), spreading from the McNally Canals, and local groundwater level rises (Figure 13). Given this collinearity of the driving variables, it would not be informative to statistically analyze the effect of filling a single pond or leaving it empty during an otherwise wet Laws spreading year when most other basins are activated.

Laws 60 is a Type C alkali meadow parcel lying between Pond C and the McNally Pasture to the east. The vegetation history as represented by NDVI shows the same trends as other parcels in the area, namely vegetation peaks during high runoff years when the water table rises and contacts or saturates the root zone. In the case of Laws 60 the increase of 0.1 to 0.4 NDVI from summer 2016 to 2017 was associated with a 15 ft. rise in the groundwater level back into the root zone, approximately 12 ft below ground surface (Figure 14). Some of the boost in vegetation productivity can likely be attributed to some direct runoff from McNally Pasture irrigation from the east and seepage from pond C to the west in years that spreading occurred.

Rush/Sedge Meadow Parcel Laws 70 includes pond D, just south of pond C, and supports perennial grass which increases with a rising water table and likely benefits from surface irrigation associated with activation of pond C and Pond D (Figure 15). Laws73 is a Type C alkali meadow parcel that lies south of pond D and Laws70 (Figure 16). It shows a similar NDVI time series as Laws 60 and like Laws 70, responds to rising water table and spreading following high runoff years.

Generally vegetation cover is negligible in the McNally Ponds compared to the annual cover in the Farmer's Pond basins. This annual vegetation in the basin bottoms could act as potential resources for waterfowl if followed with shallow fall and winter flooding.

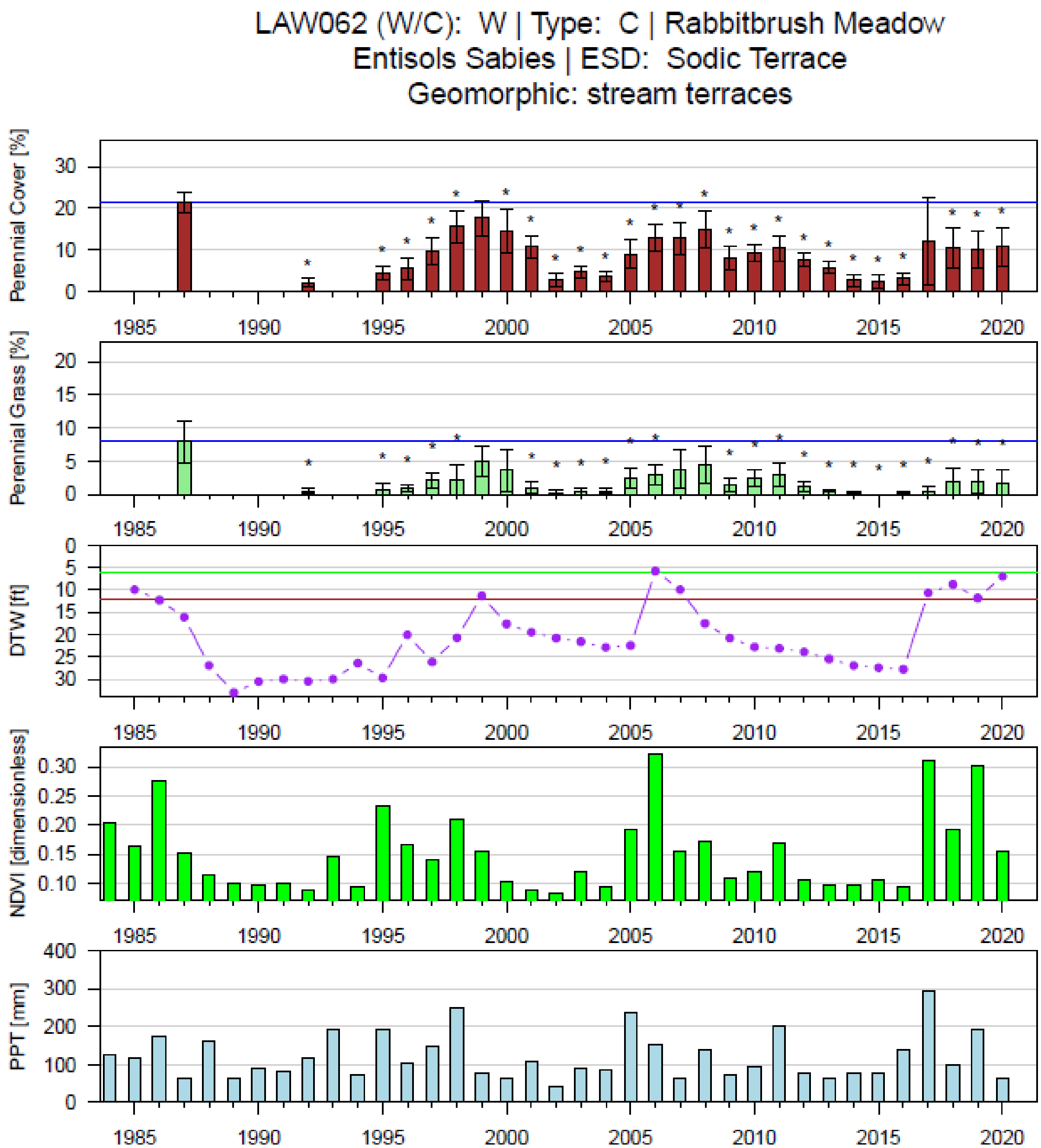


Figure 87: Two−Sample t−Test: Baseline (lpt) vs. reinventory (* p < 0.05).
Baseline sample size (n = 9). Current year sample size (n = 8). Error bars = 95% CI.

Figure 13. *Laws 62 between McNally Pond B and C. Line Point Cover, NDVI vegetation cover, depth to water, and precipitation.*

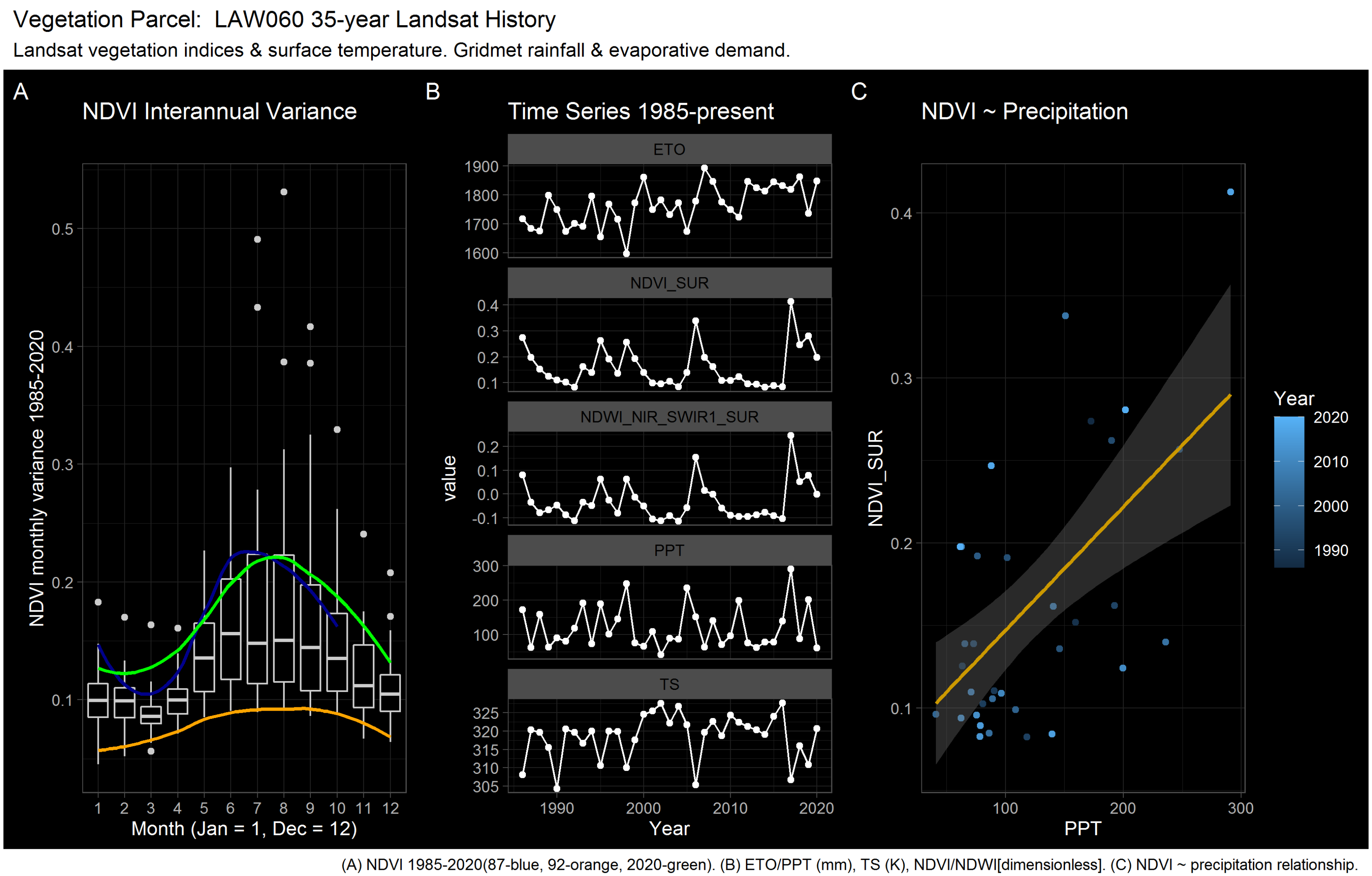


Figure 14. *NDVI cover, evapotranspiration (ETO), precipitation (PPT) and surface temperature (TS) for Laws 60 (east of McNally Pond C), depicting: 1) the boost in cover following periods of water spreading (second panel), 2) a strong relationship between NDVI and precipitation (third panel) and 3) that the response to water table rise is greater than annual variability – or the difference between summer peak productivity and winter low cover (panels 1 & 2).*

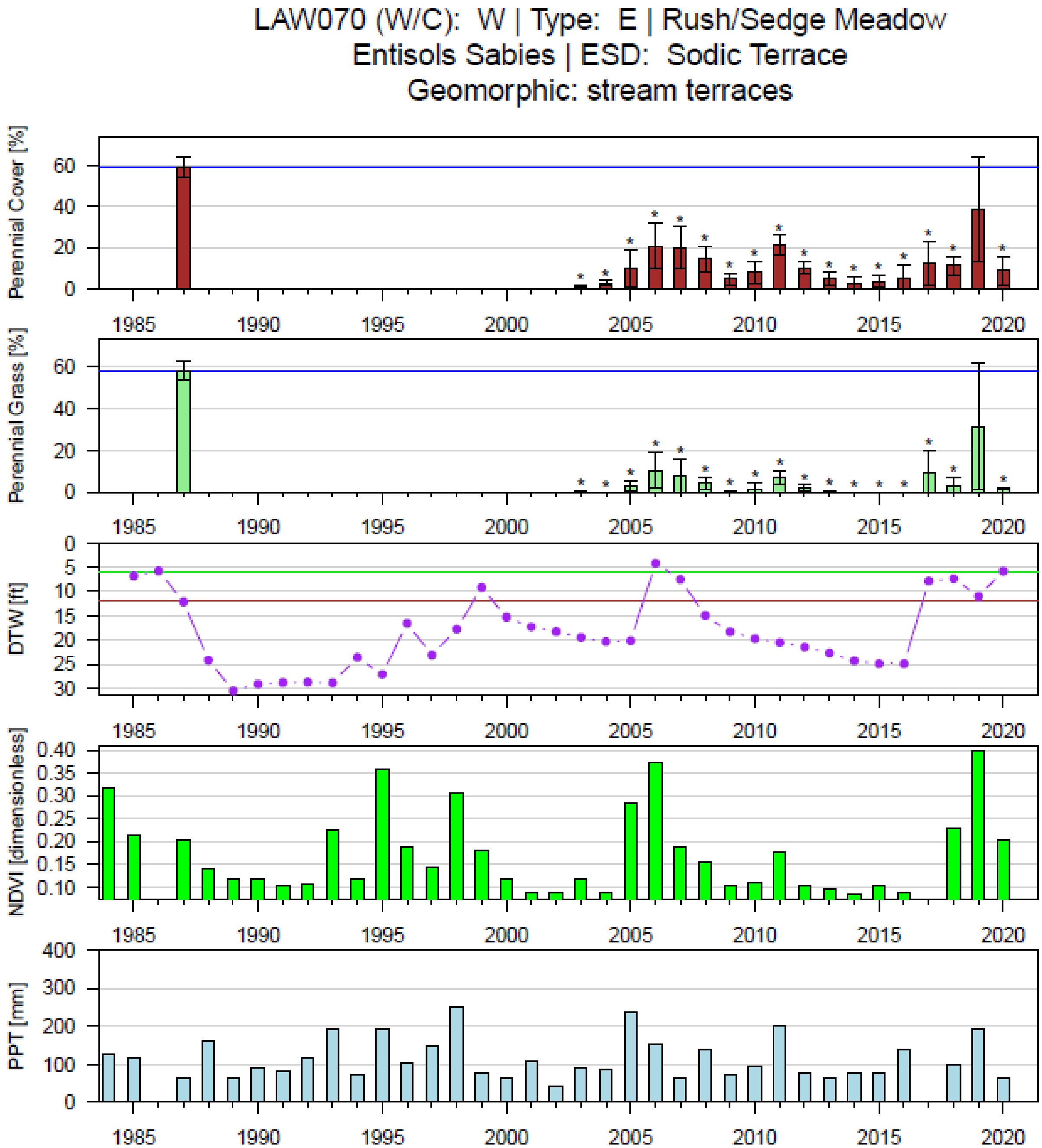
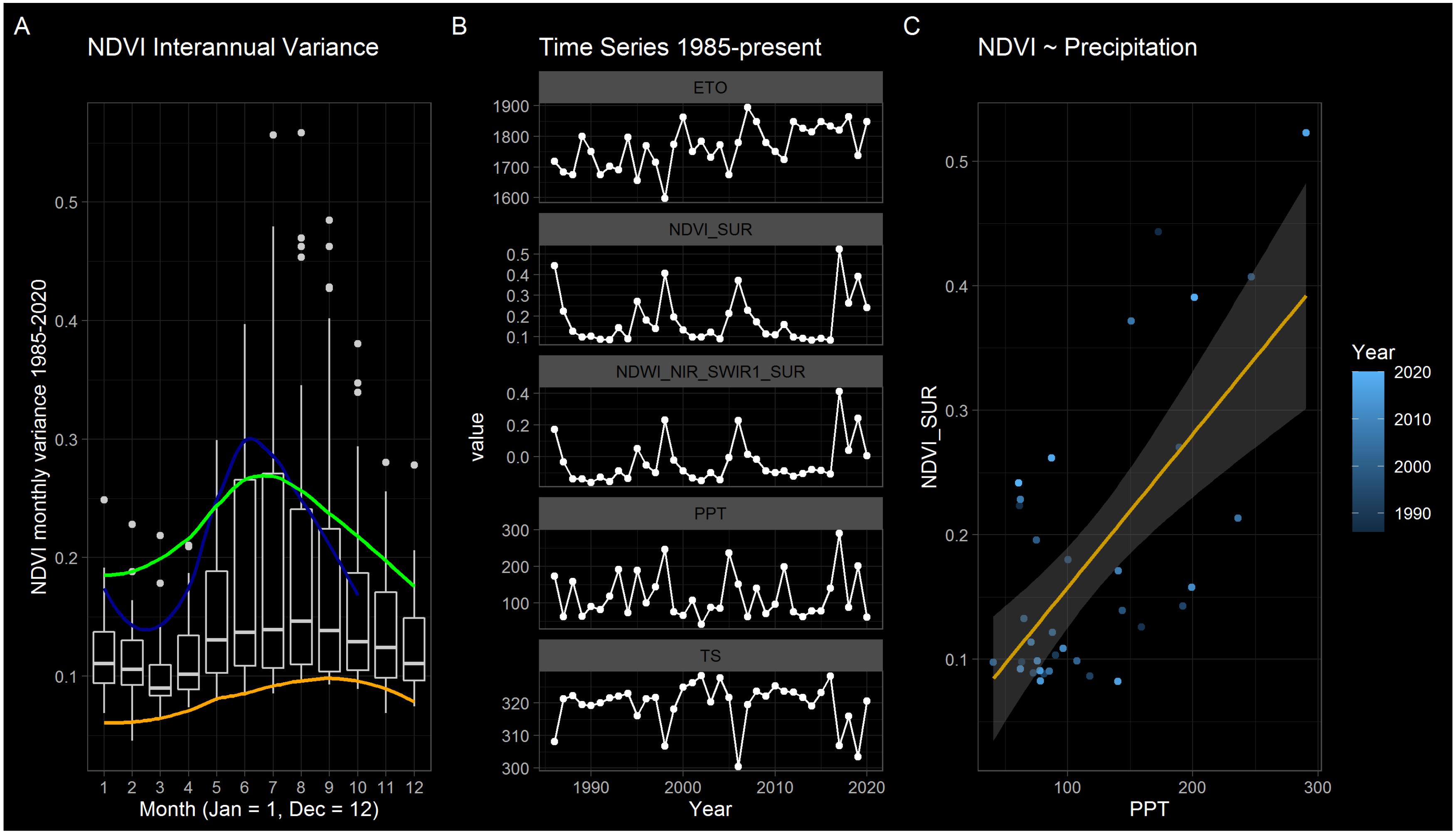


Figure 90: Two−Sample t−Test: Baseline (lpt) vs. reinventory (* $p < 0.05$).
Baseline sample size ($n = 6$). Current year sample size ($n = 5$). Error bars = 95% CI.

Figure 15. *Laws 70 encompassing McNally Pond D. Line Point Cover, NDVI, depth to water, and precipitation.*

Vegetation Parcel: LAW073 35-year Landsat History

Landsat vegetation indices & surface temperature. Gridmet rainfall & evaporative demand.



(A) NDVI 1985-2020(87-blue, 92-orange, 2020-green). (B) ETO/PPT (mm), TS (K), NDVI/NDWI[dimensionless]. (C) NDVI ~ precipitation relationship.

Figure 16. *NDVI cover, evapotranspiration (ETO), precipitation (PPT) and soil temperature (TS) for Laws 73 south of Pond D. This parcel shows a similar NDVI time series to Laws 60, vegetation responds to rising water table and high precipitation years following operational spreading.*

Farmer's Pond

Farmer's pond 1, the existing enhancement project, has had a consistent supply of water during the fall waterfowl migration season (Figure 17). It has high summer cover of annual herbaceous plants before fall flooding which provides food and attracts numerous waterfowl and shorebirds throughout the migration season (as mentioned in Eastern Sierra Audubon Society hot spot list https://www.esaudubon.org/hot_spots/farmpond.htm). Farmer's pond 1 supports a predominant ring of mature cottonwoods around and within the pond that are seasonally flooded during the waterfowl migration period suggesting cottonwoods can persist successfully through fall and winter flooding as presently managed in pond 1 (Figure 18 and Figure 19).

Basin 2 is less frequently flooded (approximately 13 out of 30 years) compared to pond 1 which is flooded every year (compare frequency NDWI above zero between Figure 19 and Figure *20*). The outflow area between pond 1 into basin 2 is dominated by native meadow or wetland species *Distichlis spicata* (DISP2), *Sporobolus airoides* (SPAI), *Juncus balticus* (JUBA), *Rosa woodsii* (ROWO), *Salix exigua* (SAEX), *Salix laevigata* (SALA3), and *Typha domingensis* (TYDO) (Figure 21). At the lower portions of basin 2, where water pools against the berm separating basins 2 and 3, the assemblage of dominant species includes annual *Melelotis albus* (MEAL2) and perennial *Malvella leprosa* (MALE3) in the pond bottom.

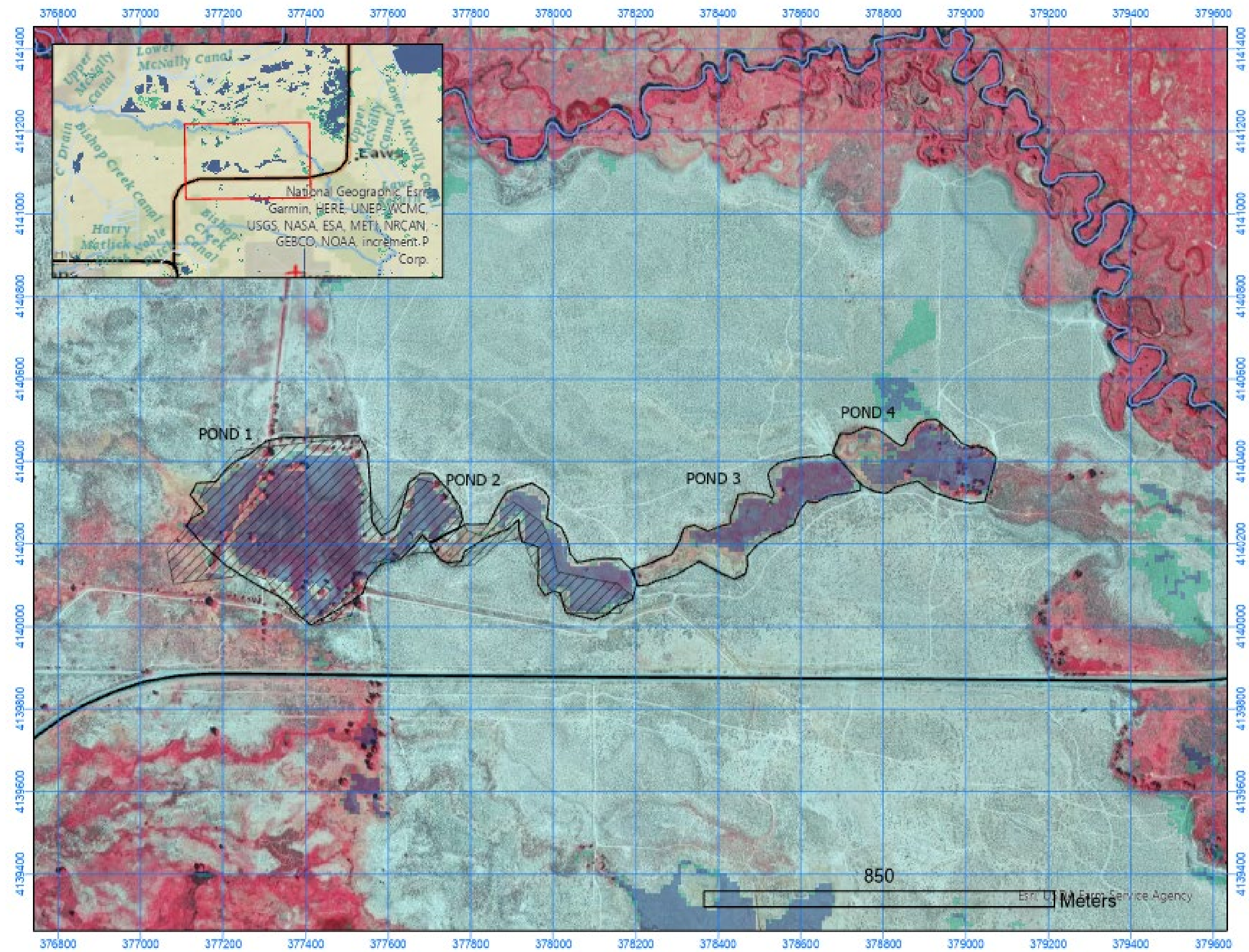


Figure 17. *Farmer's ponds 1 is included in the original Farmer's pond project (western most ponds) and ponds 2, 3 and 4 are proposed as a site for winter flooding each year as an alternative to McNally Ponds. Blue shaded area is the wetted area from 2017 water year operational spreading shown by Sentinel 2 pixels with NDWI max values above zero. Imagery is a 2018 false color NAIP.*

1998

2006

2019

Figure 18. *In wet years Farmer's pond 3 and 4 have been flooded into the growing season as shown here in 1998, 2006 and 2019 (to a lesser extent). The current distribution of perennial grass surveyed in 2021 was generally limited to the non-flooded areas in the July 2006 aerial image. An annual community currently dominates the areas shown ponded in the 2006 aerial image.*

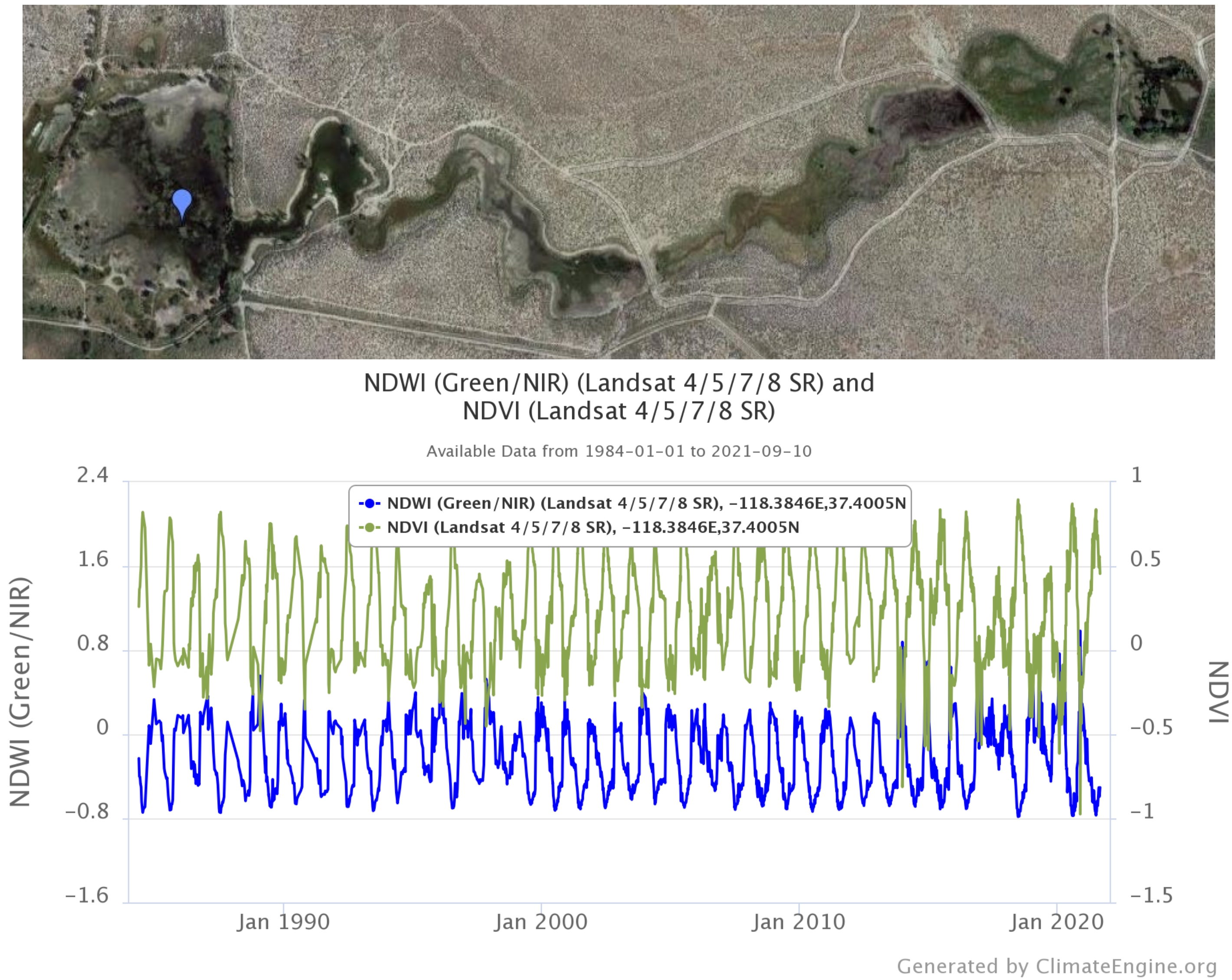


Figure 19. *Farmer's Pond 1 NDWI (blue) and NDVI (green) time series; shows a strong response to water application.* Accessed at https://climengine.page.link/Qykc.

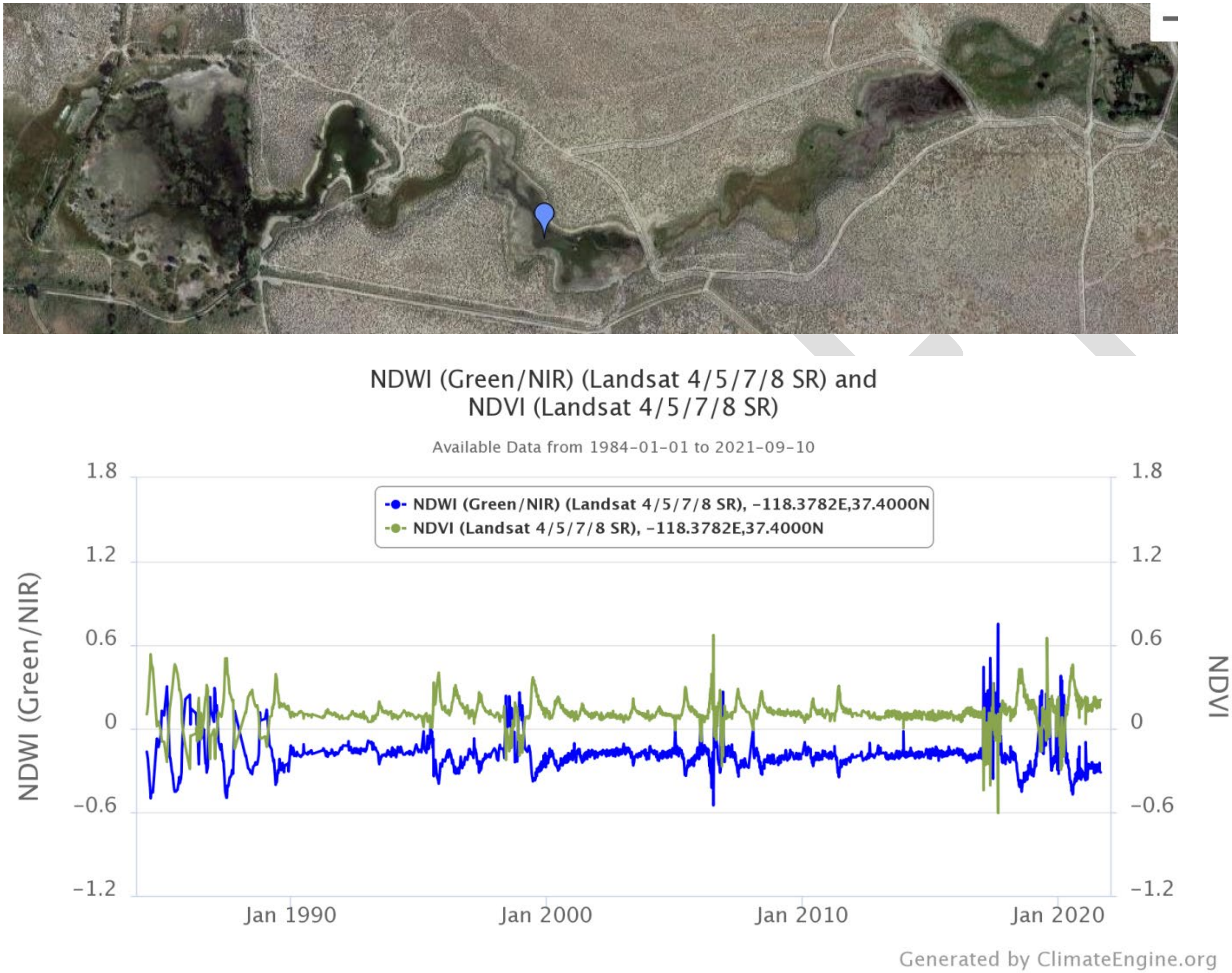


Figure 20. *Farmer's Pond 2* NDWI (blue) and NDVI (green) *time series. Accessed at https://climengine.page.link/3xnK*

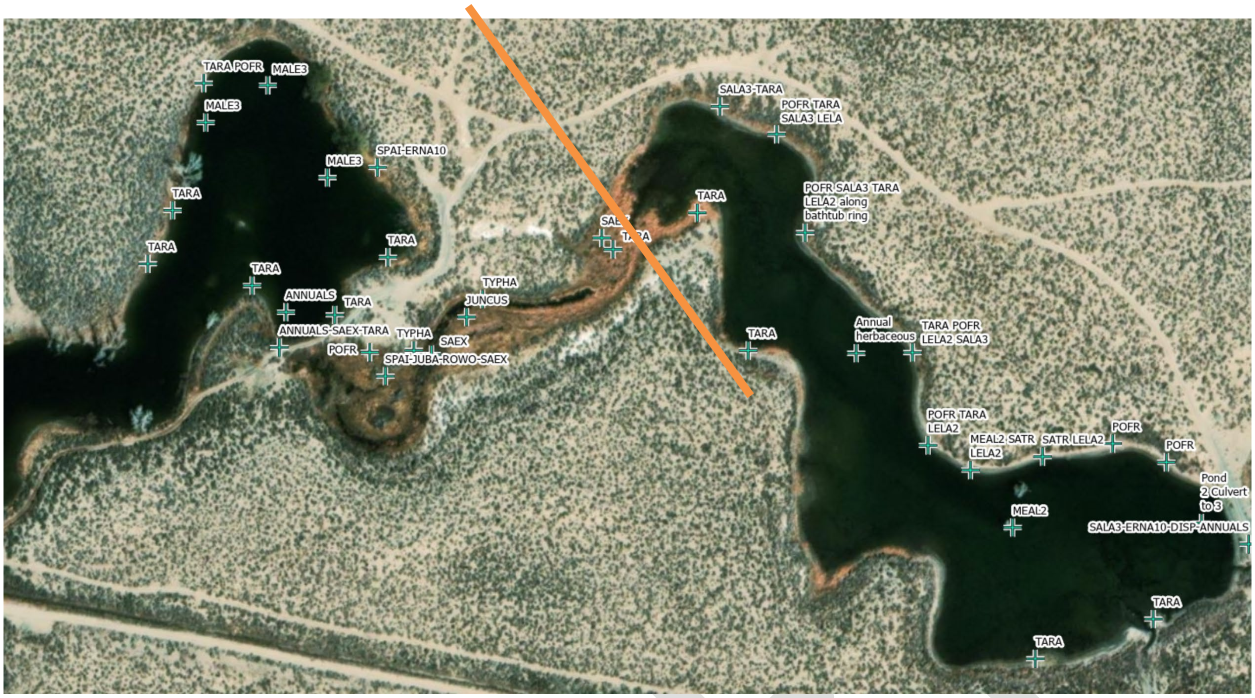


Figure 21. *Farmer's Pond 2 perennial to annual species transition zone (orange line) corresponds to ponded area when spilling into Pond 3.*

Farmer's pond 2 supports hundreds of young cottonwood recruits associated with the high-water line from the 2017-2019 LADWP operational filling of the ponds. Many of these saplings currently look stressed or have already succumbed to xylem cavitation as of 2021 (e.g. Leffler *et al*. 2000). Some may survive to maturity without additional surface water diversions, but activating pond 2 to the extent it spills into pond 3 would recharge soil moisture and likely increase survival among this exceptionally large cohort. In addition to cottonwood, the high-water line from 2017-2019 also apparently allowed recruitment of some *Tamarix ramissisima* (TARA) and *Lepidium latifolium* (LELA2) along both north and south banks of pond 2 (Figures 22 and 23).

Farmer's basin 3 is flooded approximately the same number of years as basin 2 (Figure 24). From the spillover culvert at the top of the basin towards the center of basin 3, ground cover is dominated by perennial grass (Figure 25). The recent filling of basin 3 to its capacity (and associated gradual drawdown) apparently allowed establishment of native cottonwood trees, and exotic saltcedar and perennial pepperweed along the high-water line (Figure 26). Like pond 2, vegetation transitions to *Melilotus albus* with bulrush and cattail interspersed in the lowest topographic depressions most susceptible to flooding (Figure 27).

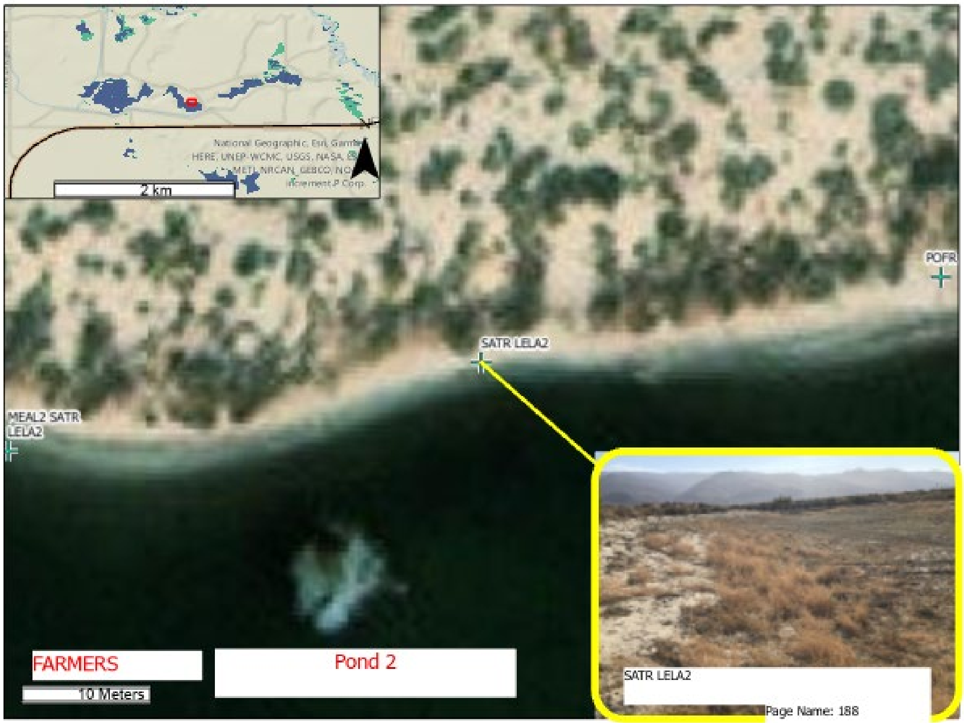


Figure 22. *Exotic species Salsola tragus and Lepidium latifolium on the margins of Pond 2.*

Figure 23. *Farmer's Pond 2 with ubiquitous establishment of non-native saltcedar and perennial pepperweed, along with native trees cottonwood and red willow along the high-water zone.*

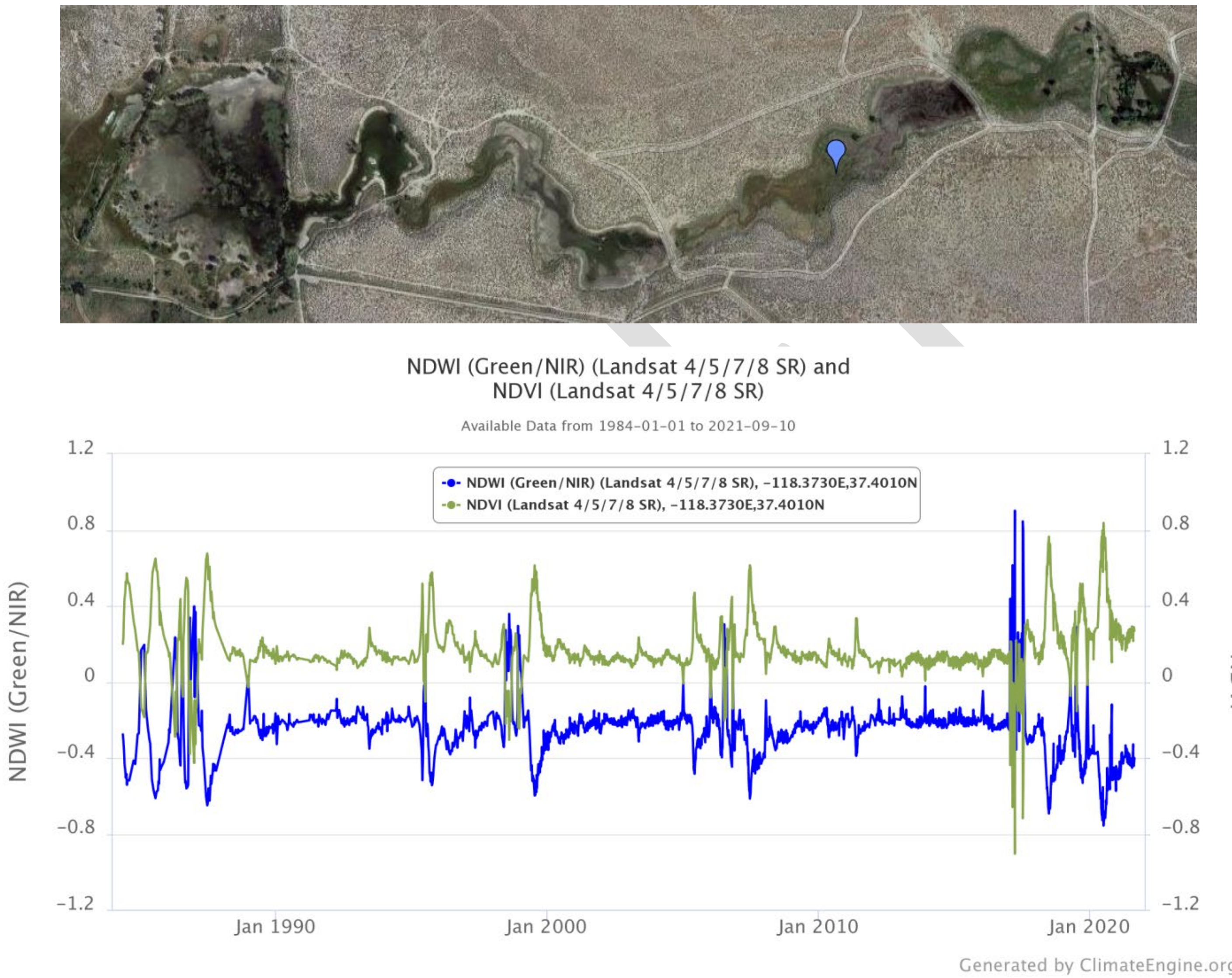


Figure 24. *The 35 year flooding frequency for Farmer's pond 3 indicated when NDWI exceeds zero (blue line). An increase in NDVI is typical following activation of the pond (green line). https://climengine.page.link/evWH.*

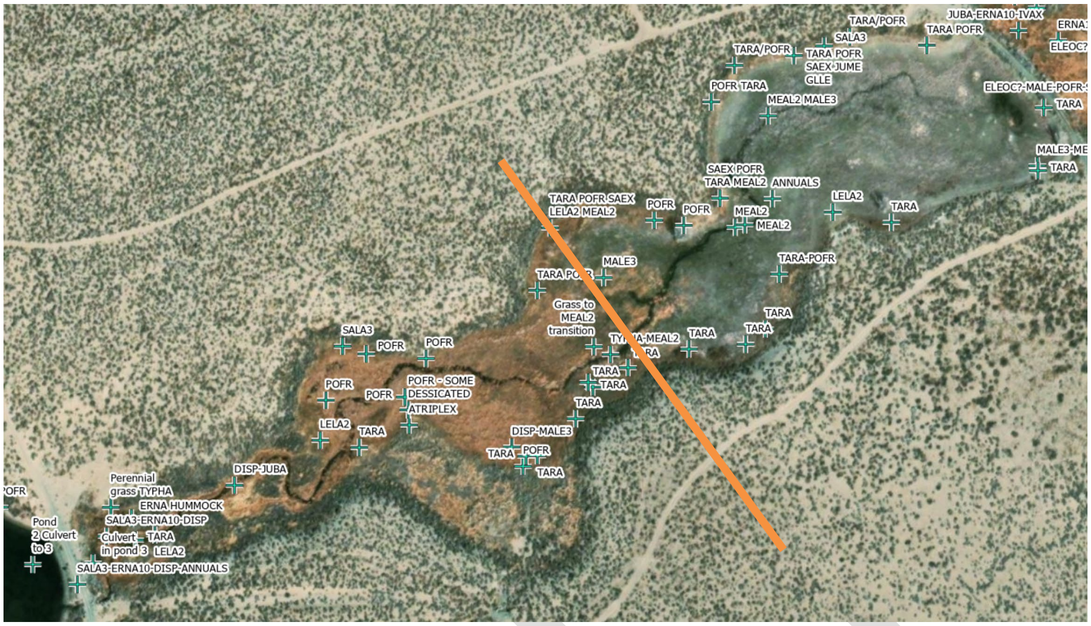


Figure 25. *Pond 3 perennial to annual species transition zone corresponds to ponded area when spilling into Pond 4.*

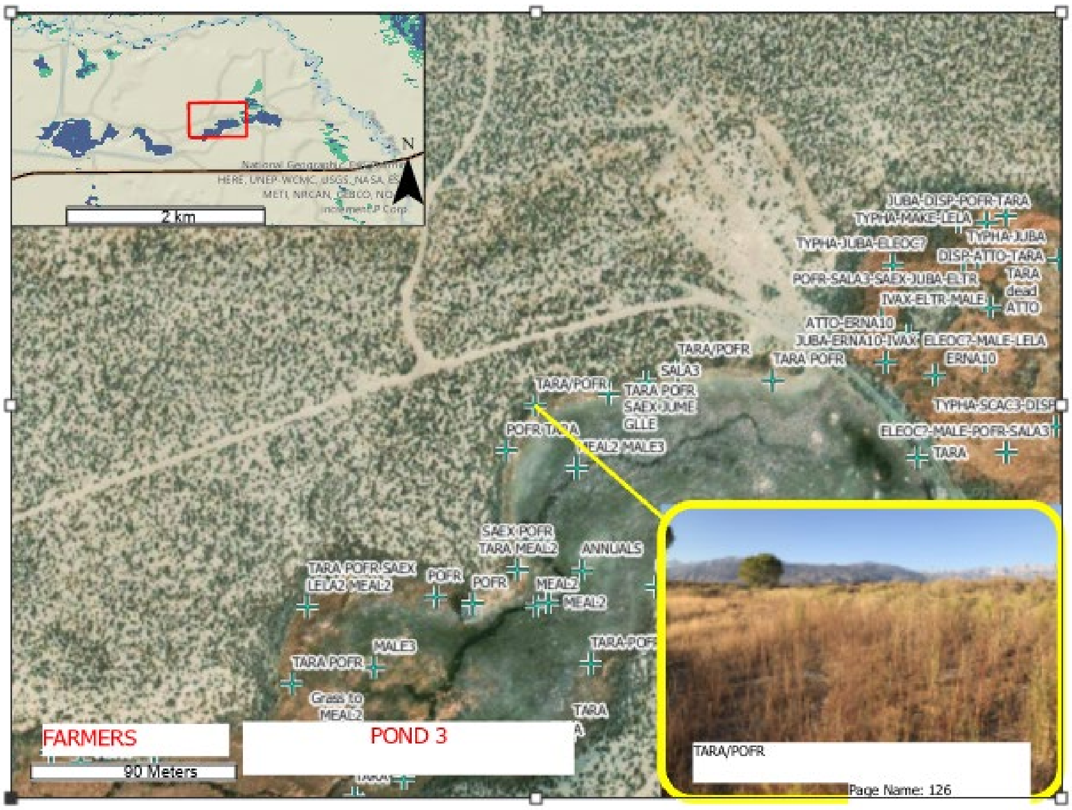


***Figure 26**. The recent filling of basin 3 in 2017 allowed germination and establishment of native cottonwood trees within a few meters of the high-water line on both north and south facing bank margins. Saltcedar and perennial pepperweed also have established within this zone.*

Figure 27. *Dense stands of non-native Melilotus albus dominate in basin 3 where ponded water is slowest to drain near the berm separating Pond 3 from 4. Native perennial Malvella leprosa is also a prevalent low stature ground cover throughout Pond 3.*

Pond 4 is flooded the least frequently of all the basins (Figure 28), and is in the lowest topographic position. In the western portion of pond 4, the vegetation consists of *Ericameria nauseosus*, *Juncus Balticus, Typha domingensis, Schoenoplectus acutus*, *Salix laevigata*, *Eleocharis* sp., *Distichlis spicata*, *Polypogon monspeliensis*, *Malvella leprosa*, and *Iva axillaris*. Further east in pond 4, vegetation transitions to a variably aged tree community with young cottonwood and red willow recruiting in a ring around the high water margins and several interspersed groves of mature trees within the interior at lower relative elevation or near basin bottom (Figures 29-32). Increased tree cover in pond 4 is apparent in aerial imagery after 1998, which likely provided favorable germination and establishment conditions. The high-water line of pond 4 has cottonwood recruitment similar to ponds 2 and 3 (Figure 33).

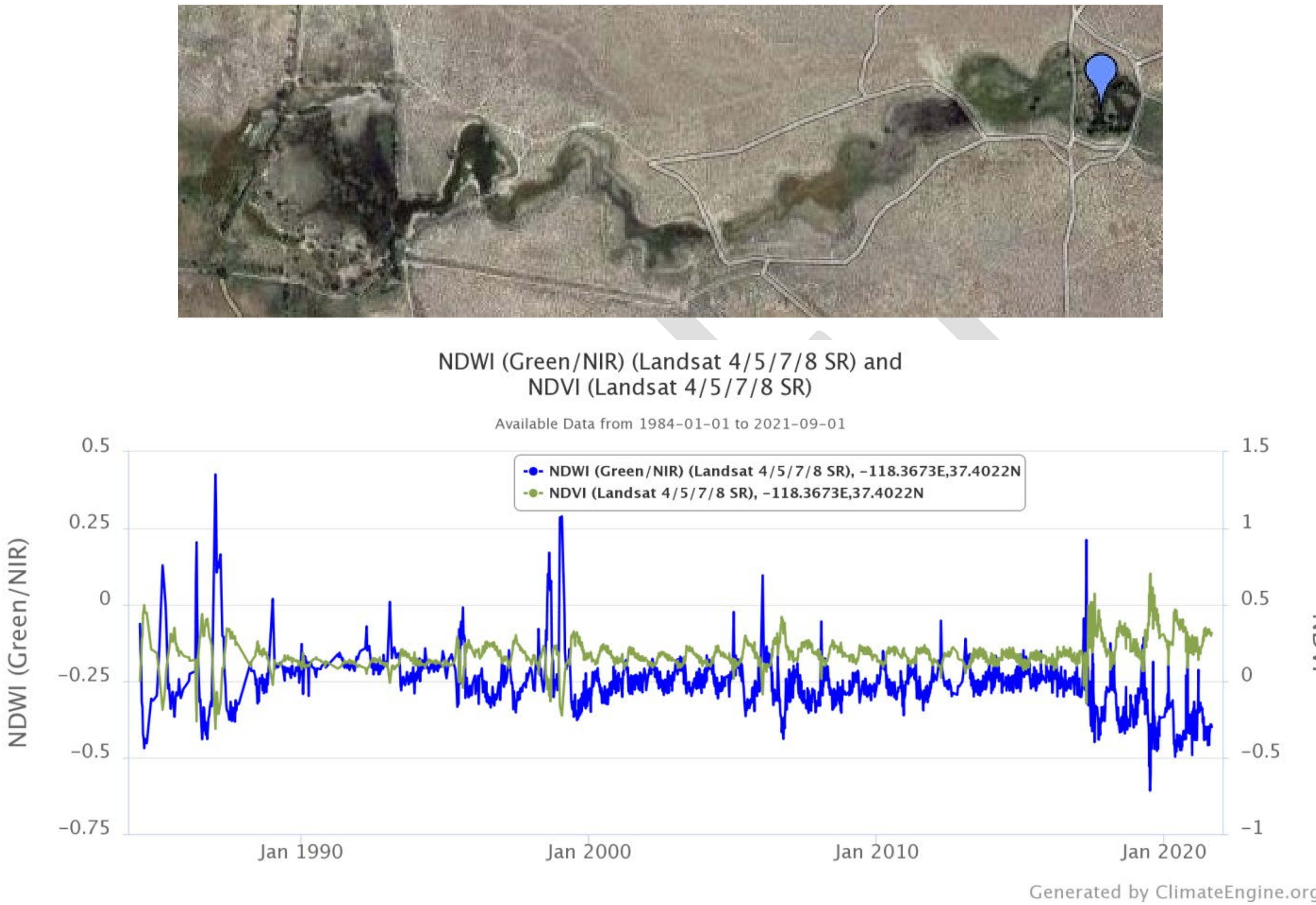


Figure 28. *Normalized difference water index (Green/NIR) and NDVI at Farmer's pond 4, from 1984 to 2021 (data and chart available at https://climengine.page.link/RQ25). Historic flooding in pond 4 is indicated by NDWI above zero. Conservatively, in at least 10 out of 35 years, Pond 4 has been flooded in some portion of the year which has likely allowed the cottonwood and willow to establish*

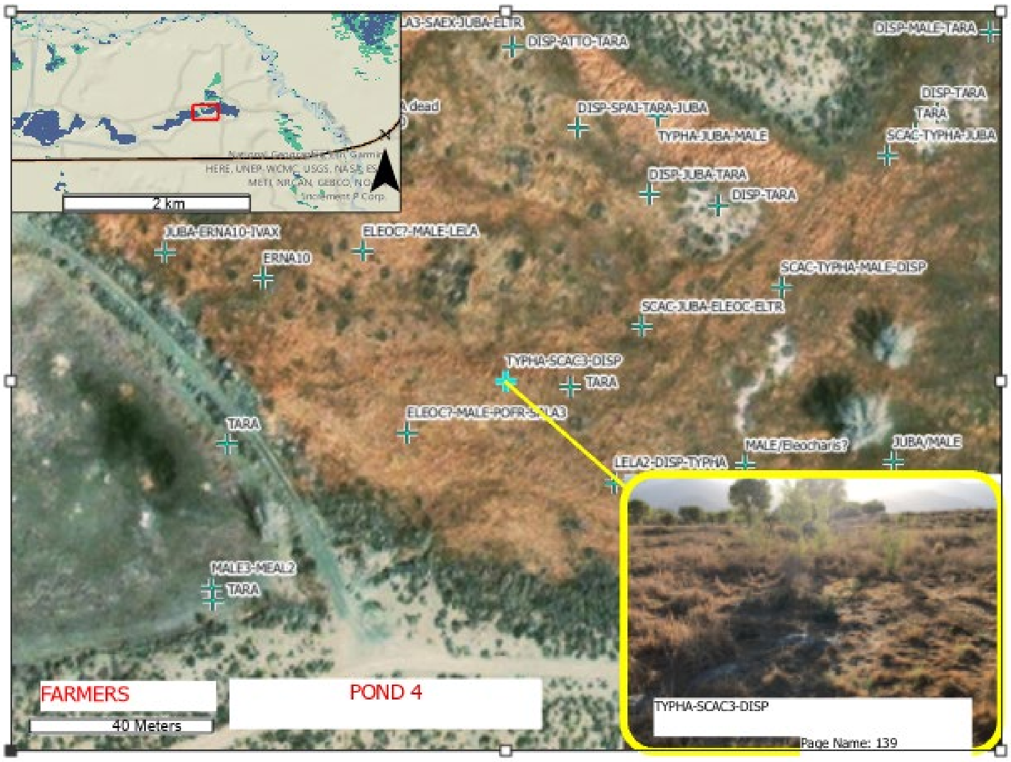


Figure 29. *Pond 4 west contains bullrush (Schoenoplectus acutus), cattail (Typha Domingensis), saltgrass (Distichlis spicata) and some cottonwood saplings (Populus fremontii); cottonwood groves in the eastern portion.*

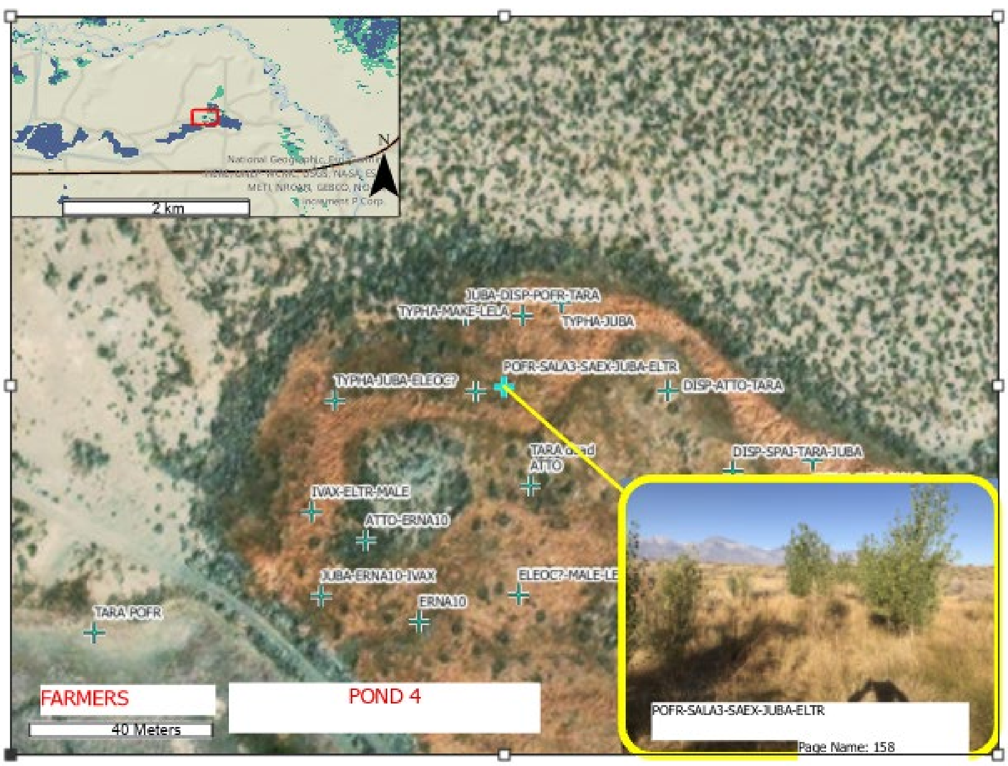


Figure 30. *Pond 4 with cottonwood (Populus fremontii) establishment from the past few years.*

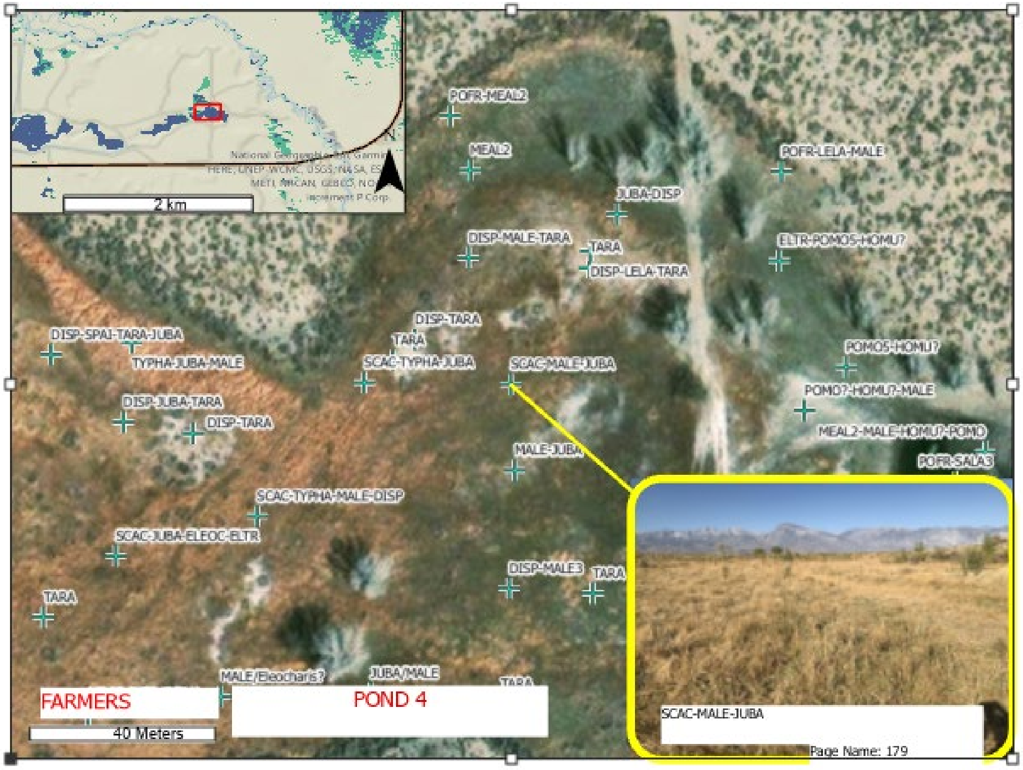


Figure 31. *Pond 4 just west of the dirt road supports wet meadow species (as in Fig 29). Mature trees visible on either side of dirt road.*

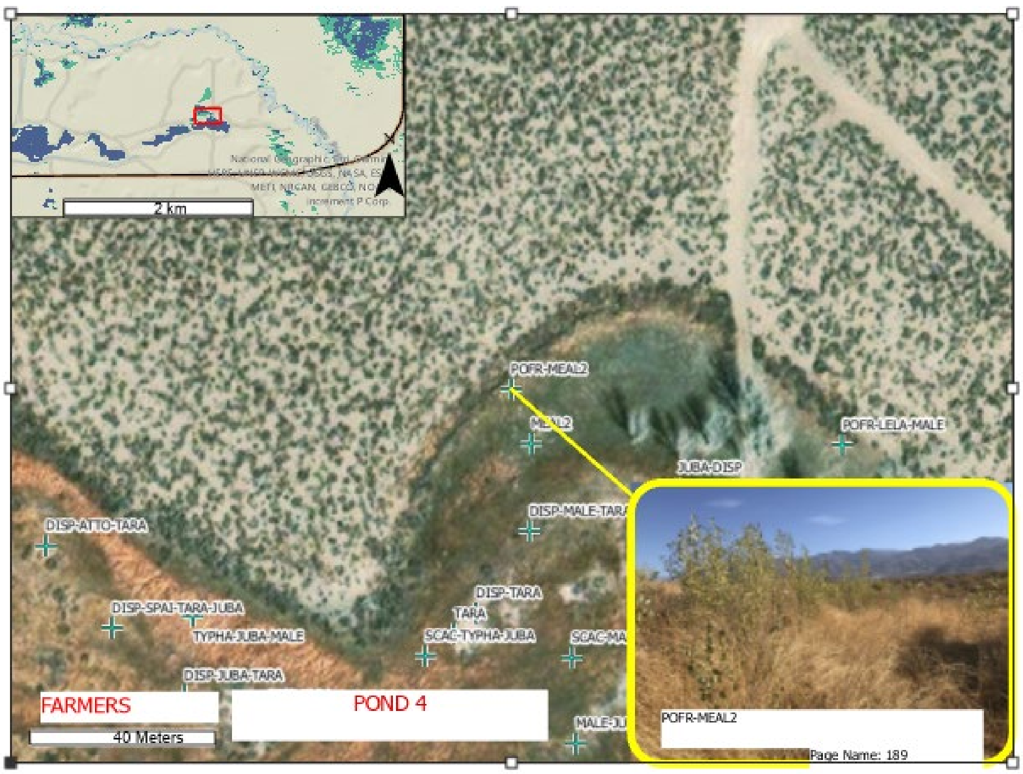


Figure 32. *Cottonwood (Populus fremontii) saplings on the northern margin of Farmer's Pond 4.*

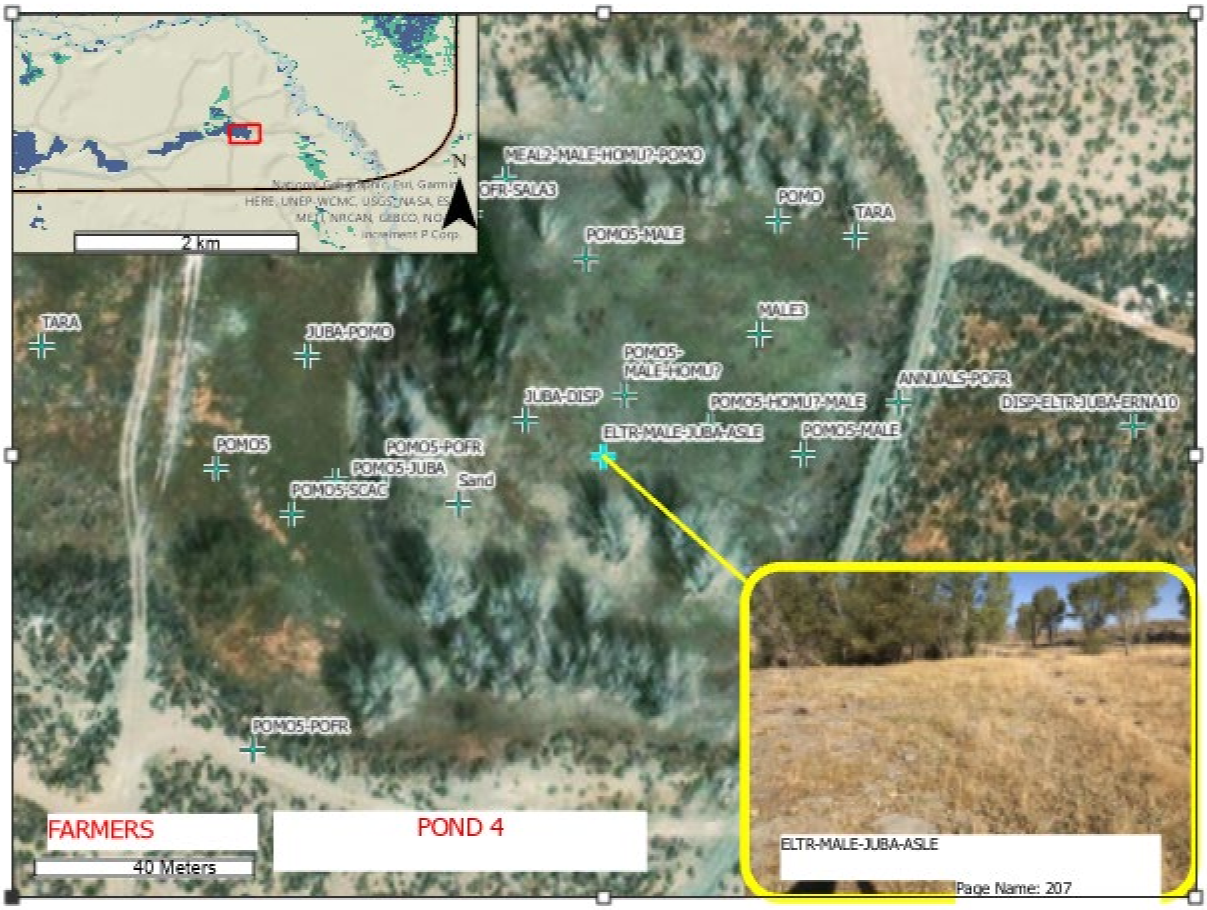


Figure 33. *Western portion of Farmer's Pond 4 depicting a wet meadow vegetation understory of Elymus triticoides, Malvella leprosa, Juncus balticus, Polypogon monspeliensis. Mature riparian woodland species Populus fremontii and Salix laevigata overstory depicted in center and bottom portion of image.*

Table 2. *Preliminary size distribution results for riparian trees from three transects in Farmer's Pond 4; these are actual tree counts not corrected to represent the entire area classified as riparian woodland.*

Size class	Number of individuals	Mean dbh *(basal diameter for seedlings)*	Mean Height (m)	Mean Potential Crown Cover
Seedling	40	2.2	1.3	55
Pole	23	4.4	2.4	67
Overstory tree	42	29.8	11.6	70
Legacy tree	2	57.2	14.9	70

Although not a goal of the original McNally Ponds project, tree-recruitment would be an additional ecological benefit. Therefore, riparian transects were completed in Farmer's pond 4 in order to preliminarily characterize the age distribution and health of the riparian tree community located in the lower, western portion of the basin (Table 2). Three transects sampled the community using a 10 m belt overlaying the transect centerline to record all trees present.

Populus fremontii (Freemont cottonwood) was the primary tree species in this basin, and the only mature tree species encountered, along with some *Salix laevigata* (red willow) recruits. The greatest number of riparian trees (Table 2) were recorded in the seedling (< 2.5 cm basal diameter and < 1.37 m tall) and overstory size class (> 15 cm and <50 cm diameter at breast height, dbh), suggesting large infrequent recruitment events have occurred, likely only in high water years. This agrees with recruitment theory for riparian tree species (recruitment occurs in wet years when soils are saturated in coordination with seed release). Although core samples were taken to better understand ages within these size classes, and therefore year of recruitment, they will not be processed in time for this report. Fewer individuals were recorded in the pole (2.5–15 cm dbh and ≥ 1.37 m tall) size class and only 2 legacy trees (≥ 50 cm dbh; Table 2) were recorded. Low potential crown cover of the seedling size class could suggest some saplings are dying, perhaps due to cavitation, or may be naturally thinning due to high density. Mature trees appeared relatively healthy (potential crown cover score of ~70) on average which corresponds to the low end of stressed (Merritt et al., 2017).

Below Pond 4, Laws184 is a rabbitbrush meadow parcel that receives outflow from pond 4 when it is overflowing and is likely subirrigated through seepage when pond 4 is flooded to any degree (Figure 34). Allowing water to overtop pond 4 and flow towards the Owens River would not be part of the Farmer's Pond alternative.

The Farmer's Ponds support a higher density of annual cover than do the McNally ponds based on cover differences represented by NDVI, Farmer's Pond likely produces greater seed yield from annual species, important for quality stopover and wintering waterfowl habitat (quantifying seed yield was beyond the scope of this evaluation).

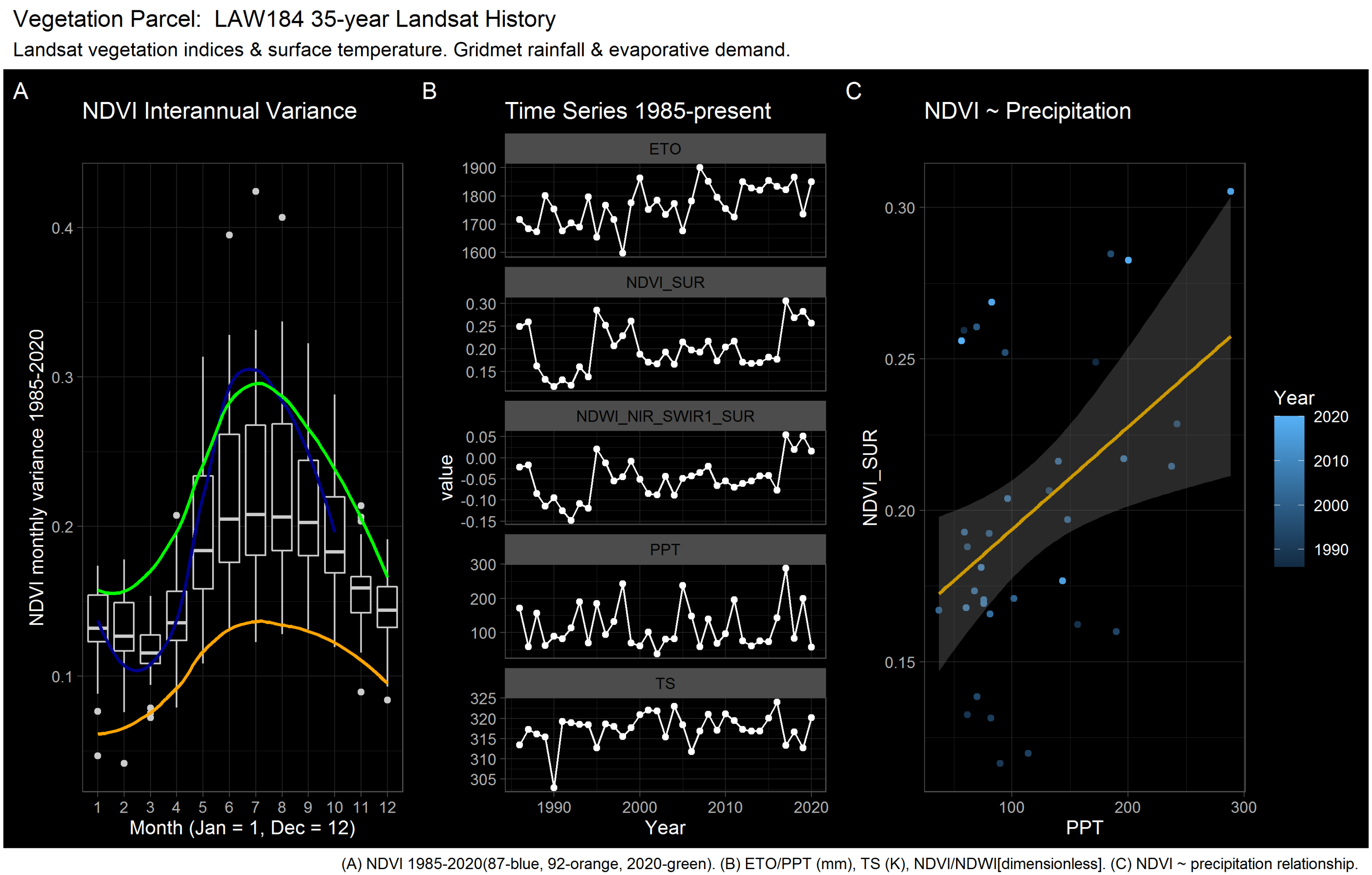


Figure 34. *NDVI cover, evapotranspiration (ETO), precipitation (PPT) and soil temperature (TS) in Laws 184 Type C parcel adjacent to and downgradient of Farmer's Pond 4.*

With regard to perennial plant species, there is a much higher cottonwood and willow seed source within Farmer's Ponds compared to the McNally Ponds. If favorable establishment conditions arise periodically due to wet years stimulating LADWP operational spreading with associated late pond drawdowns, tree establishment would be less inhibited by lack of seed at Farmer's Pond compared to McNally Ponds. Fall and winter flooding of Farmer's pond 2, 3 and 4 would recharge soil moisture to the root zone of the recently established ring of cottonwoods and would likely increase the frequency of survival to maturity for this cohort. Even though the proposed flooding (starting in October and drawdown in March) is likely too early to provide suitable germination sites for cottonwood and willow seed dispersal later in the spring, years when later drawdown is associated with LADWP operational spreading may offer ephemeral windows for tree recruitment. Regular watering at this location would enhance the persistence of recruits that become established in wet years. Aanecdotally based on pond 1, winter flooding adjacent to mature trees seems to not cause undue stress probably because the trees are senescent and roots have access to aerated soil adjacent to the pond. There is a concern that if water remains in pond 4 for an extended period regularly (i.e. in wet years into the spring and summer) there is the risk of killing the existing stand of mature trees in the center of the pond. Inundation should be managed to prevent mature riparian tree loss and be addressed in any operational plan for pond 4 if a project is implemented at this location. The gain of consistently available stopover and wintering habitat for waterfowl and other wildlife and potential to increase and maintain riparian woodland along the Farmer's Pond corridor suggest water supplied consistently at Farmer's vs. sporadic water delivery to McNally, as long as it is adaptively managed to prevent mature tree loss, appears to have higher potential mitigation value.

Perennial Pepperweed

The current distribution of perennial pepperweed within both McNally Ponds and Farmer's Ponds could lead to undesirable expansion when additional water is provided each winter (Figure 35). Expansion might occur independent of basin 2, 3 and 4 activation, and whether or not herbicide treatment is used to control the populations. Given general expansion of perennial pepperweed in the Bishop/Laws area and difficulty eradicating populations once they have become established elsewhere in the Owens Valley, it is reasonable to postulate that perennial pepperweed will expand in both the Farmer's pond complex and McNally Ponds. Farmer's pond 1, however, has experienced the annual fall-winter flooding schedule without large perennial pepperweed populations dominating; rather sparser groups of individuals exist within and around pond margins and in adjacent meadows. Pond 1 also provides high quality waterfowl habitat and maintains mature cottonwood and willow canopy. Early drawdown of the ponds before optimum temperature for germination of perennial pepperweed has probably been a compatible schedule for minimizing colonization in pond 1. A later spring drawdown when day-time temperatures begin exceeding 90-95 degrees and receding ponds leave moist soil are likely optimal conditions for perennial pepperweed seed establishment. Once established a single plant can become a small population, several meters in diameter in 2 growing seasons (Blank and Young 1997). Early drying of the ponds in late winter/early spring would help minimize seed establishment at either the McNally or Farmer's locations.

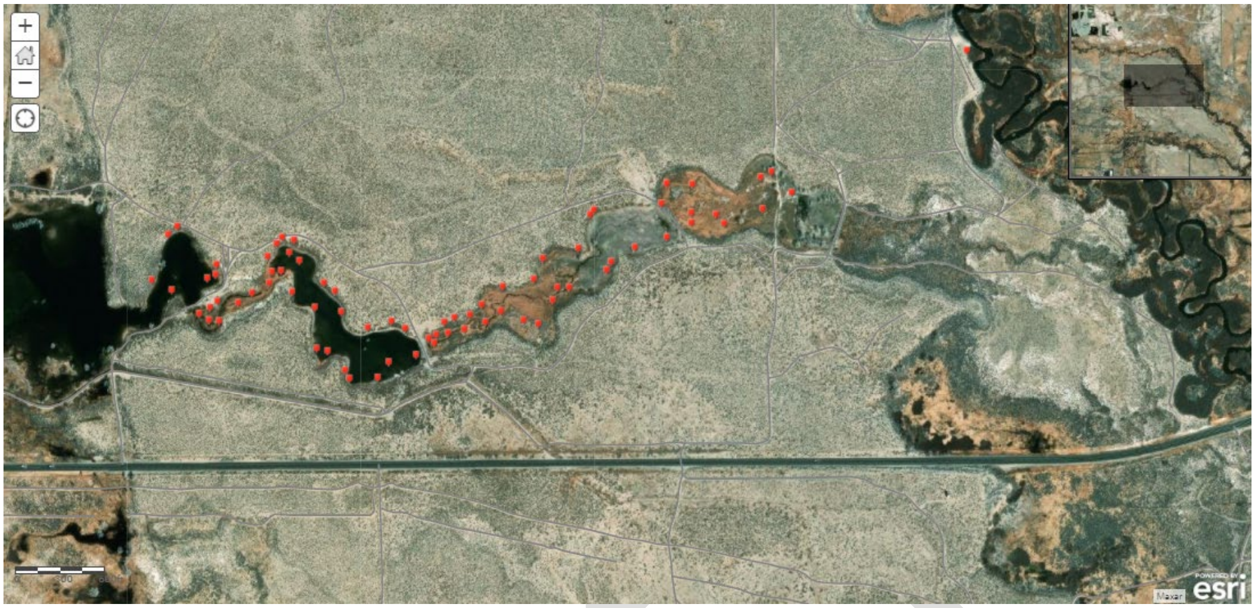


Figure 35. Perennial pepperweed (Lepidium latifolium) was mapped within Farmer's Ponds 2-4 to provide a general understanding of its distribution (red points on map). The high water line in Ponds 2 and 3 have a continuous ring of perennial pepperweed around the pond margins. The Pond 4 margin establishment is sparser.

A treatment plan for perennial pepperweed populations should be developed for the McNally Ponds and before annual activation of Farmer's Ponds is considered.

Saltcedar

Saltcedar is sparsely distributed throughout the Farmer's ponds. It is locally dense along the high-water line created during above normal runoff years when ponds were filled in the spring as part of operational spreading. Saltcedar has established repeatedly in the McNally Ponds. Unlike LELA, effective methods to control saltcedar exist. The McNally Ponds location is more suitable to mechanical control methods than Farmer's Ponds, but the combined Inyo and LADWP saltcedar programs have successfully applied manual methods to treat individual trees and recruits. Weed control will be a necessary component of a wetland/waterfowl project at either project location.

Hydrologic Evaluation

Groundwater pumping is an element of the McNally E/M project, and therefore it is necessary to compare the effects of pumping to supply water for the current project and the Farmer's Pond alternative. Two options for a mitigation project were evaluated using the 2020 draft Bishop/Laws numeric groundwater model: 1) Supply water to McNally Ponds and Pasture Project west of Highway 6 using the existing wells W247, W248, and W249 or 2) Transfer the surface ponds to Farmer's ponds 2, 3, and 4 supplied using pumped water from wells located on Bishop Cone while retaining the McNally pasture at its current location (Table 3). For both options, several groundwater model runs were designed to simulate water level change (drawdown) caused by pumping for the project. All model scenarios were conducted using the1999 to 2005 time period which experienced five consecutive dry years followed by two wet years. This dry/wet pattern is representative of the recent past and allows analysis of the cumulative effects of drought and pumping on the water table. With the exception of the simulated project pumping wells, actual runoff, recharge and pumping that occurred elsewhere in Laws and Bishop were not altered in the model scenarios.

As part of the initial evaluation, pumping W247, W248, and W249 to annually supply McNally Ponds was examined. The existing well screen configuration of these three wells allows pumped water to be drawn from both shallow and deeper aquifers. Predicted drawdown in preliminary model runs was many feet under phreatophytic vegetation (Laws-area type C parcels) to the south of the wells. These results were consistent with additional model runs associated with LADWP's Preconstruction Evaluation for W247 replacement well and also with measured groundwater response data from area monitoring wells.

Given the history of concerns over supplying the project in drought years discussed previously by the Technical Group and Standing Committee, pumping annually for the project with the wells as presently constructed was deemed undesirable. Additionally, this string of three wells is governed by On/Off permanent monitoring site Laws 1. Laws 1 can enter Off-status, limiting LADWP's ability to consistently implement the winter flooding in some years. LADWP has suggested previously that it could modify or replace these three wells by sealing their screens to the shallow-most aquifer thereby reducing drawdown and pumping stress on phreatophytic vegetation. Therefore, for the final project comparison, all three wells (W247, W248 and W249) were modeled with deep screen intervals only.

As noted previously, none of the project alternatives propose changes to location or pumping amount for the McNally Pasture. The pasture requires approximately 450 AF per year from late spring to early summer. All three final modeling scenarios included pumping a deep-screened W247 from late May to early July to supply the pasture.

The three project alternatives focused on either 1) pumping deep screened W248 and W249 to supply water to the existing McNally Ponds location, 2) pumping W406 (located south of Dixon Lane) to supply water for the Farmer's Ponds alternative or 3) pumping proposed well B-2 located north of US 395 along the C-Drain to supply water for the Farmer's Ponds alternative.

The McNally pond groundwater model scenario assumed that the ponds would receive about 1,500 acre-feet/year (AFY) during winter seasons consistent with the current project design and historical water demand. In the model, well W248 was designated to operate for two months from October through November, and well W249 for four months from October through January to supply the McNally Ponds. It was also assumed that 25% of water supplied to the ponds would infiltrate back to the shallow aquifer. In effect, consumptive water (evaporation) use would be 1,125 AFY.

Table 3. *Project options that were evaluated using the groundwater model.*

Project options	Water Supply	Pumping wells
Keep project at current location along McNally Canal	Use well W247 to supply pasture, and use W248 and W249 to supply McNally ponds	Replace W247, W248 and W249 and screen to deep aquifer only
Keep pasture at current location & move ponds to alternative expanded Farmer's Pond location	Use W247 to supply pasture at current location	Replace W247 and screen to deep aquifer only
	Move ponds to expanded Farmer's Pond	Use existing well W406, or
		Use new well at B-2

The water demand necessary to create habitat at the expanded Farmer's Pond site is not known, but for consistency in the model comparisons, 1,500 AFY of groundwater was also assumed to be provided October through March. The extended time period to supply the Farmer's Pond reflects the lower instantaneous pumping and conveyance rates available for delivery. The same proportion of pumped water (25%) was assumed to infiltrate back to the shallow groundwater aquifer under the ponds.

Two versions of the Farmer's Pond alternative were evaluated: pumping an existing well, W406, located along the Bishop Creek Canal or pumping proposed new well B-2 located in west Bishop. Staff investigated whether the Farmer's pond alternative would be consistent with the strictures of the Hillside Decree and associated Bishop Cone Audit. Water pumped from the Bishop Cone is required to be used on the Bishop cone for irrigation, stockwater, or surface water (e.g. Buckley/Saunders Ponds). Wells W371 and W410 are currently operated year-round to supply downstream uses along the Bishop Creek Canal. Groundwater from W410 would be used to supply water for the Farmer's alternative, and W406 groundwater would supply the downstream uses that W410 has historically supplied. The proposed B-2 well would be located upgradient from W410 (with delivery from the C-Drain to the Bishop Creek Canal) and could either supply the project directly or supply groundwater for downstream uses along the Bishop Creek Canal. Therefore, based on historic surface water data combined with ditch and well capacity information, it is feasible to supply the Farmer's pond alternative using either W406 or B-2 and comply with the Hillside decree. The model simulations were based on the proposed well design and potential capacity for B-2 of 3.25 cfs described in the preconstruction report for that well prepared by LADWP in 2017.

Final model simulations (scenarios) completed as part of this evaluation are described below:

1. The baseline simulation for all predictive scenarios had no project pumping for either alternative but includes historical pumping practices in the area, including summer irrigation. W371 was modeled to pump 3.25 cfs year-round from its recently converted deep screen interval; W410 pumps at 4 cfs year-round; W406 pumps at 3.25 cfs for the 6-month irrigation season but is off from October through March. This is the scenario to which all three alternatives are compared and against which project-related drawdown is measured.
2. Simulation of all three McNally wells (W247, W248, &W249) operating for the existing McNally ponds and pasture but screened in the deeper part of the aquifer. W247 pumps to supply the pasture in June-July; W248 pumps for McNally ponds from October-November, W249 pumps for ponds from October-January; with 25% infiltration from the ponds returning to the shallow aquifer (Figure 36, Appendix A).
3. Farmer's Pond alternative one with W406 now pumping year-round to supply summer irrigation and then surface water from October-March (Figure 37, Appendix A). W247 was pumped for the McNally Pasture from June-July.
4. Farmer's Pond alternative two with B-2 pumping from October-March at 3.25 cfs to supply the ponds (Figure 38, Appendix A). W247 is still pumped for the McNally Pasture from June-July.
5. Farmer's Pond alternative two but with B-2 pumping year-round, supplying water for irrigation from April through September and surface water to the Farmer's ponds from October-March (Figure 39, Appendix A). W247 is still pumped for the McNally Pasture from June-July.

The effect of pumping for scenarios 2-4 listed above was determined from the amount of water table decline at the end of the pumping stress compared with the baseline simulation, scenario 1. For the existing McNally Pond alternative (pumping W248-W249), the February 2005 drawdown reflected the maximum cumulative effects of pond pumping for the project during the five consecutive low runoff years. For the Farmer's Ponds alternatives (either W406 or B-2), April 2005 reflected the maximum cumulative effects of pumping for the project during the five consecutive low runoff years. Drawdown contours related to McNally Pasture pumping from W247 are presented for August 2004 which represented the maximum drawdown in that area for June-July pumping for the pasture (Figure 40, Appendix A). Modeled hydrographs for specific locations are also presented in each drawdown figure to graphically demonstrate the modeled time-history of drawdown and recovery.

Results from groundwater modeling are as follows. For the McNally Pond option with pumping from W248 & W249 (Scenario 2), maximum drawdown occurs in 2005 with approximately 3 feet of drawdown caused by project pumping near Type-C vegetation (starred location amongst Laws 60,72,73 parcels). The cone of depression after five years did not stabilize, implying continued drawdown would be expected in a longer drought or period between spreading in the McNally basins. There was also 5-6 feet of drawdown northwest of W249 under the Volcanic Tablelands. Drawdown from this scenario would stress an area of Laws (see above) where vegetation cover is frequently below baseline. Screening the wells deeper alleviates the drawdown but the confining layers are leaky and drawdown in the shallow aquifer persists.

For the expanded Farmer's Pond alternative with pumping from W406 (Scenario 3), maximum drawdown was approximately 2 feet and the cone of depression stabilized within 5 years. Drawdown occurred only under actively flood-irrigated vegetation parcels. Drawdown from the additional W406 pumping on the northern extent of the irrigated pastures was less than 0.6 feet.

For the expanded Farmer's Pond alternative supplied by pumping from B-2 from October to March (Scenario 4), maximum drawdown was approximately 1 foot and the cone of depression stabilized within 5 years. Drawdown occurred under actively flood-irrigated parcels south of US 395, but also under non-irrigated Type-E parcel FSL 158 north of Highway 395. FSL 158 is a Type E subirrigated parcel (ICWD 2018 Annual Report). The parcel is Type E based on vegetation type (rush-sedge meadow) not land management practices, and does not consistently receive irrigation water.

It is likely that B-2 would also be pumped for irrigation in the summer months if installed; therefore Scenario 5 examined the effects of pumping this well year round from 1999-2008 to represent more realistic operations. Although the cone of depression stabilized within 5 years, there was no significant recovery from running the Bishop Bypass in summer 2006. Maximum drawdown was approximately 2.5 feet with about 2 feet of pumping-related drawdown in the northern part of FSL158. Groundwater levels measured in the southern portion of FSL 158 at V279 range from 6-15 feet below ground surface, with prolonged periods below 12 feet during droughts. ICWD staff is concerned that the additional drawdown related to pumping B-2 could negatively affect this parcel. The Technical Group could develop operational protocols for B-2 to address Inyo County concerns on effects to vegetation and private wells but those discussions have not occurred.

LADWP and Inyo County discussed the construction of production well B-2 (and B-5) from fall 2015 thru summer 2017. Inyo County expressed concerns that potential impacts to more recently installed domestic wells in west Bishop were not fully assessed in the 1991 EIR and that additional CEQA analysis regarding B-2 was necessary. LADWP stated that the installation of wells at sites B-2 and B-5 were evaluated as part of the 15 new wells in the 1991 EIR and that the county was improperly adhering to the Agreement provisions regarding the installation of new wells to withhold well permits. The two agencies were unable to agree on the appropriate CEQA and Agreement processes and also disagreed over the new well's potential impacts. Therefore, LADWP postponed B-2 construction. The outstanding issues related to the use of a well at Site B-2 should be resolved before this well could be considered as a source of water for the Farmer's Pond alternative. LADWP believes that protection provisions for non-LADWP wells can be included as part of the pre-construction evaluation and the monitoring plan for the well at Site B-2.

Comparative Evaluation

Inyo and LADWP staffs agree that discontinuation of pumping to supply the McNally pasture west of Highway 6 could potentially create vegetation and air quality impacts. We recommend continuing to supply surface water to the McNally pasture when available. If the past practice of pumping in dry years for irrigation continues, based on the preliminary groundwater modeling results and the preconstruction plan for W247, ICWD and LADWP staffs recommend that W247 be modified to draw water only from the deeper aquifer to lessen drawdown under native vegetation.

Relative strengths and potential drawbacks of the Farmer's Pond vs the McNally Pond location for a mitigation project to create seasonal ponds is summarized in Table 4. Based on the relative conditions at the two sites and the potential advantages and limited negative outcomes, Inyo and LADWP staffs agree that the Farmer's Pond alternative is feasible and potentially preferable to the existing McNally Ponds. Either the W406 or proposed well B-2 supply options are hydrologically viable, but Inyo and LADWP staff differ on the preferred option for water supply.

LADWP staff recommends if McNally Project is relocated to the expanded Farmer's Pond, B-2 should be installed to supply water for the project through C-Drain and Bishop Creek Canal from October through March. The existing downstream uses on Bishop Cone will continue to be supplied by W410 and W371. This option provides LADWP with operational flexibility to supply water to all uses on the Bishop Cone, as needed. Potential groundwater drawdown in the shallow aquifer near Site B-2 occurs in the winter in the areas with Type A or E vegetation that are not dependent on groundwater. Typical groundwater levels in this area are well below the vegetation root zone in normal and dry years but rise in very wet years when Bishop Creek Bypass Canal is operated. LADWP believes B-2 would not result in pumping-related impacts on groundwater-dependent vegetation. Resource protection provisions for non-LADWP wells could be included as part of the pre-construction evaluation report and the monitoring plan for the operation of the well at Site B-2.

Based on comparison of the conditions of the two project locations and pumping analysis, ICWD staff recommends pursuing the additional steps required for potential relocation of McNally ponds to the Farmers Pond with W410 supplying water for ponds 2, 3, and 4 and W406 pumping to supply the existing downstream uses on Bishop Cone from October through March. The additional drawdown related to pumping W406 during the winter was the least of all scenarios, less than 1.7 ft (Figure 39). The drawdown cone for pumping in this scenario was restricted to under an actively irrigated parcel minimizing the risk to vegetation.

Table 4. *Potential benefits and disadvantages of the alternate mitigation project at Farmer's Pond. Concerns over weeds apply equally at both locations.*

Potential Benefits	Potential Disadvantages
Increased waterfowl habitat during migration.	Increased costs due to possible invasive species management.
Increased recreation (birding, hunting).	Pumping B2 may affect Type E subirrigated meadows.
It should be possible to supply Farmer's ponds all but the most extreme dry years.	Additional pumping and surface water management required on the Bishop Cone.
The Standing Committee will not need to address frequent requests to adjust or to not supply water for mitigation.	Reduced infiltration in Laws compared to the original project.
Enhanced recruitment potential for riparian vegetation and increased woodland connectivity and associated species.	Modifying the project requires several steps to comply with the LTWA and CEQA.
Pumping impacts on vegetation in the area of McNally Canal will be avoided.	
The Farmer's Pond will likely require less water than the original McNally project; therefore overall pumping to supply the project will be reduced.	
Wells on the Bishop Cone are managed according to the Hillside Decree. No additional well exemptions are needed during drought years.	
The W406 pumping option creates the least drawdown and only under irrigated vegetation.	
The Farmer's Ponds are more accessible to the public.	
Installation well at Site B-2 provides LADWP with operational flexibility to supply water to in-valley uses on Bishop Cone.	

Unrelated to this McNally Ponds comparison, based on conversations with the lessee, it will be desirable to develop a water supply/irrigation/grazing strategy to improve conditions in the McNally pasture supplied by W247 to ensure the best use of water for forage and habitat.

Finally, if the McNally Ponds project is to continue as originally designed, pumping wells W247, W248, and W249 to supply the existing project should be evaluated whether sealing the shallow aquifer portion of the well screen limits the effect on neighboring phreatophytic vegetation.

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NAIP False Color .6m resolution. Acquisition Date: 9/8/2018. Quarter Quadrangle Map Name: FISH SLOUGH SE. Quadrant Key: 3722301182230. ESRI map service.

Appendix A:

Groundwater modeling, Figures 36 - 40

Figure 36. Scenario 2: Model predictions pumping W247-249 with deep screen intervals vs no project "baseline" (Scenario 1)

February 2005 drawdown, Layer 1, W248 & W249 pumping (deep screen intervals) for existing McNally Ponds, W247 pumping for McNally Pasture in summer. Modeled drawdown (feet below "Baseline") with additional hydrograph from starred location, shallow aquifer amongst Type-C parcels Laws 60, 72, 73.

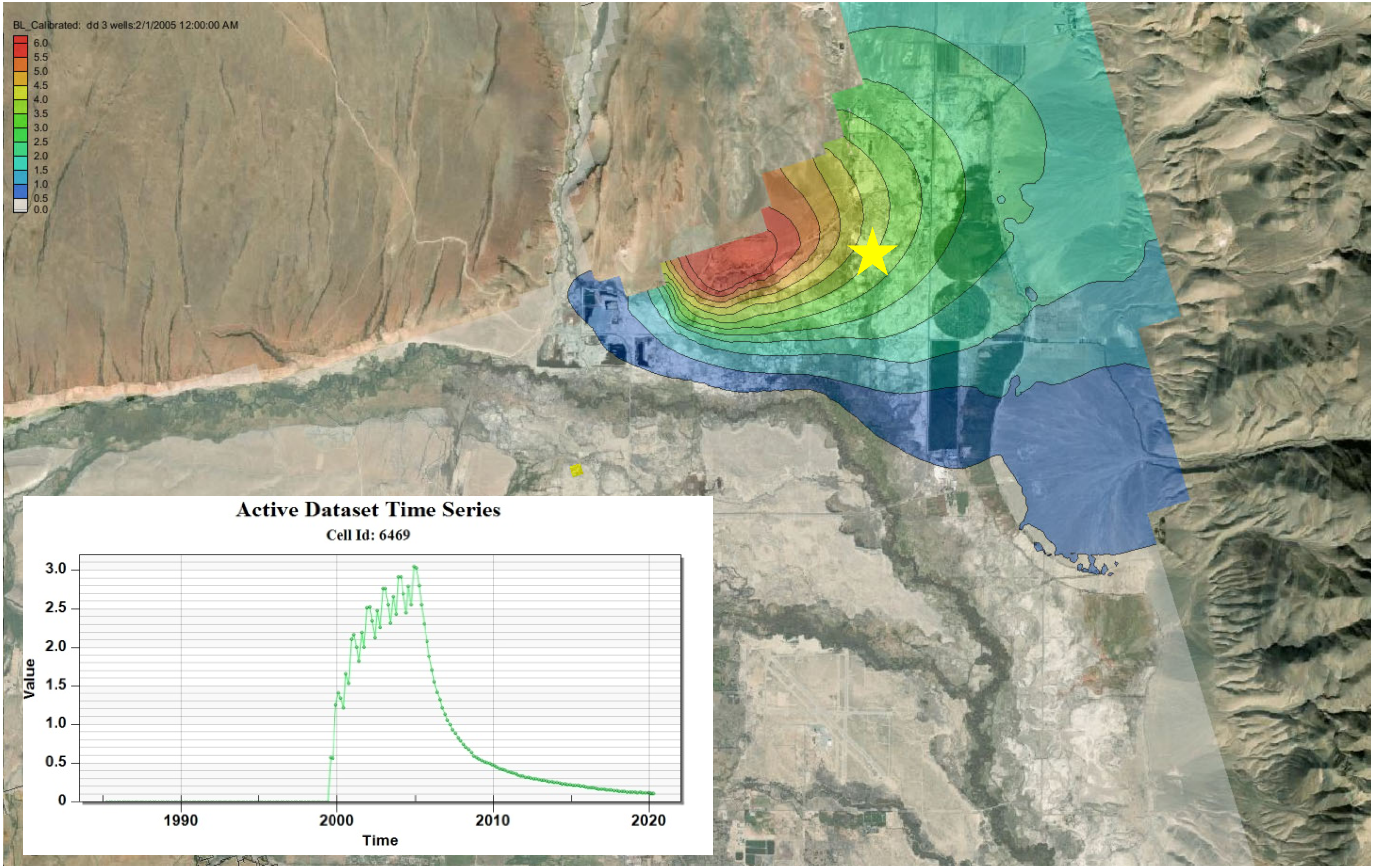


Figure 37. Scenario 3: Model predictions pumping W406 October to March vs no project "baseline" (Scenario 1)

April 2005 drawdown, Layer 1, W406 pumping for Farmer's Ponds. Modeled drawdown (feet)with hydrograph from starred location, shallow aquifer. Starred location at northern edge of Type-e irrigated parcel FSL109 .

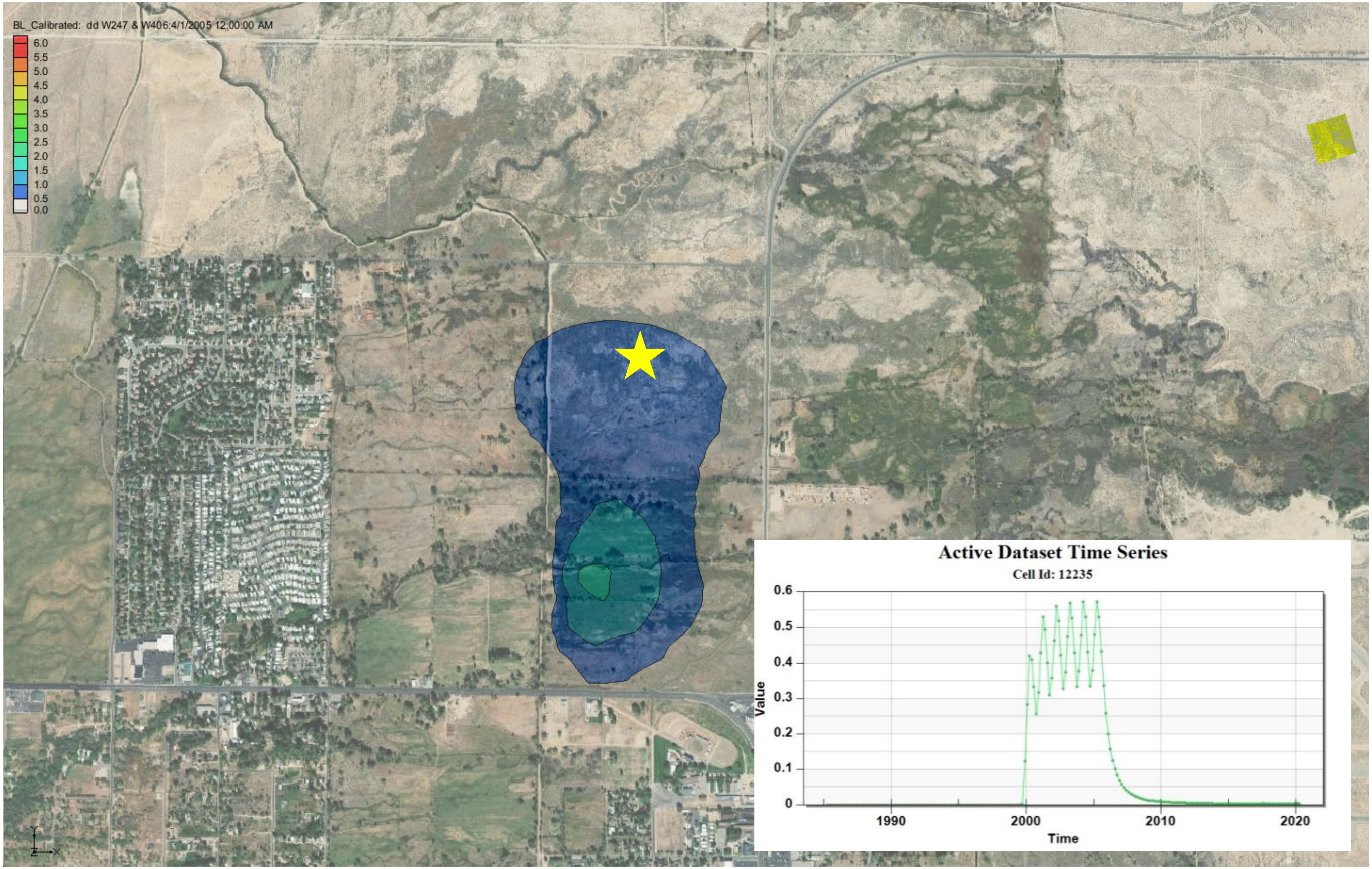


Figure 38. Scenario 4: Model predictions pumping B-2 October to March vs no project "baseline" (Scenario 1)

Large scale representation of April 2005 drawdown, Layer 1, B2 for Farmer's Pond alternative. Modeled drawdown (feet) with hydrograph from starred location, shallow aquifer. Starred location within sub-irrigated parcel FSL158.

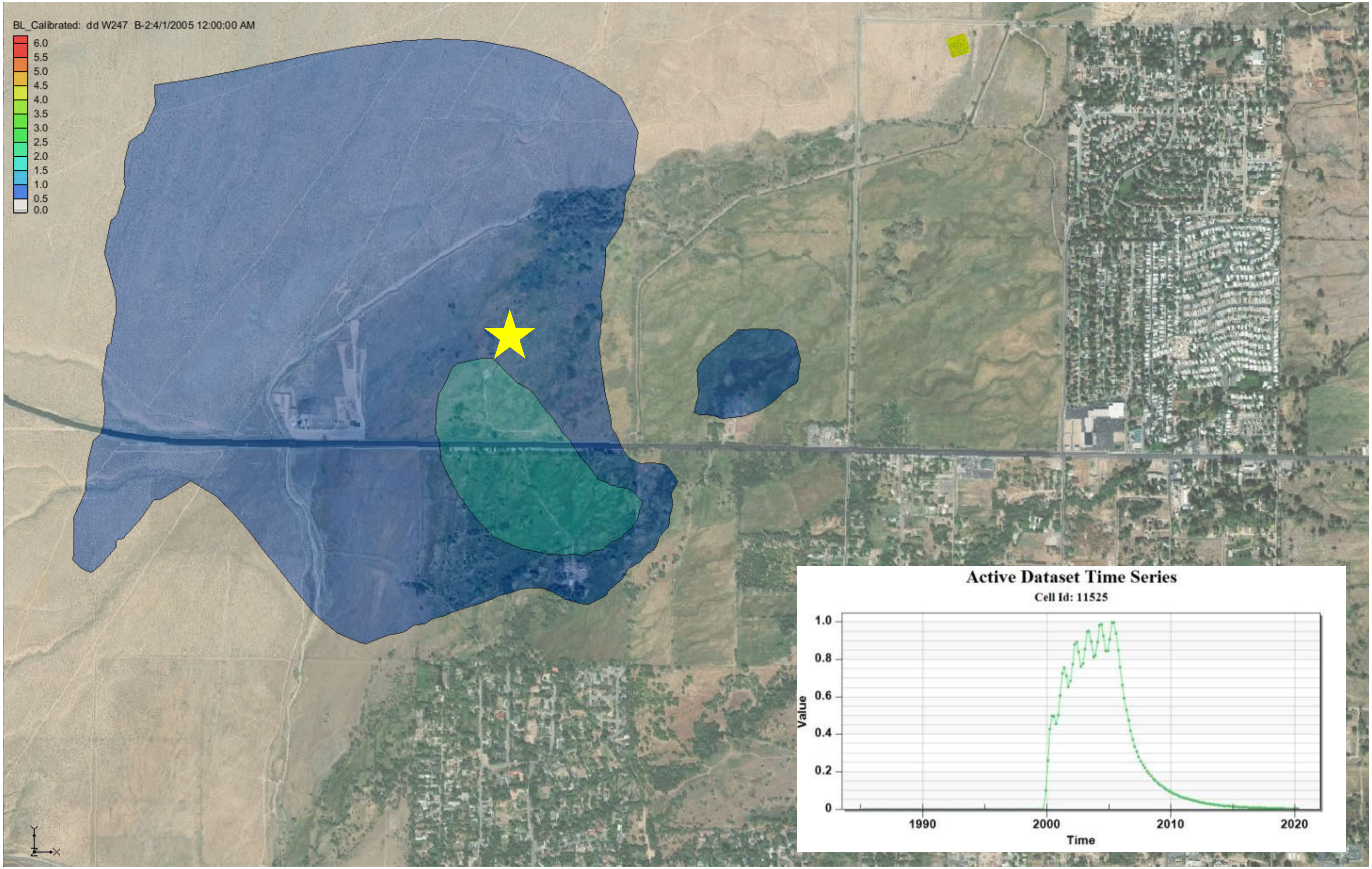


Figure 39. Scenario 5: Model predictions pumping B-2 year-round vs no project "baseline" (Scenario 1)

Large scale representation of April 2005 drawdown, Layer 1, B2 pumping for Farmer's Ponds and Bishop Cone. Modeled drawdown (feet) with hydrograph from starred location. Starred location within sub-irrigated parcel FSL158.

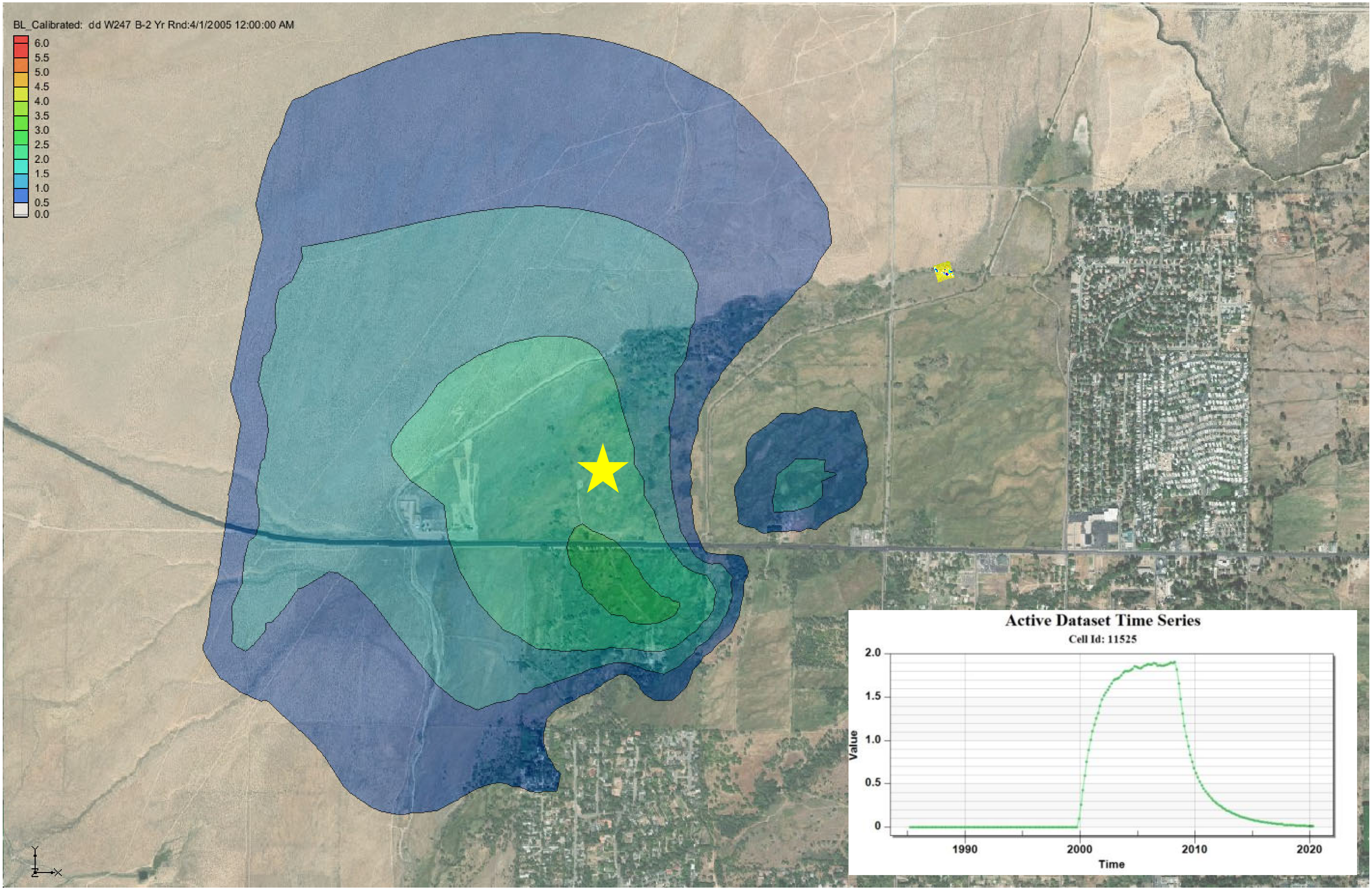
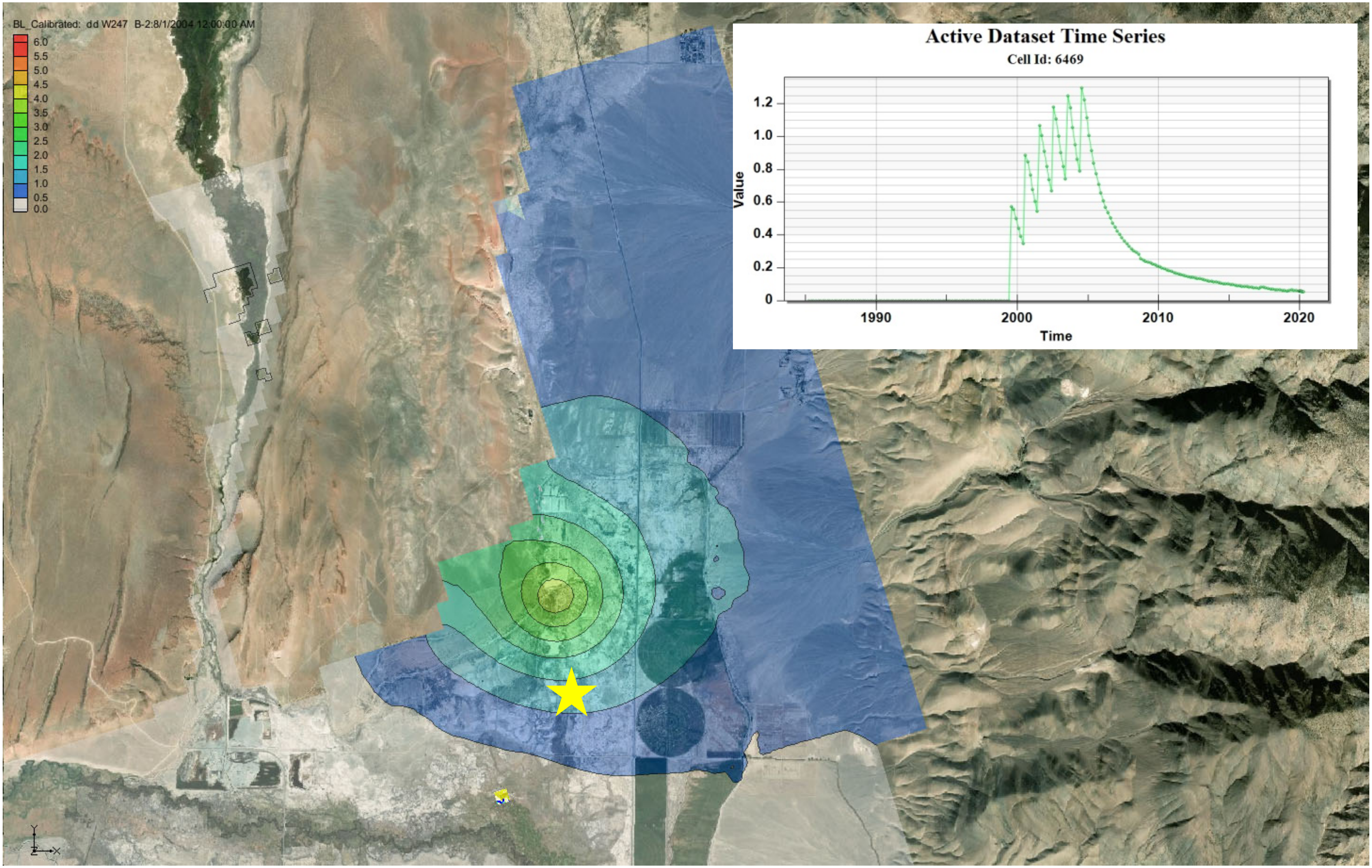


Figure 40. W247 Pumping to supply McNally Pasture.

Summer drawdown 8/1/2004 in Layer 1 (W247 is pumping from deep screen interval for pasture only, no pumping from W248 &W249). Modeled drawdown (feet) with hydrograph from starred location, shallow aquifer. This maximum drawdown from W247 pumping for the pasture is the same in for the W406 and B2 scenarios.



Appendix B:

Plant Species in the McNally and Farmer's Pond area

Appendix A: Plant Species in the McNally and Farmer's Pond area.

Code	Species	Common Name	Life cycle	Life form	Order
HOJU	Hordeum jubatum	barley, Foxtail	Annual	Grass	Poales
LEFUF	Leptochloa fusca ssp. fascicularis	sprangletop, Bearded	Annual	Grass	Poales
PACA6	Panicum capillare	Witchgrass	Annual	Grass	Poales
POMO5	Polypogon monspeliensis	grass, Annual rabbitsfoot	Annual	Grass	Poales
CLLU2	Cleome lutea	bee plant, Yellow	Annual	Herb	Adoxales
CLEOM	Cleome sp.	Bee plant/Spiderflower	Annual	Herb	Adoxales
CLOB	Cleomella obtusifolia	stinkweed, Mojave	Annual	Herb	Adoxales
CLPA4	Cleomella parviflora	cleomella, Slender	Annual	Herb	Adoxales
CLPL2	Cleomella plocasperma	cleomella, Twisted	Annual	Herb	Adoxales
CLEOM2	Cleomella sp.	Cleomella/Stinkweed	Annual	Herb	Adoxales
AMAC2	Ambrosia acanthicarpa	ragweed, Bur	Annual	Herb	Asterales
COCA5	Conyza canadensis	horseweed, Canada	Annual	Herb	Asterales
ERCA20	Erigeron canadensis	horseweed, Canada	Annual	Herb	Asterales
ERDI4	Erigeron divergens	daisy, Pastel	Annual	Herb	Asterales
HEAN3	Helianthus annuus	sunflower, Annual	Annual	Herb	Asterales
LASE	Lactuca serriola	lettuce, Prickly	Annual	Herb	Asterales
LACO13	Laennecia coulteri	horseweed, Coulter's	Annual	Herb	Asterales
PSLU6	Pseudognaphalium luteoalbum	cudweed, Jersey	Annual	Herb	Asterales
STEX	Stephanomeria exigua	mitra, Annual	Annual	Herb	Asterales
XAST	Xanthium strumarium	cocklebur, Rough	Annual	Herb	Asterales
AMTE3	Amsinckia tessellata	fiddleneck, Bristlly	Annual	Herb	Boraginales
LELA	Lepidium lasiocarpum	peppergrass, Shaggyfruit	Annual	Herb	Capparales
SIAL2	Sisymbrium altissimum	mustard, Tall tumble	Annual	Herb	Capparales
AMARA	Amaranthus sp.	Pigweed /Amaranth	Annual	Herb	Caryophyllales
ATCO12	Atriplex covillei	Arrowscale	Annual	Herb	Caryophyllales
ATPH	Atriplex phyllostegia	Arrowscale	Annual	Herb	Caryophyllales
ATPR	Atriplex prostrata	Spearscale	Annual	Herb	Caryophyllales
ATSE2	Atriplex serenana	Bractscale	Annual	Herb	Caryophyllales
ATTR	Atriplex truncata	Wedgescale	Annual	Herb	Caryophyllales

Code	Species	Common Name	Life cycle	Life form	Order
BAHY	Bassia hyssopifolia	bassia, Fivehook	Annual	Herb	Caryophyllales
BASC5	Bassia scoparia	Burningbush	Annual	Herb	Caryophyllales
CHBE4	Chenopodium berlandieri	goosefoot, Pitseed	Annual	Herb	Caryophyllales
CHHI	Chenopodium hians	goosefoot, Hians	Annual	Herb	Caryophyllales
CHIN2	Chenopodium incanum	goosefoot, Mealy	Annual	Herb	Caryophyllales
CHLE4	Chenopodium leptophyllum	goosefoot, Narrowleaf	Annual	Herb	Caryophyllales
CHENO	Chenopodium sp.	Goosefoot	Annual	Herb	Caryophyllales
SATR12	Salsola tragus	Tumbleweed /thistle, Russian	Annual	Herb	Caryophyllales
CUSCU	Cuscuta sp.	Dodder	Annual	Herb	Convolvulales
MEAL2	Melilotus albus	sweetclover, White	Annual	Herb	Fabales
CAMIM6	Castilleja minor ssp. minor	Indian paintbrush, Lesser	Annual	Herb	Lamiales
CHMAC	Chloropyron maritimum ssp. canescens	bird's-beak, Alkali	Annual	Herb	Lamiales
CABO7	Camissonia boothii	evening primrose, Booth's	Annual	Herb	Myrtales
AAFF	Annual Forbs	**	Annual	Herb	NA
AAFF	UNK	UNK	Annual	Herb	NA
ERBA7	Eriogonum baileyi	buckwheat, Bailey's	Annual	Herb	Polygonales
ERDE6	Eriogonum deflexum	buckwheat, Skeleton	Annual	Herb	Polygonales
ERMA2	Eriogonum maculatum	buckwheat, Spotted	Annual	Herb	Polygonales
ERIOGa	Eriogonum sp.	buckwheat, Annual	Annual	Herb	Polygonales
COMA5	Cordylanthus maritimus	bird's-beak, Saltmarsh	Annual	Herb	Scrophulariales
CORA5	Cordylanthus ramosus	bird's-beak, Bushy	Annual	Herb	Scrophulariales
MEOF	Melilotus officinalis	sweetclover, Yellow	Annual/Bien nial	Herb	Fabales
MELIL	Melilotus sp.	sweetclover	Annual/Bien nial	Herb	Fabales
GNAPH	Gnaphalium sp.	Cudweed	Annual/Bien nial/Perennial	Herb	Asterales
CYPER	Cyperus sp.	nutsedge	Annual/Peren nial	Grass	Cyperales
ASTER	Aster sp.	Aster	Annual/Peren	Herb	Asterales

Code	Species	Common Name	Life cycle	Life form	Order
			nial		
HELIO3	Heliotropium sp.	Heliotrope	Annual/Perennial	Herb	Boraginales
TRIFO	Trifolium sp.	Clover	Annual/Perennial	Herb	Fabales
OXCO	Oxalis corniculata	clover, Creeping sour	Annual/Perennial	Herb	Oxalidales
OXALI	Oxalis sp.	clover, Sour/Sorrel, wood	Annual/Perennial	Herb	Oxalidales
ERIN4	Eriogonum inflatum	trumpet, Desert	Annual/Perennial	Herb	Polygonales
POLYG4	Polygonum sp.	Smartweed/Knotweed	Annual/Perennial	Herb	Polygonales
AMBRO	Ambrosia sp.	Ragweed	Annual/Perennial	Herb_Shrub	Asterales
LUPIN	Lupinus sp.	Lupine	Annual/Perennial	Herb_Shrub	Fabales
ERIOG	Eriogonum sp.	Buckwheat	Annual/Perennial	Herb_Shrub	Polygonales
CADO2	Carex douglasii	sedge, Douglas'	Perennial	Grass	Cyperales
CAREX	Carex sp.	Sedge/Carex	Perennial	Grass	Cyperales
ELMA5	Eleocharis macrostachya	spikerush, Pale	Perennial	Grass	Cyperales
ELPA3	Eleocharis palustris	spikerush, Common	Perennial	Grass	Cyperales
ELRO2	Eleocharis rostellata	spikerush, Walking	Perennial	Grass	Cyperales
ELEOC	Eleocharis sp.	Spikerush	Perennial	Grass	Cyperales
SCMA	Scirpus maritimus	bulrush, Saltmarsh	Perennial	Grass	Cyperales
JUARL	Juncus balticus	rush, Baltic	Perennial	Grass	Juncales
JUBA	Juncus balticus	rush, Baltic	Perennial	Grass	Juncales
JUME4	Juncus mexicanus	rush, Mexican	Perennial	Grass	Juncales
DISP	Distichlis spicata	Saltgrass	Perennial	Grass	Poales
ELCI	Elymus cinereus	wildrye, Great Basin	Perennial	Grass	Poales
ELCI2	Elymus cinereus	wildrye, Great Basin	Perennial	Grass	Poales
ELTR3	Elymus tritocoides	wildrye, Beardless/Creeping	Perennial	Grass	Poales
FESTU	Festuca sp.	Fescue	Perennial	Grass	Poales
MUAS	Muhlenbergia asperifolia	muhly, Alkali/ Scratchgrass	Perennial	Grass	Poales

Code	Species	Common Name	Life cycle	Life form	Order
PADI6	Paspalum distichum	knotgrass	Perennial	Grass	Poales
PHAU7	Phragmites australis	reed, Common	Perennial	Grass	Poales
POSEJ	Poa secunda spp. juncifolia	bluegrass, Alkali	Perennial	Grass	Poales
POA	Poa sp.	Bluegrass	Perennial	Grass	Poales
SPAI	Sporobolus airoides	sacaton, Alkali	Perennial	Grass	Poales
TYDO	Typha domingensis	cattail, Southern	Perennial	Grass	Typhales
TYPHA	Typha sp.	Cattail	Perennial	Grass	Typhales
ARLU	Artemisia ludoviciana	mugwort, Silver	Perennial	Herb	Asterales
CIVU	Cirsium vulgare	thistle, Bull	Perennial	Herb	Asterales
ERBR4	Erigeron breweri	fleabane daisy, Brewer's	Perennial	Herb	Asterales
IVAX	Iva axillaris	weed, Poverty	Perennial	Herb	Asterales
PYRA	Pyrrocoma racemosa	aster, Golden-wand	Perennial	Herb	Asterales
SYAS3	Symphyotrichum ascendens	aster, Long-leaved	Perennial	Herb	Asterales
HECU3	Heliotropium curassavicum	heliotrope, Salt	Perennial	Herb	Boraginales
LELA2	Lepidium latifolium	pepperweed, Perennial	Perennial	Herb	Capparales
AMAN	Amaranthus annectens	Gregg's amaranth	Perennial	Herb	Caryophyllales
NIOC2	Nitrophila occidentalis	miterwort, Western	Perennial	Herb	Caryophyllales
GLLE3	Glycyrrhiza lepidota	licorice, American	Perennial	Herb	Fabales
MESA	Medicago sativa	Alfalfa	Perennial	Herb	Fabales
ASFA	Asclepias fascicularis	milkweed, Narrow-leaf	Perennial	Herb	Gentianales
ASCLE	Asclepias sp.	Milkweed	Perennial	Herb	Gentianales
MALE3	Malvella leprosa	mallow, Alkali	Perennial	Herb	Malvales
MARSI	Marsilea sp.	Waterclover	Perennial	Herb	Marsileales
MAVE2	Marsilea vestita	waterclover, Hairy	Perennial	Herb	Marsileales
ERDE2	Eriastrum densifolium	woolly-star, Giant	Perennial	Herb	Polemoniales
STEPH	Stephanomeria sp.	Wire-lettuce	Perennial	Herb_Shrub	Asterales
AMDU2	Ambrosia dumosa	Burrow-bush	Perennial	Shrub	Asterales
ERNA10	Ericameria nauseosa	rabbitbrush, Common	Perennial	Shrub	Asterales

Code	Species	Common Name	Life cycle	Life form	Order
ALOC2	Allenrolfea occidentalis	bush, Iodine	Perennial	Shrub	Caryophyllales
ATCA2	Atriplex canescens	saltbush, Fourwing	Perennial	Shrub	Caryophyllales
ATCO	Atriplex confertifolia	Shadscale	Perennial	Shrub	Caryophyllales
ATLET2	Atriplex lentiformis ssp. torreyi	saltbush, Nevada/Torrey's	Perennial	Shrub	Caryophyllales
ATTO	Atriplex torreyi	saltbush, Nevada/Torrey's	Perennial	Shrub	Caryophyllales
GRSP	Grayia spinosa	hop-sage, Spiny	Perennial	Shrub	Caryophyllales
SUMO	Suaeda moquinii	inkweed, Bush	Perennial	Shrub	Caryophyllales
SAVE4	Sarcobatus vermiculatus	Greasewood	Perennial	Shrub	Caryophyllales
ROWO	Rosa woodsii	rose, Wood's	Perennial	Shrub	Rosales
SAEX	Salix exigua	willow, Coyote/Narrow-leaf	Perennial	Shrub	Salicales
TARA	Tamarix ramosissima	cedar, Salt	Perennial	Shrub	Tamaricales
POFR2	Populus fremontii	cottonwood, Fremont's /Alamo	Perennial	Tree	Salicales
SALA3	Salix laevigata	willow, Red	Perennial	Tree	Salicales
SALIX	Salix sp.	Willow	Perennial	Tree	Salicales