Staff Report

TO: Board of Directors

FROM: Doug Roderick, P.E., Engineering Manager

DATE: February 23, 2022

SUBJECT: **Lower Cascade Canal and Upper Grass Valley Canal Tree Health, Canopy Cover and Pond Monitoring Report – Year 8 (Project # 6593-2)**

ENGINEERING

RECOMMENDATION:

Informational item. Receive presentation from Stantec to review the Lower Cascade Canal and Upper Grass Valley Canal Tree Health, Canopy Cover, and Pond Monitoring Report – Year 8.

BACKGROUND:

The District contracted with Stantec to facilitate environmental compliance with the Mitigation Monitoring and Reporting Program (MMRP) with the Banner Cascade Pipeline Project, which replaced the Lower Cascade Canal (LCC) and Upper Grass Valley Canal (UGVC), which had reached capacity.

The District kept the canals in limited service with reduced flows and water levels that were thought to have a negative effect on vegetation and wildlife adjacent to the canals.

The Environmental Impact Report specified mitigation measures that the District develop long-term monitoring of riparian and ponded areas on a specific schedule.

Study Type	Duration	Frequency
1. Tree Health Assessment	10 years	Every 2 years
2. Canopy Cover Assessment	10 years	Every 4 years
3. Pond Study	10 years	Every 4 years

2021 is the eighth year since the pipeline was completed, and the flows were reduced in the LCC and UGVC canals. This monitoring cycle required the Tree Health Assessment, Canopy Cover Assessment, and Pond Study.

No action is necessary at this time. The next and final round of monitoring will occur in 2023. The final monitoring report will be prepared and presented to the Board in 2024.

BUDGETARY IMPACT:
To be determined per the conditions of the Project EIR for the Banner Cascade Pipeline Project

DR

Attachments: (2)

- Banner Cascade Pipeline Project Tree Health, Canopy Cover, and Pond Monitoring Report
- PowerPoint Presentation

Banner Cascade Pipeline Project Tree Health, Canopy Cover, and Pond Monitoring Report – Year 8

Banner Cascade Pipeline Project

Tree Health, Canopy Cover, and Pond Monitoring Report – Year 8

Lower Cascade, Upper Grass Valley, and DS Canals

February 14, 2022

Prepared for:

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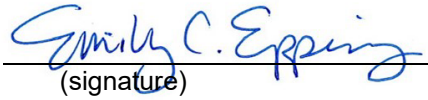
Technically Reviewed by  (signature)

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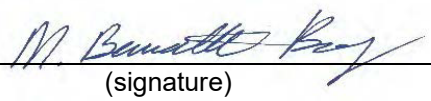
Senior Review by  (signature)

Bernadette Bezy, Principal Biologist

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Abbreviations

CEQA	California Environmental Quality Act
CFS	cubic feet per second
CRLF	California red-legged frog
DBH	diameter at breast height
FEIR	Final Environmental Impact Report
LCC	Lower Cascade Canal
MM	Mitigation Measure
NID	Nevada Irrigation District
Project	Banner Cascade Pipeline Project
Report	Lower Cascade Canal and Upper Grass Valley Canal Long Term Canopy Cover and Pond Studies Report
UGVC	Upper Grass Valley Canal

1.0 EXECUTIVE SUMMARY

Nevada Irrigation District (NID) committed to develop a plan and implement three types of long-term ecological monitoring between 2013 and 2023 along the Lower Cascade Canal (LCC) and Upper Grass Valley Canal (UGVC) in compliance with the Banner Cascade Pipeline Project (Project) California Environmental Quality Act (CEQA) Final Environmental Impact Report (FEIR) Mitigation Monitoring and Reporting Program Mitigation Measure (MM) 3.8-1: Monitor for Evidence of Dewatering Impacts to Riparian Habitats (NID 2006).

In 2021, NID implemented the Year 8 Canopy Assessment (which includes the Canopy Cover Assessment and Tree Health Assessment) and the Pond Study monitoring along the the LCC and UGVC. The 2013 (Year 0) to 2021 (Year 8) results are variable with a slight increase in tree health at the LCC sites while still remaining within the "good health" category[1]. Therefore, the overall analysis concludes that after 8 years of flow reduction, the tree health is fairly consistent with Baseline Year 0 surveys along the LCC and UGVC as compared to the DS Canal reference site (which did not receive flow reduction). Similarly, pond area and depth have varied slightly over the monitoring period, but the Year 8 and Baseline Year 0 pond characteristics were similar in the study sites and reference site. NID will continue to monitor riparian and pond health until 2023 and will develop conclusions based on the full ten-year data set. If it is necessary, as a part of MM 3.8-1, water replacement standards will be developed if it is apparent that canopy cover has been lost as a result of disease, parasitism, and/or water stress caused directly from the reduced flow in the canal (NID 2006). The next required monitoring events are the Canopy Assessment and the Pond Study, currently scheduled for Year 10 (2023) of the CEQA required long-term monitoring period.

This Canopy Cover and Pond Studies Report (Report) provides data and analysis for the Monitoring Year 8 (2021) surveys.

2.0 INTRODUCTION

2.1 PROJECT DESCRIPTION

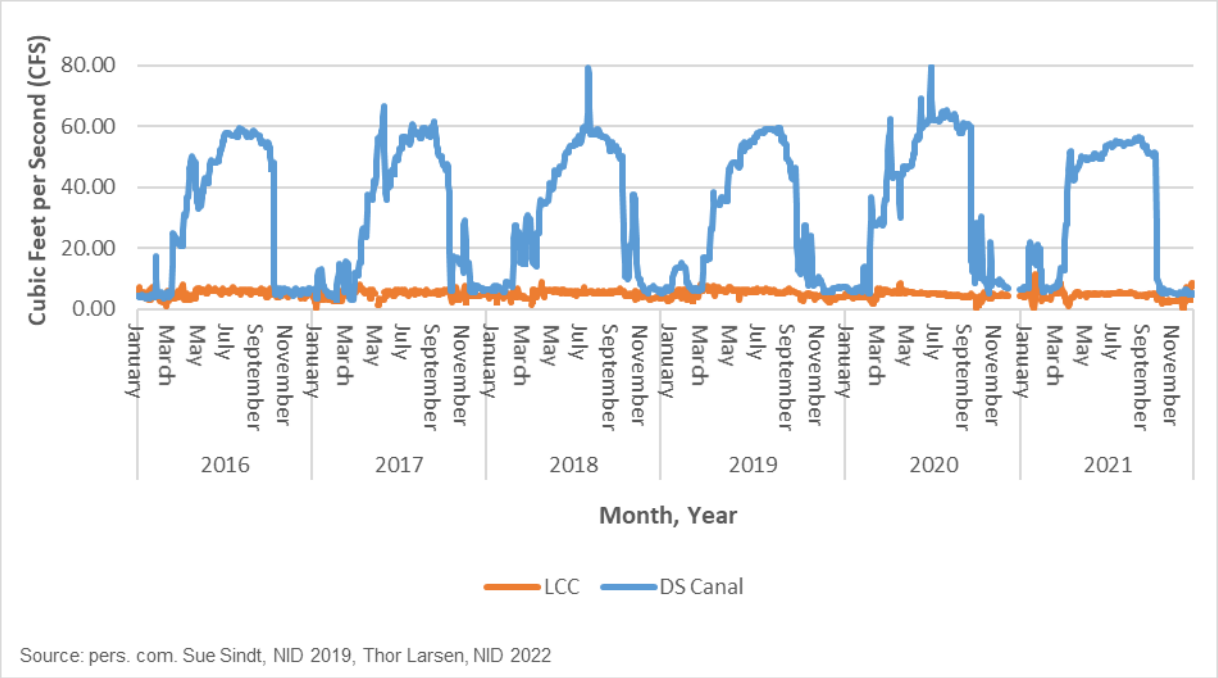
NID constructed the Project to help ensure reliable water deliveries to the areas of Grass Valley and Nevada City, as well as the Loma Rica and Elizabeth George Wastewater Treatment Plants in Nevada County, California. The Project replaced both LCC and UGVC, which had reached capacity and no longer met the needs of the area. NID keeps both LCC and UGVC in service as historical, cultural, scenic, and recreational amenities, but with reduced flows (NID 2019). DS Canal is also located in Nevada City and

[1] The category of "good health" is a score that an evaluated tree receives, and generally has the following parameters: partial to medium canopy cover, new growth present, minimal bark and leaf discoloration, no significant disease, normal surface growth, and little to some insect infestations/damage.

maintained by NID. It is not experiencing flow reductions as a result of the Project and acts as a reference to LCC and UGVC.

In 2013, flows in LCC were reduced from approximately 45 to 5 cubic feet per second (CFS) as part of the Project. Branching from LCC, flows in the UGVC were reduced from 12 to 1 CFS as part of the Project. Flows in DS Canal have continued per normal operating conditions at rates averaging approximately 50 CFS during the summer (May-September) and 15 CFS during winter months (October-April) (Sindt, pers. comm. 2019; Larsen, pers. comm. 2022) (Graph 2-1).

Graph 2-1 Canal Flow in Lower Cascade Canal and DS Canal, 2016-2021



2.2 ENVIRONMENTAL SETTING

LCC, UGVC, and DS Canal are located on Banner Mountain in Nevada County, California, in the western foothills of the Sierra Nevada mountain range at approximately 3,000 to 3,325 feet (920 to 1,010 meters) above mean sea level. These canals contain water diverted from Deer Creek above (LCC/UGVC) and below (DS Canal) Scotts Flat Reservoir. The primary vegetation community present along all three canals is Sierran Mixed Conifer-Hardwood Forest, comprised of both upland and riparian, or wet-adapted (i.e., emergent, hydrophytic, mesic) plant species (Sawyer et al. 2009).

2014, 2015, 2018, 2020, and 2021 were considered drought conditions (i.e., there was an overall decrease in annual precipitation as well as a spike in overall seasonal temperatures), 2013, 2016, 2017, and 2019 experienced average to above-average rainfall (DWR 2021, NRCS 2021) (Table 2.1 and Table 2.2).

Table 2-1. Water Year (October - September) Totals for the Project Region

Location/Water Year		2013	2014	2015	2016	2017	2018	2019	2020	2021
Nevada City, CA	Precipitation (inches)	56.8	37.6	37.1	62.8	103.8	49.9	76.6	35.9	29.1
	Percent of average	106%	70%	70%	118%	194%	93%	144%	67%	54%
Grass Valley, CA	Precipitation (inches)	47.2	33.9	32.1	55.7	95.9	48.0	68.2	32.7	25.0
	Percent of average	88%	63%	60%	104%	179%	89%	127%	61%	46%

Source: DWR 2021

Table 2-2. Highest Temperatures for the Project Region

Location/Calendar Year		2013	2014	2015	2016	2017	2018	2019	2020[2]	2021
Nevada City, CA	Temperature (degrees Fahrenheit)	98	99	98	99	101	99	94	-	98
	Percent of average	110%	112%	110%	112%	114%	112%	106%	-	110%
	Month of Occurrence	Jun	Jul	Jun/ Jul	Jul	Sept	Jul	Jul/ Aug	-	July
Grass Valley, CA	Temperature (degrees Fahrenheit)	100	98	99	99	102	98	104	101	105
	Percent of average	114%	112%	113%	113%	116%	112%	118%	115%	120%
	Month of Occurrence	Jun	Aug	Jul	Jul	Sept	Jul	Jul	Aug/ Sept	July

Source: NRCS 2021

2.3 PROJECT PURPOSE

Reducing flows in LCC and UGVC reduces the wetted perimeter in each canal and the head on the remaining wetted perimeter. As identified in the Project's Draft Environmental Impact Report, this change in hydraulic conditions may reduce the amount of leakage and seepage from the canals and has the potential to impact the environment created and maintained by canal leakage over the years (NID 2004).

[2] NRCS data not available for the Grass Valley station for 2020.

Possible stress from the flow reductions could lead to increased susceptibility of riparian trees to disease and parasitism and, in turn, result in loss of trees, associated shade canopy, and habitat for common and special-status wildlife species. As such, the FEIR deemed it necessary to study the effects of the reduced flows on riparian vegetation adjacent to the affected canals (NID 2006). The purpose of NID's long-term monitoring is to evaluate and make interpretations based on potential observed changes in spatial and compositional land cover as canal flows decreased/were shifted to the Lower Cascade Pipeline.

3.0 METHODS

3.1 CANOPY COVER STUDY

3.1.1 Tree Health Assessment

A total of six representative Tree Health Assessment study sites were selected (Figure 1 located at the end of this Report). The six Tree Health Assessment sites comprise four study sites along LCC (Sites 1-4), one study site along UGVC[3] (Site 5), and one reference site along DS Canal (Site 6). Representative sites were specifically selected based on vegetation type, areas suspected of maximum leakage (i.e., unlined stretches of the canal), and other associated riparian plant species that have the greatest potential to be adversely impacted by reductions in canal flows. Each study site is approximately 20 meters in length and includes riparian trees both downslope and upslope of the canals. However, the majority of the study trees are located downslope of the canal. Figure 2 shows the location of the trees at each site.

The Tree Health Assessment comprises the following parameters (NID 2012):

- Evaluations of changes in vegetation patterns over time conducted along the impacted LCC and UGVC and the DS Canal reference site
- Data collection within each of the appropriate study years in the late summer (typically August through October) when the trees are most water stressed, but prior to abscission or leaf shedding
- Surveys completed by a qualified botanist and/or biologist
- Data collected for a total of 10 years, at 2-year intervals

Surveys required for Baseline Year 0 (2013), Monitoring Year 2 (2015), Monitoring Year 4 (2017), and Monitoring Year 6 (2019) have been conducted and presented to the NID Engineering Committee and Board of Directors. Surveys conducted in Monitoring Year 8 (2021) are detailed in this Report. Therefore, one remaining survey effort will be conducted in 2023 (NID 2012).

For Monitoring Year 8, visual inspections of previously tagged trees at the six study site locations were conducted by a qualified Stantec botanist and a qualified Stantec biologist on September 14, 15, and 16,

[3] Due to limited suitable study sites, only one site was established along the UGVC.

2021, along LCC (Sites 1-4), UGVC (Site 5), and DS Canal (Site 6). Diameter at breast height (DBH) and tree health was evaluated using a variety of criteria, including the amount of canopy present, leaf and bark health, and presence of new growth, disease, parasites, and insect infestations (Appendix C). Normal seasonal variations were considered in overall health scoring. Data was documented in ArcGIS Collector, and general site conditions were also recorded. Photos were taken to document site conditions and trees assessed and are included in Appendix D. Field datasheets and notes for Monitoring Year 6 are included in Appendix E.

3.1.2 Canopy Cover Assessment

A Canopy Cover Assessment (via Densiometer Analysis) was conducted as part of the Canopy Cover Study. Canopy data is collected in conjunction with the Tree Health Assessment data (i.e., within the same Ten-Year monitoring period) every four years- Years 0, 4, 8, and 10 (NID 2012). Like the tree health data collection period, canopy data collection occurs within each of the appropriate study years in the late summer (i.e., typically August through September).[4]

The Canopy Cover Assessment Reaches were established along the same canal portions as the Tree Health Assessment sites. However, the Canopy Cover Assessment Reaches do not directly correlate to the Tree Health Assessment study sites, but rather extend along the canal and comprise a study Reach. Canopy cover data was collected along each Reach of (1) approximately seven miles of the LCC, (2) 0.5 mile of the UGVC, and (3) along one mile of the DS Canal as a reference site. Figure 3 shows each observation point along the reaches where data was collected.

Canopy data for monitoring Year 4 was collected on September 10, 15, 16, and 17, 2021, by two qualified Stantec Botanists. Observations were made using a densiometer and methods described in the Riparian Monitoring Procedures Section of the Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment (SWRCB 2012), and the canopy cover monitoring protocols referenced in the Project Impact Assessment Workplan (NID 2012). Specifically, the densiometer method uses the Strickler modification (17-point) of a convex spherical densiometer to correct for overestimation of canopy density (thickness and consistency of plant foliage) that occurs with unmodified readings (Strickler 1959). Observations were made facing upstream, downstream, facing the right bank, and facing the left bank (i.e., north, south, east, and west to the greatest extent possible). Each observation location was documented with an Arrow 100 GPS unit. During Year 4 monitoring, the Canopy Cover Assessments on the LCC (i.e., 7-mile Reach) had less observation points from the previous monitoring Year 0 (i.e., baseline 2013) due to the standardization of observation intervals (i.e., 79 less densiometer observation points). During Year 8 monitoring, the same observation points were measured as the Year 4 (2017) location.

[4] The Canopy Cover Assessment interval specification in the Workplan outlines 5- year intervals for Canopy Cover Assessments; however, this is contradicted with a specification to occur every 2–4 years (i.e., 0, 4, 6, 10). Considering ongoing environmental conditions within the time frame of tree health and canopy studies (e.g., drought), to be complimentary to the Tree Health Assessments, and to increase study time and efficiency, it has been recommended and adopted as an adaptive management strategy to update the Canopy Cover Assessments to occur every 4 years with one final assessment to conclude the study on year 10 (i.e., 0, 4, 8, 10).

3.2 POND STUDY

The objective of the Pond Study is to evaluate whether reductions in canal flows (and associated subsurface leakage) within NID's Lower Cascade Canal (LCC) and the Upper Grass Valley Canal (UGVC) will result in negative impacts to sensitive habitats and species, specifically the federally threatened California red-legged frog (*Rana draytonii*, CRLF) (NID 2012). The sensitive habitats evaluated include two ponds located adjacent to the LCC (Pond 1 and Pond 2) and one pond adjacent to the DS Canal (Pond 3), which serves as the reference site (Figure 4). No ponds are located along the UGVC; therefore, no ponds were evaluated for the Pond Study. [5] The Pond Study is conducted in conjunction with the Canopy Cover Study, which is conducted every 4 years beginning in 2013, as well as the 10th and final year of the study (NID 2012). Therefore, to date, the Pond Study has currently been conducted a total of three times with the final assessment taking place in 2023. Similar to the tree health and canopy cover data collection period, data collection for the Pond Study has and will occur in the late summer, typically in August and/or September.[6]

As part of the Pond Study, a qualified Stantec biologist conducted a habitat assessment at each Pond Study site on August 31, 2021. For each of the three Pond Study sites, the previous years' study results were reviewed. Data collection included the following during the field assessment on August 31, 2021:

- Delineation of inundated area/ soil saturation
- Hydrology pattern(s)
- Estimated range of water depths
- Soil type(s) present
- Vegetation communities present
- Wildlife species observed
- California red-legged frog habitat assessment
- Site photos

4.0 RESULTS AND ANALYSIS

4.1 CANOPY COVER STUDY: TREE HEALTH ASSESSMENT

A total of 88 live riparian trees were assessed at the six study sites along LCC, UGVC, and DS Canal. Riparian tree species surveyed included bigleaf maple (*Acer macrophylum*), Pacific dogwood (*Cornus nuttallii*), Oregon ash (*Fraxinus latifolia*), gray alder (*Alnus incana*), and white alder (*Alnus rhombifolia*),

[5] Ponds and/or seep wetlands that are located within 50 meters of the downslope side of the canals were targeted for pond study site locations. Sites were also targeted based on property access. Due to the lack of ponds/seep wetlands and access along the LCC, UGVC, and DS Canal, fewer than five seep wetlands/ ponded areas were identified as originally targeted by the Workplan (NID 2012).

[6] Like the Canopy Cover Assessment, it was recommended as an adaptive management strategy to update the Pond Study to occur every 4 years with one final assessment to conclude the study on year 10 (Years 0, 4, 8, 10), which differs from the original Work Plan of conducting these surveys every 5 years.

though the species most surveyed were bigleaf maple and Pacific dogwood. Figure 2 shows the location and health category of each tree.

General canopy cover for the survey seasonal timing was normal to partial, and general bark health of surveyed trees was fair, with some trees exhibiting bark sloughing. All sites exhibited some foliage discoloration from normal seasonal changes and abscission, the process of deciduous plants seasonally shedding leaves. Other observed foliage discolorations included spotting from potential disease (i.e., rust spots) and insect and herbivory damage, which was extensive across all sites. Most trees exhibited new vascular growth of leaf buds, basal sprouts, or epicormic stems. Surface growths were mostly biological (e.g., moss, lichen, and fungi). There was very low occurrence of disease at the sites, with few trees exhibiting root rot or other diseases on trunks. In some cases, parasites were noted as vining species growing up the trunk and sometimes even into the tree canopy, and included honeysuckle (*Lonicera hispidula*), Himalayan blackberry (*Rubus armeniacus*), English ivy (*Hedera helix*), California wild grape (*Vitis californica*), and poison oak (*Toxicodendron diversilobum*).

Riparian shrub and herbaceous species observed included Himalayan blackberry (*Rubus armeniacus*), cut-leaved blackberry (*Rubus laciniatus*), and English ivy (*Hedera helix*). Upland habitats and species were also present at the LCC, UGVC, and DS Canal study site locations. Upland overstory species included black oak (*Quercus kelloggii*), canyon live oak (*Quercus chrysolepis*), Douglas-fir (*Pseudotsuga menziesii*), beaked hazelnut (*Corylus cornuta*), incense cedar (*Calocedrus decurrens*), Pacific madrone (*Arbutus menziesii*), Ponderosa pine (*Pinus ponderosa*), and tanoak (*Notholithocarpus densiflorus*). Upland shrub species included coyote brush (*Baccharis pilularis*). Non-native and invasive species, including landscaping cultivars and grasses, have also encroached into the study sites from residences and roads along the canals.

The following sections outline the Tree Health Assessment findings for each study site and provides a comparison analysis for Tree Health Assessment data between years (Baseline Year 0 and Monitoring Years 2, 4, 6, and 8) and locations (LCC, UGVC, and DS Canal). Data collection varied slightly per year based on weather and drought conditions. Flow rates, climate (i.e., the region's precipitation and temperatures), and general botanical bloom and abscission periods are considered in the analysis.

The compiled tree health data for all LCC sites (Site 1-4) yielded a relative score of 10 during the 2021 survey, and a relative score of 8 to 12 over the past 8 years. The tree health data for the UGVC site (Site 5) yielded a score of 10 during the 2021 survey, and a relative score of 8 to 11 over the past 6 years. The tree health data for the DS Canal reference site (Site 6) yielded a score of 10 during the 2021 survey and a relative score of 8 to 10 over the past 6 years. Overall, the tree health for all sites (including the DS Canal reference site) has been categorized as "good health", with the exception of LCC Site 4 that had a score of 12 in 2013, which falls within the "excellent health" category.

4.1.1 Site Specific Results and Analyses

4.1.1.1 Lower Cascade Canal Site 1 Results and Analyses

Monitoring Year 8

In Monitoring Year 8, 19 riparian trees were surveyed at Site 1 on LCC on September 20, 2019, including bigleaf maple, Pacific dogwood, and gray alder. Three new dead trees were found. Most trees surveyed had full to partial canopy cover and good bark health, and exhibited DBH growth, new growth, surface growths, foliage discoloration, and insect damage. Disease was minimal at this site, but a few tree trunks were encroached by parasites such as honeysuckle and poison oak. Overall tree health at Site 1 is good, with a range of health scores from 8 to 14 and an average health score of 10 (Table 4-1, Graph 4-1).

General site conditions included down woody debris in the understory on both up and downslope portions of Site 1. Various upland tree species are also present at Site 1, including Douglas-fir, beaked hazelnut, incense cedar, and Pacific madrone (Appendix F).

Monitoring Year Comparisons

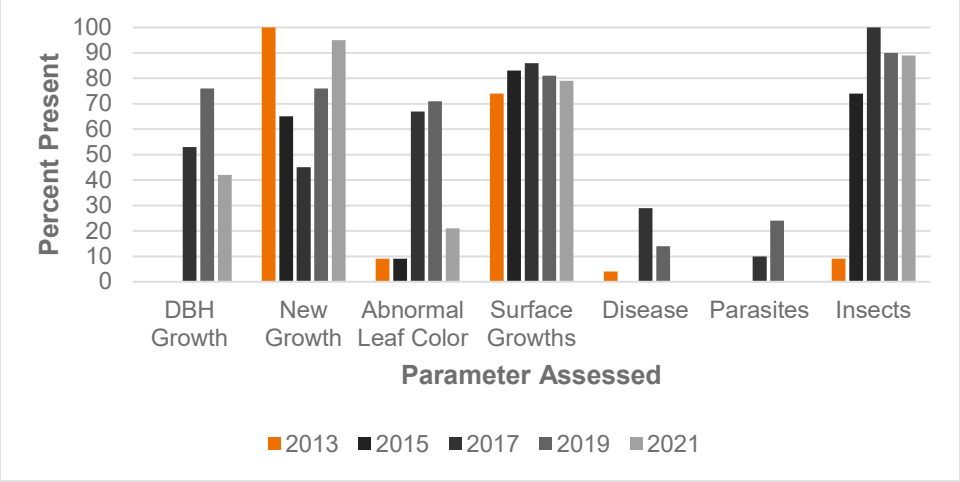
Since Baseline Year 0, trees at Site 1 improved from partial to medium canopy cover, and bark health remained good. However, presence of abnormal leaf color and insects increased from barely present at Site 1 to present in most trees. Presence of new growth greatly decreased from Baseline Year 0 to Monitoring Year 4 but made a substantial recovery in Monitoring Year 6 and sustained that into Monitoring Year 8. Surface growth remained highly prevalent and diseases and parasites remained minimal across monitoring years, though honeysuckle and other parasitic plants were observed in increasing quantity at Site 1. Two tree deaths were observed at Site 1 between Baseline Year 0 and 6, and three new trees were confirmed dead in Monitoring Year 8. In comparison with Monitoring Year 6, trees surveyed in Monitoring Year 8 exhibited overall improvements in DBH and new growth, as well as less disease. Overall tree health at Site 1 remains good since Baseline Year 0, oscillating on health between Monitoring Years 2 through 8 (Table 4-1, Graph 4-1). Although three new trees were found dead, the other surviving trees are showing better health at this site as compared to the previous two monitoring years. The three trees that died were previously in the “fair health” category and had been declining over the years.

Table 4-1. Lower Cascade Canal Site 1 Tree Health Assessment Data

Site 1 LCC					
Monitoring Year	**2013**	**2015**	**2017**	**2019**	**2021**
Survey Date	9/12	10/7	9/12	9/20	9/14
Trees Surveyed[1]	23	23	21	21	19
Tree Death[2]	0	1	1	0	3
Canopy Cover[3]	2	3	3	3	3
Bark Health	3	3	3	3	3
Overall Tree Health	10	10	8	9	11

[1] Tree Heath Assessment criteria values are averages of all individual live trees surveyed per site (dead stems were not included in final calculations).
[2] Number of new trees confirmed dead each year; not cumulative.
[3] Individual tree foliage cover values, not total canopy cover as assessed in the canopy cover study.

Graph 4-1 Lower Cascade Canal Site 1 Tree Health Assessment Data



4.1.1.2 Lower Cascade Canal Site 2 Results and Analysis

Monitoring Year 8

During Year 8 monitoring, 13 riparian trees were surveyed at Site 2 on LCC on September 15, 2021. Tree species surveyed include bigleaf maple, gray alder, and Pacific dogwood. No new trees were found dead. Most trees surveyed had full to partial canopy cover and good bark health, and exhibited new growth, surface growths, and insect damage and infestation. Disease was minimal at this site, but approximately half the trees surveyed exhibited foliage discoloration and parasites such as honeysuckle and Himalayan blackberry (*Rubus armeniacus*) on trunks and branches. Overall tree health at Site 2 is good, with a range of health scores from 8 to 13 and an average health score of 10 (Table 4-2, Graph 4-2).

General site conditions included excessive encroachment by non-native understory species (e.g., Himalayan blackberry), as noted in previous years. Mechanical removal of upslope study trees in 2018 and installation of fencing by private landowners rendered the upslope portion of the site unable to be surveyed. As such the upslope trees are no longer a part of the study. Drainage fed by LCC and rainfall/runoff was observed near trees surveyed downslope of LCC; it did not have water at the time of the survey this year. Various upland tree species are also present at Site 2, including black oak, beaked hazelnut, and incense cedar.

Monitoring Year Comparisons

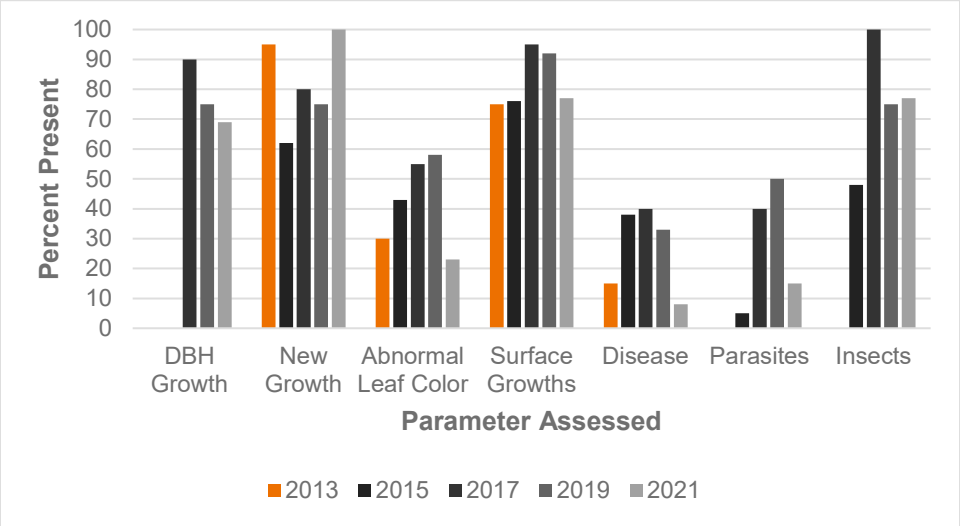
Since Baseline Year 0, canopy cover of trees at Site 2 remained consistent, and bark health varied over the years but remained in the good health category in Monitoring Year 8. DBH growth has steadily declined since Baseline Year 0, however new growth has oscillated over the years and increased in Monitoring Year 8. Abnormal leaf color, surface growths, diseases, and parasites decreased during Monitoring Year 8, however insect presence increased. Only one tree death was observed at Site 2 since Baseline Year 0, and no new trees were confirmed dead in Monitoring Year 8. In comparison with Monitoring Year 6, trees surveyed in Monitoring Year 8 exhibited improvements in new growth, less abnormal leaf color, surface growth, disease, and parasites. However, there was an increased presence of insects and insect damage and less evidence of DBH growth. Overall tree health at Site 2 remains good since Baseline Year 0, with a slight decrease between Monitoring Years 2 through 6 (Table 4-2, Graph 4-2), but increasing in Monitoring Year 8.

Table 4-2. Lower Cascade Canal Site 2 Tree Health Assessment Data

Site 2 Lower Cascade Canal					
Monitoring Year	**2013**	**2015**	**2017**	**2019**	**2021**
Survey Date	9/11	10/6	9/8	10/17	9/15
Trees Surveyed[1]	20	21	20	12	13
Tree Death[2]	0	1	0	0	0
Canopy Cover[3]	3	3	3	3	3
Bark Health	3	3	3	2	3
Overall Tree Health	10	10	9	8	10

[1] Tree Heath Assessment criteria values are averages of all individual live trees surveyed per site (dead stems were not included in final calculations).
[2] Number of new trees confirmed dead each year; not cumulative.
[3] Individual tree foliage cover values, not total canopy cover as assessed in the canopy cover study.

Graph 4-2. Lower Cascade Canal Site 2 Tree Health Assessment Data



4.1.1.3 Lower Cascade Canal Site 3 Results and Analysis

Monitoring Year 8

During Monitoring Year 8, 20 riparian trees were surveyed at Site 3 on LCC on September 15, 2021. Tree species surveyed include bigleaf maple, gray alder, and Pacific dogwood. No new trees were found dead. Most trees surveyed had full to partial canopy cover and good bark health. Trees exhibited some surface growth, in the presence of and insect damage and infestation. Over half the trees surveyed exhibited new growth. Disease amongst some of the trees was observed at this site, in addition to parasites such as California wild grape and english ivy present on several tree trunks and branches. Little abnormal leaf color was observed. Overall tree health at Site 3 is good, with a range of health scores from 4 to 14 and an average health score of 10 (Table 4-3, Graph 4-3).

General site conditions included encroachment by non-native and invasive understory species that also were vining up the tree trunks (e.g., English ivy). Various upland tree species are also present at Site 3, including Douglas-fir and incense cedar.

Monitoring Year Comparisons

Since Baseline Year 0, trees at Site 3 improved from partial to medium canopy cover, as well as fair to good bark health. However, between Monitoring Year 6 and Monitoring Year 8, more disease was detected throughout the trees. The presence of new growth declined over the years, but rebounded this year and abnormal leaf color and parasites declined as compared to the last monitoring year. Presence of insects also increased from barely present at Site 3 to present in a majority trees, though the prevalence of insect damage dropped in Monitoring Years 6 and 8. Surface growths remained highly and consistently prevalent, although slightly decreased this year. No tree deaths were observed at Site 3 since Baseline Year 0. In comparison with Monitoring Year 6, trees surveyed in Monitoring Year 8 exhibited

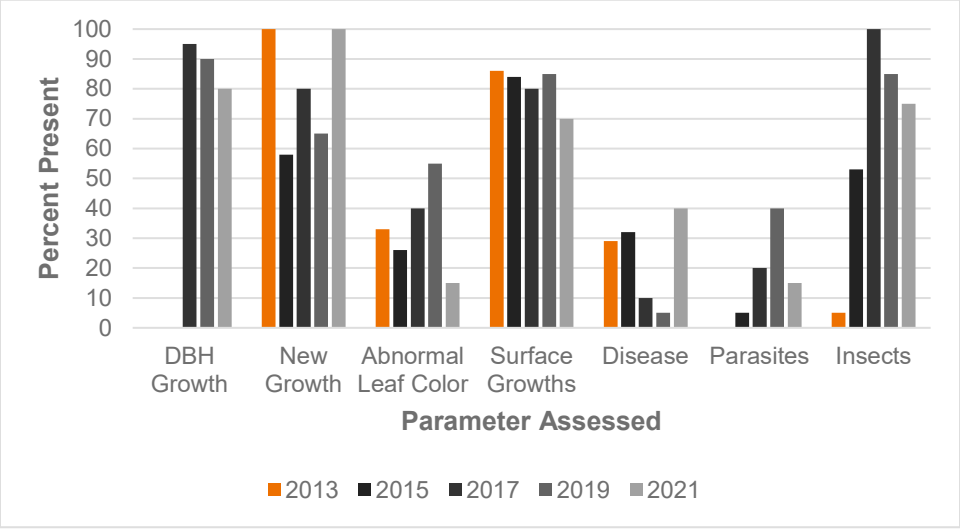
improvements in the presence insect damage, parasites, new growth, and abnormal leaf color. The trees surveyed exhibited greater presence of disease, as well as less evidence of DBH and new growth. Overall tree health at Site 3 remained consistently good, even increasing slightly in Monitoring Year 8 (Table 4-3, Graph 4-3).

Table 4-3. Lower Cascade Canal Site 3 Tree Health Assessment Data

Site 3 Lower Cascade Canal					
Monitoring Year	**2013**	**2015**	**2017**	**2019**	**2021**
Survey Date	9/11	10/8	9/8	10/17	9/15
Trees Surveyed[1]	21	19	20	20	20
Tree Death[2]	0	0	0	0	0
Canopy Cover[3]	2	3	3	3	3
Bark Health	2	3	3	3	3
Overall Tree Health	9	9	9	8	10

[1] Tree Heath Assessment criteria values are averages of all individual live trees surveyed per site (dead stems were not included in final calculations).
[2] Number of new trees confirmed dead each year; not cumulative.
[3] Individual tree foliage cover values, not total canopy cover as assessed in the canopy cover study.

Graph 4-3. Lower Cascade Canal Site 3 Tree Health Assessment Data



4.1.1.4 Lower Cascade Canal Site 4 Results and Analysis

Monitoring Year 8

During Year 8 monitoring, 19 riparian trees were surveyed at Site 4 on LCC on September 14, 2021. Tree species surveyed include bigleaf maple, gray alder, and Oregon ash. No new trees were found dead. Most of the trees surveyed exhibited insect damage and infestation. On average, trees surveyed had full to partial canopy cover and good bark health, and over half the trees surveyed exhibited new growth and foliage discoloration. Disease, surface growth, and parasites were minimal at this site, though english ivy and root rot were present on some tree trunks. Overall tree health at Site 4 is good, with a range of health scores from 4 to 14 and an average health score of 10 (Table 4-4, Graph 4-4).

General site conditions included beaked hazelnut, thimbleberry (*Rubus parviflorus*), and poison oak. Various upland tree species are also present at Site 4, including black oak, Douglas-fir, incense cedar, and tanoak.

Monitoring Year Comparisons

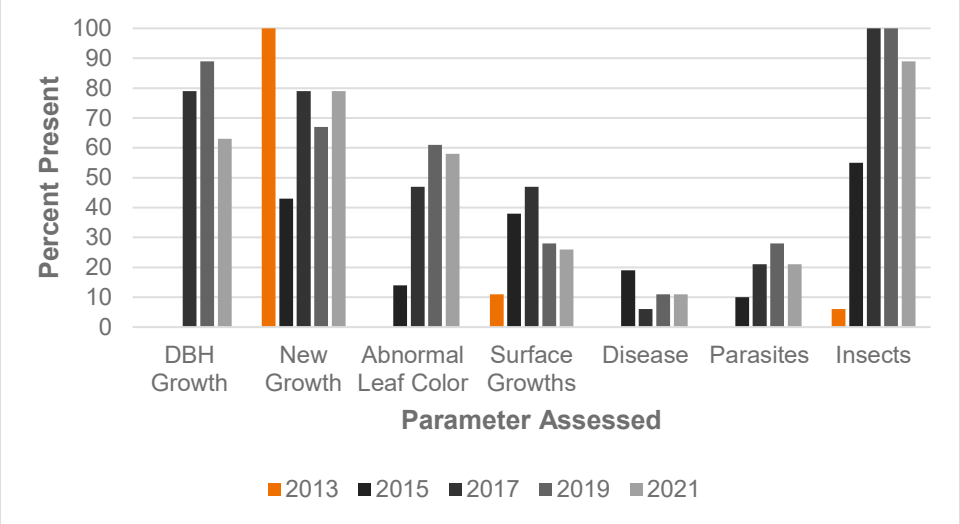
Since Baseline Year 0, trees at Site 4 remained consistent in partial to full canopy cover and good bark health. However, presence of new growth declined, and abnormal leaf color and insects increased from barely present at Site 4 to present in most to all trees. Surface growths, diseases, and parasites remained low but also generally increased since Baseline Year 0, though the prevalence of surface growth and parasites dropped in Monitoring Year 8. No new tree deaths were observed. In comparison with Monitoring Year 6, trees surveyed in Monitoring Year 8 exhibited improvements in the presence of new growth, insect damage, and parasites, but also exhibited less evidence of DBH growth. Overall tree health at Site 4 decreased from excellent to good since Baseline Year 0, but remained consistently good between Monitoring Years 2 through 8, although exhibiting a slight decrease over the monitoring years (Table 4.4, Graph 4-4).

Table 4-4. Lower Cascade Canal Site 4 Tree Health Assessment Data

Site 4 LCC					
Monitoring Year	**2013**	**2015**	**2017**	**2019**	**2021**
Survey Date	9/11	10/6	9/12	9/20	9/14
Trees Surveyed[1]	18	21	19	18	19
Tree Death[2]	0	0	0	1	0
Canopy Cover[3]	3	3	3	3	3
Bark Health	3	3	3	3	3
Overall Tree Health	12	11	9	9	10

[1] Tree Heath Assessment criteria values are averages of all individual live trees surveyed per site (dead stems were not included in final calculations).
[2] Number of new trees confirmed dead each year; not cumulative.
[3] Individual tree foliage cover values, not total canopy cover as assessed in the canopy cover study.

Graph 4-4. Lower Cascade Canal Site 4 Tree Health Assessment Data



4.1.1.5 Upper Grass Valley Canal Site 5 Results and Analysis

Monitoring Year 8

During Year 8 monitoring, four riparian trees were surveyed at Site 5 on UGVC on September 15, 2021. Tree species surveyed include bigleaf maple, Pacific dogwood, and white alder. Two trees appeared to have been mechanically removed for road maintenance. All trees surveyed exhibited insect damage and infestation, but also new growth. Most trees surveyed exhibited full to partial canopy cover, excellent bark health, and no disease. There was a presence of abnormal foliage discoloration. Parasitic honeysuckle was present on some tree trunks and adjacent saplings. Mechanical damage to trees from roadside tree-trimming was observed, as well as new growth of various riparian tree species saplings within the site.

Overall tree health at Site 5 is good, with a range of health scores from 8 to 12 and an average health score of 10 (Table 4-5, Graph 4-5).

General site conditions included some mechanical damage to trees due to proximity to the road. Various upland tree species are also present at Site 5, including black oak and incense cedar.

Monitoring Year Comparisons

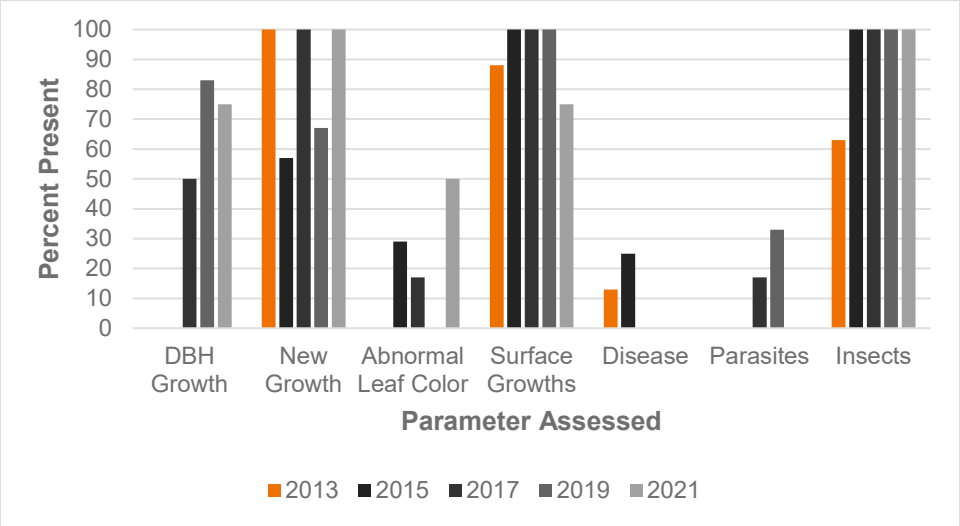
Since Baseline Year 0, trees at Site 5 exhibited oscillating canopy cover and bark health, though canopy cover remained steady in Monitoring Year 8 and bark health increased. From Monitoring Year 6 to 8, canopy cover remained medium canopy and bark health went from good to excellent health. DBH growth slightly decreased and there was an increase in abnormal leaf color. Diseases and parasites were absent from this site with some fluctuations in presence over the years. The presence of new growth has oscillated greatly since Baseline Year 0 (with an increase this year), and surface growths and insects remained highly prevalent, present in a majority to all trees. There was an increase in trees that were mechanically removed at Site 5 since Baseline Year 0, with two trees confirmed missing in Monitoring Year 8. In comparison with Monitoring Year 6, trees surveyed in Monitoring Year 8 exhibited improvements in the presence of new growth and less surface growth and parasites, but also exhibited less DBH growth, more abnormal leaf color, and a continued presence of insects. Overall tree health at Site 5 remains good since Baseline Year 0, oscillating in health over the years and slightly increasing in health since Baseline Year 0 (Table 4-5, Graph 4-5. This site continues to have mechanical removal of trees, and therefore is becoming more difficult to monitor the overall health of the riparian trees at this site.

Table 4-5. Upper Grass Valley Canal Site 5 Tree Health Assessment Data

Site 5 Upper Grass Valley Canal					
Monitoring Year	**2013**	**2015**	**2017**	**2019**	**2021**
Survey Date	9/10	10/7	9/7	10/17	9/15
Trees Surveyed[1]	8	7	6	6	4
Tree Death[2]	0	1	0	0	2
Canopy Cover[3]	2	3	4	3	3
Bark Health	2	3	4	3	4
Overall Tree Health	9	8	11	10	10

[1] Tree Heath Assessment criteria values are averages of all individual live trees surveyed per site (dead stems were not included in final calculations).
[2] Number of new trees confirmed dead each year; not cumulative.
[3] Individual tree foliage cover values, not total canopy cover as assessed in the canopy cover study.

Graph 4-5. Upper Grass Valley Canal Site 5 Tree Health Assessment Data



4.1.1.6 DS Canal (Reference Site) Site 6 Results and Analysis

Monitoring Year 8

During Year 8 monitoring, 13 riparian trees were surveyed at the reference site, Site 6, on DS Canal on September 16, 2021. Tree species surveyed include bigleaf maple, gray alder, and Pacific dogwood. No new trees were found dead during this year's survey. A majority of trees surveyed exhibited insect damage and infestation, new growth, full to partial canopy cover, and good bark health was also observed in most trees. Foliage discoloration and surface growth was observed on less than half of the trees surveyed. Little disease or parasitic presence was observed, though there was some root rot and parasitic honeysuckle was present on some tree trunks and branches, similar to previous years. Overall tree health at Site 6 is good, with a range of health scores from 6 to 13 and an average health score of 10 (Table 4-6, Graph 4-6).

General site conditions included down woody debris, and vining plant encroachment on tree trunks primarily by honeysuckle. Various upland tree species are also present at Site 6, including Douglas-fir, incense cedar, and Ponderosa pine.

Monitoring Year Comparisons

Since Baseline Year 0, trees at Site 6 exhibited improvements in canopy cover and bark health. However, abnormal leaf color, surface growths, parasites, and insects increased since Baseline Year 0, though observations of all but parasites dropped in Monitoring Year 8. Presence of new growth also greatly decreased from Baseline Year 0 to Monitoring Year 2 but recovered to baseline by Monitoring Year 6 and increased in Monitoring Year 8. In comparison with Monitoring Year 6, trees surveyed in Monitoring Year 8 exhibited improvements in the presence of new growth, abnormal leaf color, and surface growths, but bark health, canopy cover, and the presence of disease and parasites remained fairly consistent. Overall

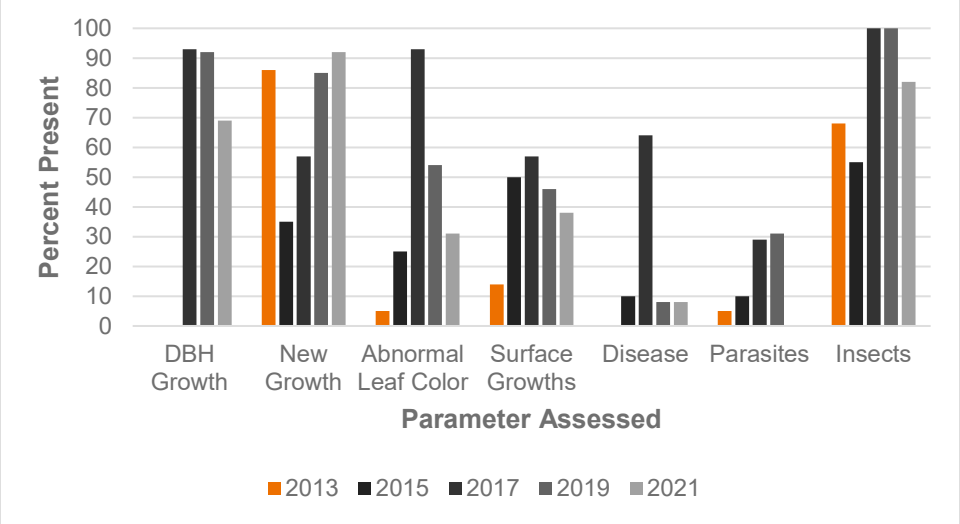
tree health at Site 6 remained consistently good between Baseline Year 0 through Monitoring Year 8. The health score decreased slightly during Monitoring Year 4 but recovered to baseline health scores by Monitoring Year 8 (Table 4-6, Graph 4-6).

Table 4-6. DS Canal Site 6 Tree Health Assessment Data

Site 6 DS Canal					
Monitoring Year	**2013**	**2015**	**2017**	**2019**	**2021**
Survey Date	9/10	10/7	9/15	10/18	9/16
Trees Surveyed[1]	22	20	14	13	13
Tree Death[2]	0	3	2	1	0
Canopy Cover[3]	2	3	4	3	3
Bark Health	2	3	3	3	3
Overall Tree Health	10	10	8	10	10

[1] Tree Heath Assessment criteria values are averages of all individual live trees surveyed per site (dead stems were not included in final calculations).
[2] Number of new trees confirmed dead each year; not cumulative.
[3] Individual tree foliage cover values, not total canopy cover as assessed in the canopy cover study.

Graph 4-6. DS Canal Site 6 Tree Health Assessment Data



4.1.2 Site Comparisons

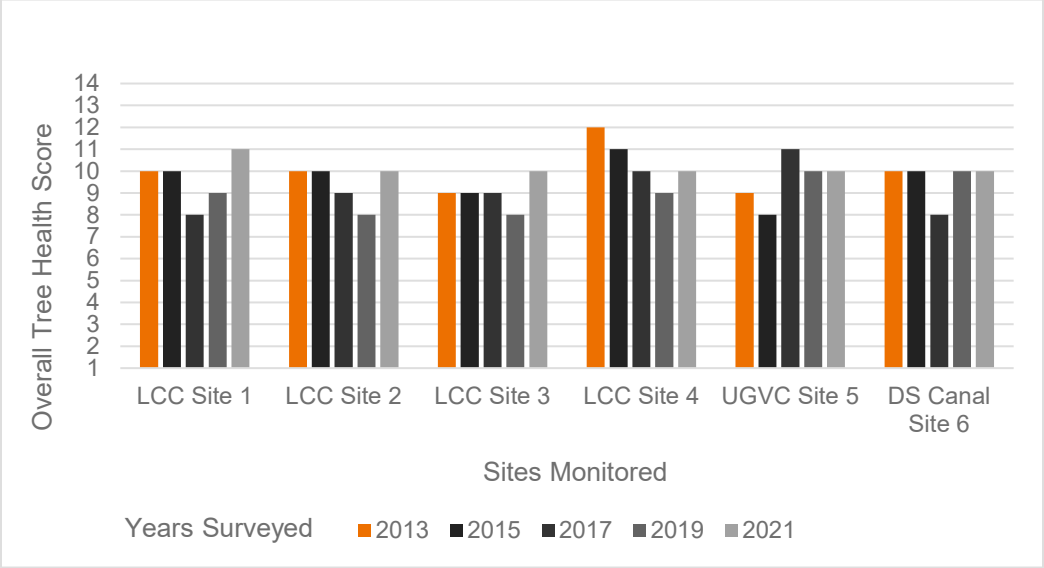
Overall tree health at Sites 1, 2, 3, and 4 on LCC increased from Monitoring Years 6 to 8 (Graph 4-7). Overall tree health at Sites 2, 3, and 4 on LCC was consistent with sites on the other two canals (i.e., UGVC and DS Canal) and higher at Site 1 than any of the other sites. Decreased growth in DBH as compared to previous years was the only negative factor amongst the sites in Monitoring Year 8 as compared to previous years. Otherwise, canopy cover remained consistent at all sites, so it can be

concluded that associated riparian shade canopy remains intact. There was also minimal loss of riparian tree species along the LCC study sites, with three total confirmed tree deaths (all at LCC Site 1) out of 84 trees total amongst the sites for the duration of the study. This year (differing from the previous 6 years), all sites had notable increases in new growth observations (i.e., riparian forest regeneration) rebounding to baseline levels.

Overall tree health at Site 5 on UGVC is consistent from Monitoring Year 6 to 8, and greater than Baseline Year 0 (Graph 4-7). In Monitoring Year 8, overall tree health at Site 5 was consistent with LCC Sites 2, 3, and 4 and the same as Site 6 on DS Canal. Unfortunately, two of the trees had been removed since Monitoring Year 6 likely for road maintenance purposes. There was a slight increase in overall bark health, presence of new growth, and a decreased presence of parasites that contributed to the consistent overall health at Site 5. However, Monitoring Year 8 showed an increase in abnormal leaf color. Canopy cover remained consistent from Monitoring Year 6 to 8 but was overall greater than in Baseline Year 0, so it may be concluded that associated riparian shade canopy remains intact.

Overall tree health at DS Canal remained consistent from Monitoring Year 6 to 8, and also remained consistent with baseline overall health levels (Graph 4-7). In Monitoring Year 8, overall tree health at Site 6 was consistent with Sites 2, 3, and 4 on LCC and the same as Site 5 on UGVC. It had slightly lower tree health than at LCC Site 1. Increased presence of new growth and a decrease of abnormal leaf color and surface growths on the trees are the primary drivers leading to consistent overall health at Site 6. Canopy cover was similarly consistent from Monitoring Year 6 to 8 and generally increased from Baseline Year 0, so it may be concluded that associated riparian shade canopy remains intact. Over the past 6 years, there was a moderate loss of riparian tree species at Site 6, with six total confirmed tree deaths out of 22 trees; however, no new losses were recorded this year.

Graph 4-7. Average Overall Tree Health Scores[7] by Study Site



[7] Health scores: 1-4, poor health; 5-7, fair health; 8-11, good health; 12-14, excellent health.

4.2 CANOPY COVER STUDY: CANOPY COVER ASSESSMENT

Monitoring Year 8 (2021) Canopy Cover Assessment data was collected on September 10, 15, 16, and 17, 2021 for each assessment Reach. Data collection and canopy density percentages were calculated based on methods and formulas for calculating the 17-point methods results described in the Use of the Densiometer to Estimate Density of Forest Canopy on Permanent Sample Plots (Strickler 1959). The following results average and summarize the overall canopy cover data densiometer readings collected on each canal Reach during Monitoring Year 8 (2021) monitoring. Baseline Year 0 and Monitoring Year 4 have also been provided. A compiled data summary of Canopy Cover Assessment metrics has been provided below in Table 4.7. The locations of the observation points can be referenced in Figure 3.

4.2.1 Canopy Cover Assessment Results

4.2.1.1 LCC Canopy Cover Assessment Results

An approximate 7-mile reach of the LCC was sampled for Canopy Cover Assessment in Year 8 monitoring. A total of 273 canopy cover densiometer observation points were identified and collected. The LCC canopy cover ranges from a minimum density of zero to a maximum density of 100 percent. The average density of canopy cover along the LCC Reach was 62.2 percent, therefore yielding medium canopy cover.

4.2.1.2 Upper Grass Valley Canal Canopy Cover Assessment Results

An approximate 0.5-mile reach of the UGVC was sampled for Canopy Cover Assessment in Year 8 monitoring. A total of 27 canopy cover densiometer observation points were identified and collected. The UGVC canopy cover ranges from a minimum density of 2.1 percent to a maximum density of 95.1 percent. The average density of canopy cover along the LCC Reach was 75.6 percent, therefore yielding medium to full canopy cover.

4.2.1.3 DS Canal (Reference Site) Canopy Cover Assessment Results

An approximate one-mile Reach of the DS Canal was sampled as a reference for Canopy Cover Assessment in Year 8 monitoring. A total of 85 canopy cover densiometer observation points were identified and collected. The DS Canal canopy cover ranges from a minimum density of 4.2 to a maximum density of 98.7 percent. The average density of canopy cover along the DS Canal Reach was 57.7 percent, yielding medium canopy cover.

Table 4-7. Canopy Cover Assessment Results

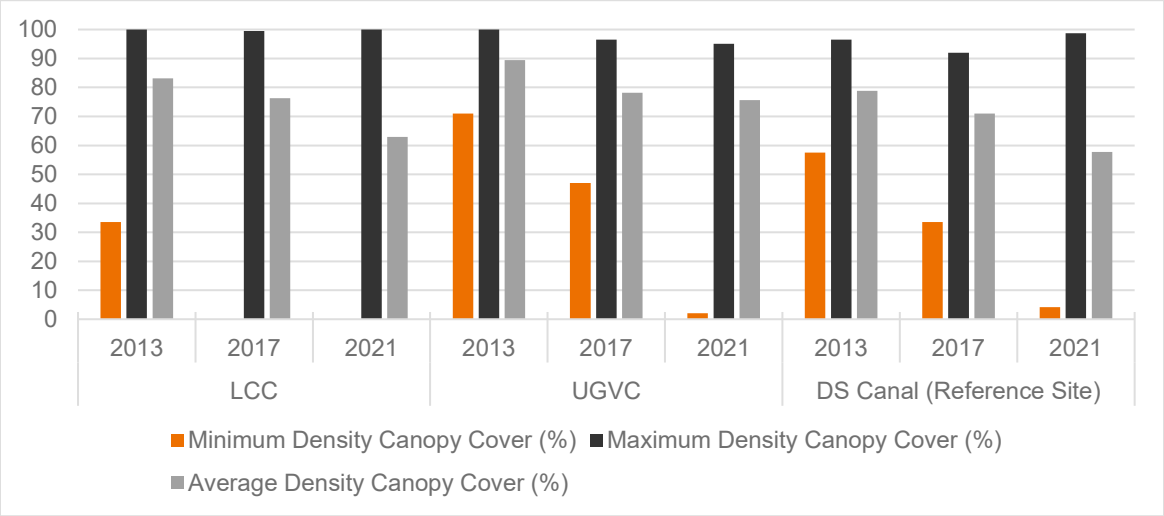
	Lower Cascade Canal			Upper Grass Valley Canal			DS Canal (Reference Site)		
	2013	**2017**	**2021**	**2013**	**2017**	**2021**	**2013**	**2017**	**2021**
Survey Date(s)	9/19; 9/30	9/19; 9/22	**9/10; 9/15**	9/10	9/22	**9/15**	9/10	9/15; 9/22	**9/16**
Study Reach Length (miles)	7	7	**7**	0.5	0.5	**0.5**	1	1	**1**
Total Observation Points[1]	351	272	**273**	24	27	**27**	48	85	**85**
Minimum Density Canopy Cover (%)	33.5	0	**0**	71	47	**2.1**	57.5	33.5	**4.2**
Maximum Density Canopy Cover (%)	100	99.5	**100**	100	96.5	**95.1**	96.5	92	**98.7**
Average Density Canopy Cover (%)	83.2	76.3	**62.9**	89.4	78.2	**75.6**	78.8	71	**57.7**

[1] Variation in the total number of observation points along each canal Reach for the Canopy Cover Assessment is due to the interval distance for each set of observations. Baseline Year 0 (2013) observation interval for Lower Cascade Canal (LCC) and DS Canal (reference site) was averaged at approximately 50–65 feet for each densiometer reading along the canal Reach. Upper Grass Valley Canal (UGVC) was averaged at 100 feet for each densiometer reading along the canal. To be consistent with baseline and create a standard, Year 4 (2017) averaged all observations intervals for LCC, UGVC, and DS Canal (reference site) to 100 feet for each set of densiometer readings. This same methodology continued in Year 8 (2021).

4.2.2 Canopy Cover Assessment Monitoring Year Comparisons

From Year 0 to Year 4, average canopy cover density marginally decreased by approximately 7 percent on the LCC and 6 percent on the DS Canal reference site. From Year 4 to Year 8, average canopy cover density had a greater decrease by approximately 13.4 percent on the LCC and 13.3 percent on the DS Canal reference site. The UGVC site only experienced a 2.7 decrease in canopy cover. Graph 4-8 shows the minimum, maximum, and average density of canopy cover over the years. Due to the fact that there is a similar decrease in canopy cover at the LCC and DS Canal sites indicates that the minor decline is potentially due to seasonal climate conditions and natural abscission variation from year-to-year. The UGVC site has a higher proportion of conifer trees which likely allows for less abscission and therefore less variability year-to-year.

Graph 4-8. Average Overall Canopy Cover Study



4.3 POND STUDY

Data for the Pond Study was collected on Tuesday, August 31, 2021, for the three Pond Study sites adjacent to the LCC (Pond 1 and Pond 2) and DS Canal (Pond 3). As stated in the methods section above, no data was collected along the UGVC because no ponds were identified during the initial development of the study. During the field assessment, the parameters evaluated included the area of inundation and soil saturation, approximate water depth(s), apparent hydrology patterns, soil type(s) present, vegetation communities present, wildlife species present, and habitat for CRLF. Table 4.8 summarizes Pond Study results for metrics collected during surveys conducted in 2013, 2017, and 2021 (Year 0, Year 4, and Year 8). Figure 4 includes maps of LCC Ponds 1 and 2 and the DS Canal Pond 3.

4.3.1 Pond Study Results Summary

4.3.1.1 Lower Cascade Canal

POND 1

Pond 1, located at latitude 39.23571 and longitude -120.988615 (WGS-84), adjacent to the LCC is within an upland forested habitat in a rural residential area. The dominant tree species includes incense cedar (*Calocedrus decurrens*) with the dominant understory species including Himalayan blackberry (*Rubus armeniacus*), as well as various other non-native and ornamental species. With the exception of a few (mostly dead) branches present on the north-northwest side of pond, little to no vegetation overhangs into the pond, and emergent vegetation within the area of inundation is minimal. The northwest and west sides of the pond are steep and at the time of the assessment, the shoreline included approximately three feet of bare mud and dead leaves before meeting with vegetation (Appendix D, Photographs 45−46). As were found in 2017, habitats in present surrounding Pond 1 appear to be healthy despite the drought

conditions in California in recent years. For a list of observed wildlife species at Pond 1, please refer to Appendix F of this report.

Pond 1 is supplied with purchased water from April 15 through October 15 from the LCC. During the 2021 assessment, water was observed entering the pond through an approximate 4-inch pipe on the north slope and is also by a seepage from the LCC on the northeastern shore of the pond. During the previous assessment conducted in 2017, two seepages were identified. The property owner indicated that the additional seepage from the LCC is sub-surface most of the year but experiences above-ground flow during heavy winter rains. The land manager also indicated that both seepage inputs were highly variable based upon NID flow controls. In a typical year, Pond 1 annually overflows and flushes out. Pond 1 is a perennial body of water due to the relatively consistent supply of water despite fluctuating water levels throughout the year (NID 2013).

Pond 1 is adjacent to but physically separated from Pond 2 by a dirt access road. However, the two ponds are connected via an approximate 6-inch culvert, which allows water to flow from Pond 1 to Pond 2 when water levels allow. At the time of the 2021 assessment, water levels were much too low to be hydrologically connected (Photographs 45−48).

POND 2

Pond 2 is located at latitude 39.235182 and longitude -120.989522 (WGS-84) and adjacent to the LCC. As described above, Pond 2 is situated within an upland forest habitat and includes the same dominant overstory and understory vegetative species. Pond 2 is also a perennial wetland, with little to no overhanging vegetation; but approximately 50% of its surface is comprised of emergent vegetative species including narrowleaf plantain (*Alisma lanceolatum*) and narrowleaf cattail (*Typha angustifolia*) (Appendix D, Photographs 49−50). Pond 2 is located adjacent to and downslope of Pond 1 and is surrounded by dirt access roads on all sides. As mentioned above, Pond 1 is supplied with purchased water from April 15 through October 15 from the LCC, and feeds Pond 2 via a culvert approximately 6 inches diameter when water levels allow (Appendix D, Photographs 47−48). Potential seepage from the NID canal located upslope and to the northeast may also supply Pond 2 with water.

In 2017, the land manager indicated that the landowner has been using Pond 2 for irrigation via a 1-inch PVC (polyvinyl chloride) pipe since 2014. Usage of Pond 2 water for irrigation is intermittent, minor, and has negligible effects on the water level. Additionally, the property owner indicated that water levels vary widely over the course of the year due to debris blockages to the inflow culvert and overflows caused by winter precipitation events. Both the inflow culvert (i.e., culvert between Pond 1 and Pond 2) and the outflow culvert were replaced in early August 2017 due to rust, debris blockage, and subsequent seasonal overflows from each pond. The relatively consistent supply of water in Pond 2 allows for its perennial state despite fluctuating water levels throughout the year (NID 2013). For a list of observed wildlife species at Pond 2, please refer to Appendix F of this report.

4.3.1.2 DS Canal (reference site)

POND 3

Pond 3, the reference site for the Pond Study, is located at latitude 39.24093 and longitude -121.02055 (WGS-84) and adjacent to a piped section of the DS Canal. Pond 3 is in upland forest habitat including incense cedar and ponderosa pine (*Pinus ponderosa*). No overhanging vegetation is present; however, emergent species including common cattail (*Typha latifolia*) is choking out much of the pond's surface area (Appendix D, Photographs 53−54). There is a water service agreement on the parcel where Pond 3 is located that purchases water through the irrigation season (i.e., April 15 through October 15) from DS Canal. No water is purchased through the winter months; however, the water service could potentially leak water due to residual canal flows and increased annual precipitation. The water purchased from the DS Canal feeds through a culvert and/or overflows directly into Pond 3, which is otherwise confined by the surrounding topography. There is also an additional culvert that drains from Pond 3 to an additional pond below (Appendix D, Photographs 53−54). For a list of observed wildlife species at Pond 3, please refer to Appendix F of this report.

4.3.1.3 California Red-legged Frog and Other Special Status Species Habitat Assessment

All sites within the Pond Study on the LCC and the DS Canal (reference site) were assessed for CRLF and other potentially occurring special status species and their associated habitat. Depending on the presence of sensitive species and habitat, ponds may be removed from future monitoring (NID 2012). As with previous study years (2013 and 2017), no CRLF were observed during the habitat assessments conducted in 2021, and all Pond Study sites were found to have marginal potential suitable CRLF habitat. Therefore, CRLF are unlikely to occur within the three Pond Study Sites. Rationale for this determination is provided below.

- Pond 1: Lack of known observations within a 1-mile proximity of the study site (CDFW 2021); minimal to no emergent and overhanging vegetation present; annual flushing; and presence of potential predatory species including American bullfrog (*Lithobates catesbeianus*) and mosquitofish (*Gambusia affinis*) (both observed in previous years' studies but not in 2021).
- Pond 2: Lack of known observations within a 1-mile proximity of the study site (CDFW 2021); annual flushing; observations of potential predatory species including American bullfrog, mosquitofish, brown trout (*Salmo trutta*), and red-eared sliders (*Trachemys scripta elegans*).
- Pond 3: Lack of known observations within a 1-mile proximity of the study site (CDFW 2021), annual flushing, and the presence of fish and American bullfrog.

Additionally, no special-status species or special-status species habitat was observed within the Pond Study sites.

4.3.2 Pond Study Monitoring Year Comparisons

During Year 8 monitoring, the Pond Study on the LCC (i.e., Ponds 1 and 2) yielded very little change from the previous monitoring years, Year 0 (baseline 2013) and Year 4 (2017). The most notable variation observed during Year 8 of the Pond Study was the overall decrease in pond size/area of inundation (i.e., wetted perimeter- Pond 1 had a decrease of 418 sq. ft.; Pond 2 had a decrease of 2,380 sq. ft.). This subsequently influenced the overall visual approximation of pond depth by one to three feet. However, the differences between Year 8 and the baseline surveys are more minimal. Pond 1 has only showed a decrease of 73 sq. ft. and Pond 2 has shown a decrease of 442 sq. ft. from the 2013-2021. As for the reference site, DS Canal, the pond increased in size between 2017 and 2021 by 1,493 sq. ft. and overall increased by 338 sq. ft. between the years of 2013 and 2021 (Table 4-8).

It has been noted that the water levels at all of the ponds (Ponds 1, 2, and 3) are controlled by NID, as fluctuating canal flows are the primary input. Conversations with the property owner have also indicated that Ponds 1 and 2 are generally used for on-site irrigation; however, during 2017, irrigation was minimal due to increased natural precipitation in the region. Therefore, it can be deduced that variation in the inundated area of the ponds, as well as visual estimations of pond depth, are likely influenced by both factors.

Table 4-8. Pond Study Results for 2013, 2017, 2021

Study Pond	Lower Cascade Canal Pond 1			Lower Cascade Canal Pond 2			DS Canal Pond 3 (reference)		
Survey Year	**2013**	**2017**	**2021**	**2013**	**2017**	**2021**	**2013**	**2017**	**2021**
Study Pond Result Parameters									
Approximate Pond Size/ Inundation Area (square feet)[1]	2,010	2,355	1,937	3,090	5,028	2,648	3,885	2,730	4,223
Approximate Visual Pond Depth (feet)	4	6	3	4	5	4	4	8	5
Perennial or Ephemeral Site[2]	Perennial			Perennial			Perennial		
NWI Classification[3]	PUBFh			PUBFh			PUBk		
Soil Map Unit[4]	AfB			AfB			AfD		
Presence of Over-Hanging Vegetation	Yes	Minimal	No	Yes	Minimal	No	Yes	Minimal	No
Presence of Emergent Vegetation	Yes	Minimal	Minimal	Yes	Yes	Yes	Yes	Yes	Yes
Site in Current and/or Historic CRLF Range[5]	Yes			Yes			Yes		
Known Records of CRLF within One Mile[5]	No			No			No		

[1] In 2013, Approximate Pond Size/Inundation Area (square feet) was completed via visual estimation. In 2017 and 2019, estimation of pond size was (re)calculated from GIS via the mapped boundary collected during the field surveys to improve assessment accuracy over time.
[2] All ponds contain water year-round, but likely experience fluctuating water levels due to changes in seepage amounts from the LCC and DS Canal as well as flushing during annual rains.
[3] **National Wetlands Inventory (NWI) Classifications** (USFWS 2021)
PUBFh = Palustrine (P), Unconsolidated Bottom (UB), Semi-permanently Flooded (F), Dike/Impounded (h)
PUBk = Palustrine (P), Unconsolidated Bottom (UB), Artificially Flooded (k)
[4] **National Resources Conservation Service Soil Classification** (USDA 2019)
AfB = Aiken Loam, two to nine percent slopes, well-drained.
AfD = Aiken Loam, 15 to 30 percent slopes, well-drained.
[5] CDFW 2021.

5.0 DISCUSSION

As discussed in previous monitoring reports, the riparian tree species along NID canals are predominantly in upland habitats (i.e., surrounded by mixed coniferous forest). As such, it was hypothesized that the canals sustain these trees and a reduction in flows would reduce the hydraulic head, water infiltration, root uptake and eventually cause potential loss of the existing riparian trees.

These riparian forests along canals are complex ecological systems that have the potential to support dynamic levels of biodiversity and special-status species, exhibit high rates of nutrient cycling, and perform important ecological functions. As these vegetation communities are located at the land-water

margin, riparian plant species are greatly dependent on hydrology and generally more vulnerable to water-induced stress (Naiman and Bilby 2001).

Decreased water availability subsequently can drive increases in non-native and upland species encroachment and decreases native growth, whereas wet years can drive increases in tree growth and in the overall density of vegetation (Naiman et al. 2000). Shifts in climate may also inflate broad scale tree disease, as well as insect infestation (Liebhold and Bentz 2011). The aforementioned factors may compound with a decrease in overall canal flows to impact tree health at the sites on LCC and UGVC, complicating the differentiation between the effects of decreased canal flows and drought in the region.

During monitoring year 2015 and 2021, the region experienced an ongoing drought (2014-2015 and 2020-2021) and decreased annual precipitation. Published research states that there is a highly significant overall effect of drought on the amount of total biomass (dry weight) of riparian wetland plants which becomes critical when droughts last longer than approximately 30 days. It is noted that different species display a different tolerance to drought (Garssen et al. 2014). In addition, trees often have a delayed response to water and temperature stress. This may explain why tree health remained relatively stable at the LCC and UGVC and the DS Canal reference site during the drought years. As such, with an increase in precipitation over the years of 2017 and 2019, we may be seeing the results of those wet years during our Monitoring Year 8 studies (2021).

Over the past decade, the region has experienced intermittent drought conditions. This year, there was consistent tree health documented (i.e., an average health score of 10) on the LCC, UGVC, and the DS Canal reference site. As noted above, this increase in tree health during a drought year (2021) may be due to a latent reaction to wet years (2017 and 2019). Specifically, the drought conditions may have had an effect on riparian species, and the above-average precipitation years may compensate for such impacts. We continue to see an oscillation of tree health and canopy cover which appears to parallel the oscillation of wet and dry water years that the region has experienced over the past decade.

Overall, the Tree Health Assessment results indicate an ever-changing habitat that is likely continuously responding to changes in water regimes, property management (i.e., fencing installation at LCC Site 2 and mechanical removal at UGVC Site 5), climate, and non-native vegetation encroachment. Thus far, there is a slight indication of dieback (23%) in trees at the study sites, however, there continues to be consistent overall good tree health at the sites along with new growth and resprouts. The dieback of trees at the LCC and UGVC sites is consistent with the site at DS Canal, even having slightly less dieback than that of the DS Canal site. The overall tree health on the study canals and the reference canal remains in the “good health” category, as defined in the Executive Summary. Furthermore, all sites are within a good health range that is similar to those of baseline conditions. Therefore, at Year 8 of monitoring, it appears that the drought may have slightly reduced the overall riparian tree health; but with wet water years, the trees were able to recover despite lowered canal flows eight years ago.

The canopy cover assessment shows a steady decline among the canopy cover over the past eight years along the study reaches. There is, however, a similar decrease in canopy cover at the LCC site and DS Canal reference site indicating that the minor decline is potentially due to seasonal climate conditions and natural abscission variation from year-to-year.

The pond study results indicate little to no variability in ponded habitat. Based on information from landowners and NID, the documented pond area and depth variation has been primarily attributable to water delivery purchases and irrigation use on the properties where the ponds are located, and not associated with lowered flows in the LCC.

As a part of MM 3.8-1 and MM 3.8-2 defined in the Final EIR for the Lower Cascade Canal-Banner/Cascade Pipeline Project (NID 2006), in 2023 one more monitoring event shall conducted and summarized in a comprehensive 10 year monitoring report. At that time, water replacement standards will be assessed if it is apparent that the reduced flow in the LCC and UGVC is causing a reduction in tree health, and thus canopy cover (NID 2006).

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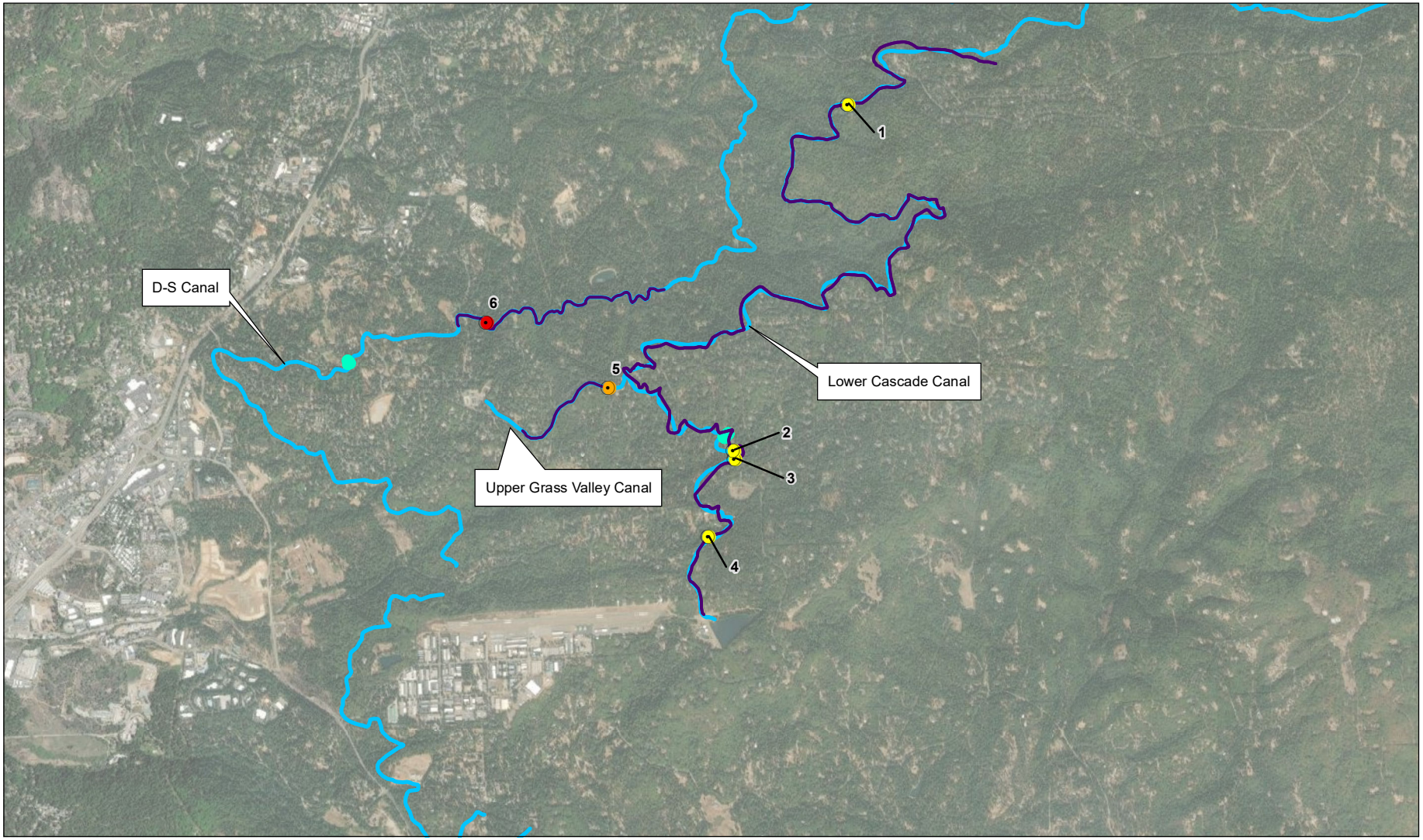
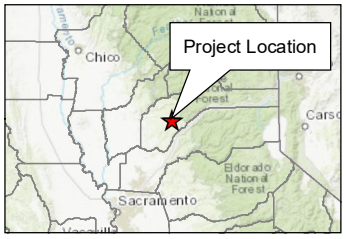
FIGURES

BANNER CASCADE PIPELINE PROJECT TREE HEALTH, CANOPY COVER, AND POND MONITORING REPORT – YEAR 8





Tree Health Assessment

- LCC Site 1
- LCC Site 2
- LCC Site 3
- LCC Site 4
- UGVC Site 5
- DS Canal Site 6

- Canopy Cover Assessment
- Pond Study Location
- NID Canal

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Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

2. Data Sources:

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Project Location

Nevada County, California

Client/Project 185705578

Nevada Irrigation District
Banner Cascade Pipeline Project

Figure No.

1

Title

Project and Study Area

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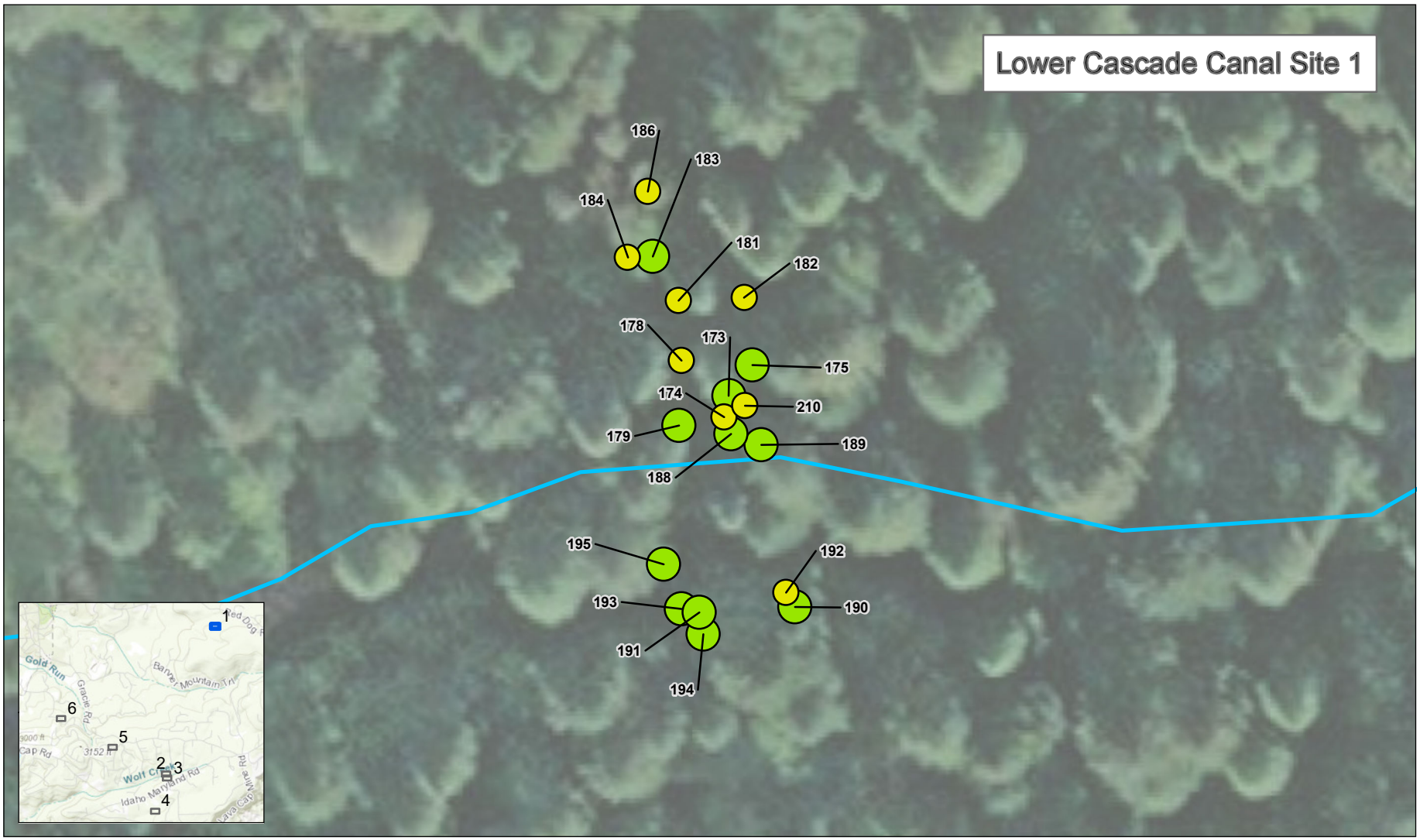

NID Canal

Tree Health Assessment Collection

Overall Health Score

- 1 - 4 (Poor Health)
- 5 - 7 (Fair Health)
- 8 - 11 (Good Health)
- 12 - 14 (Excellent Health)

N

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Notes

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2. Data Sources:

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Figure No.

2

Title

Tree Health Assessment Results

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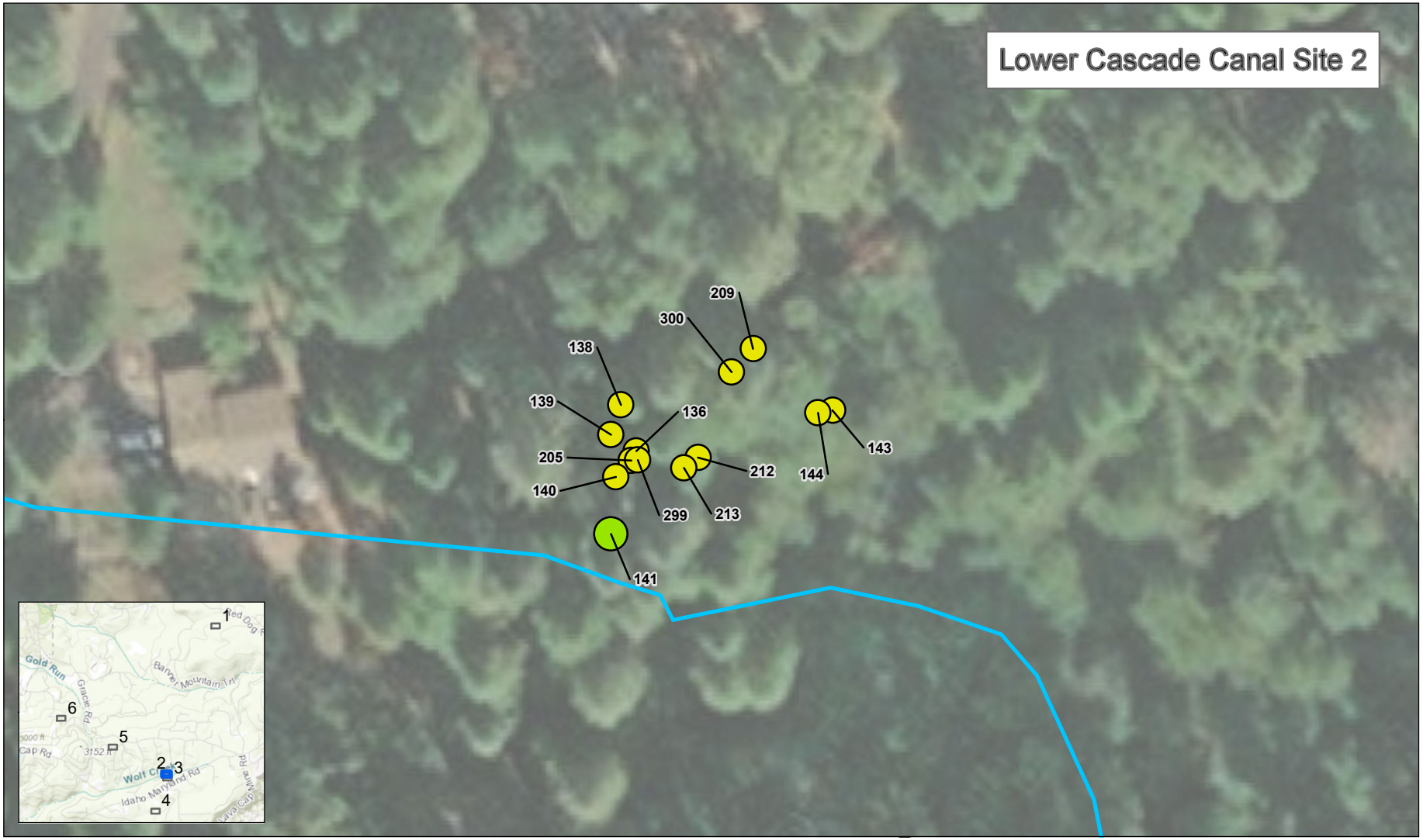
Lower Cascade Canal Site 2



NID Canal

Tree Health Assessment Collection

Overall Health Score

- 1 - 4 (Poor Health)
- 5 - 7 (Fair Health)
- 8 - 11 (Good Health)
- 12 - 14 (Excellent Health)

N

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Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

2. Data Sources:

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Project Location

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Nevada Irrigation District
Banner Cascade Pipeline Project

Figure No.

2

Title

Tree Health Assessment Results

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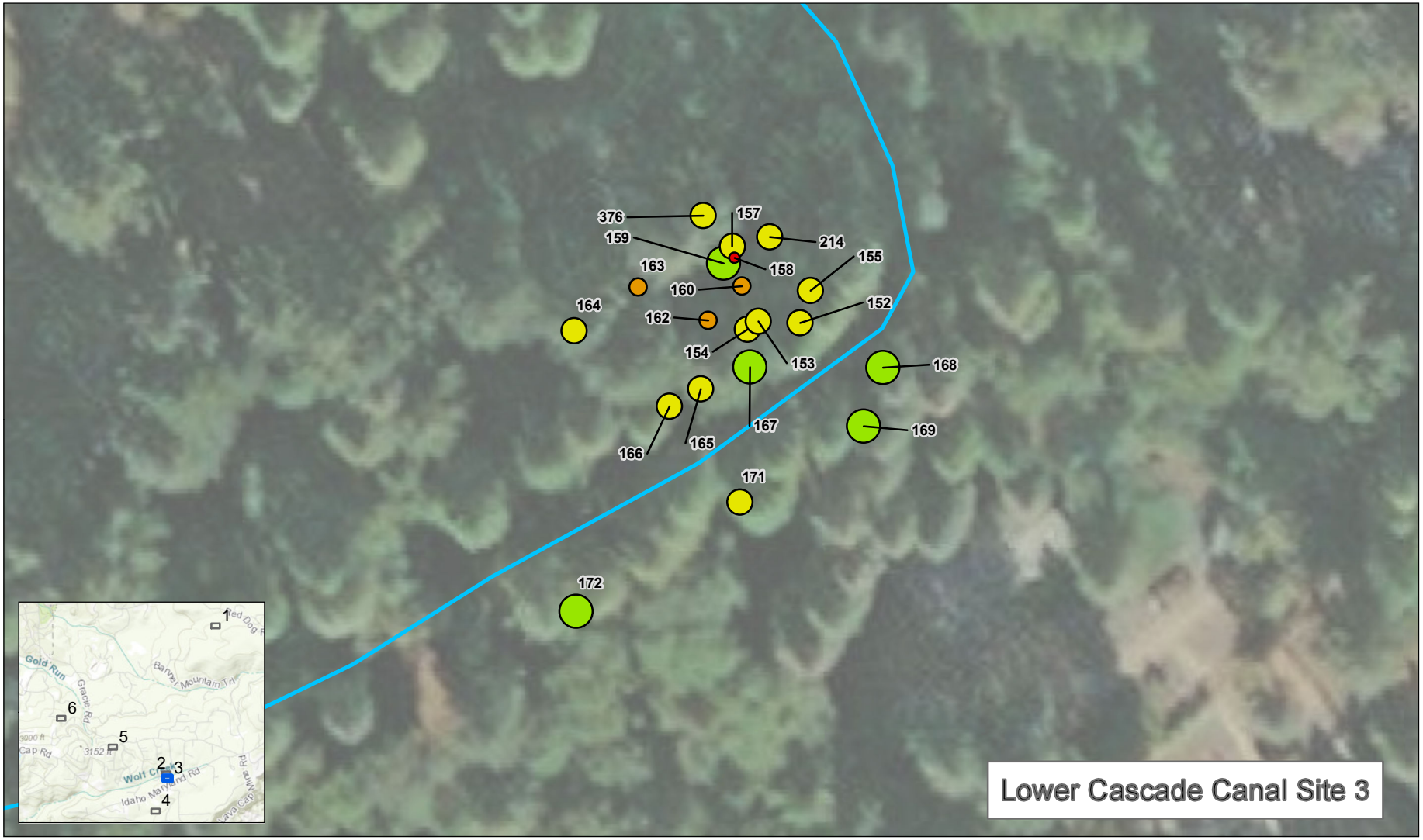

NID Canal

Tree Health Assessment Collection

Overall Health Score

- 1 - 4 (Poor Health)
- 5 - 7 (Fair Health)
- 8 - 11 (Good Health)
- 12 - 14 (Excellent Health)

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Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

2. Data Sources:

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Project Location

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Nevada Irrigation District
Banner Cascade Pipeline Project

Figure No.

2

Title

Tree Health Assessment Results

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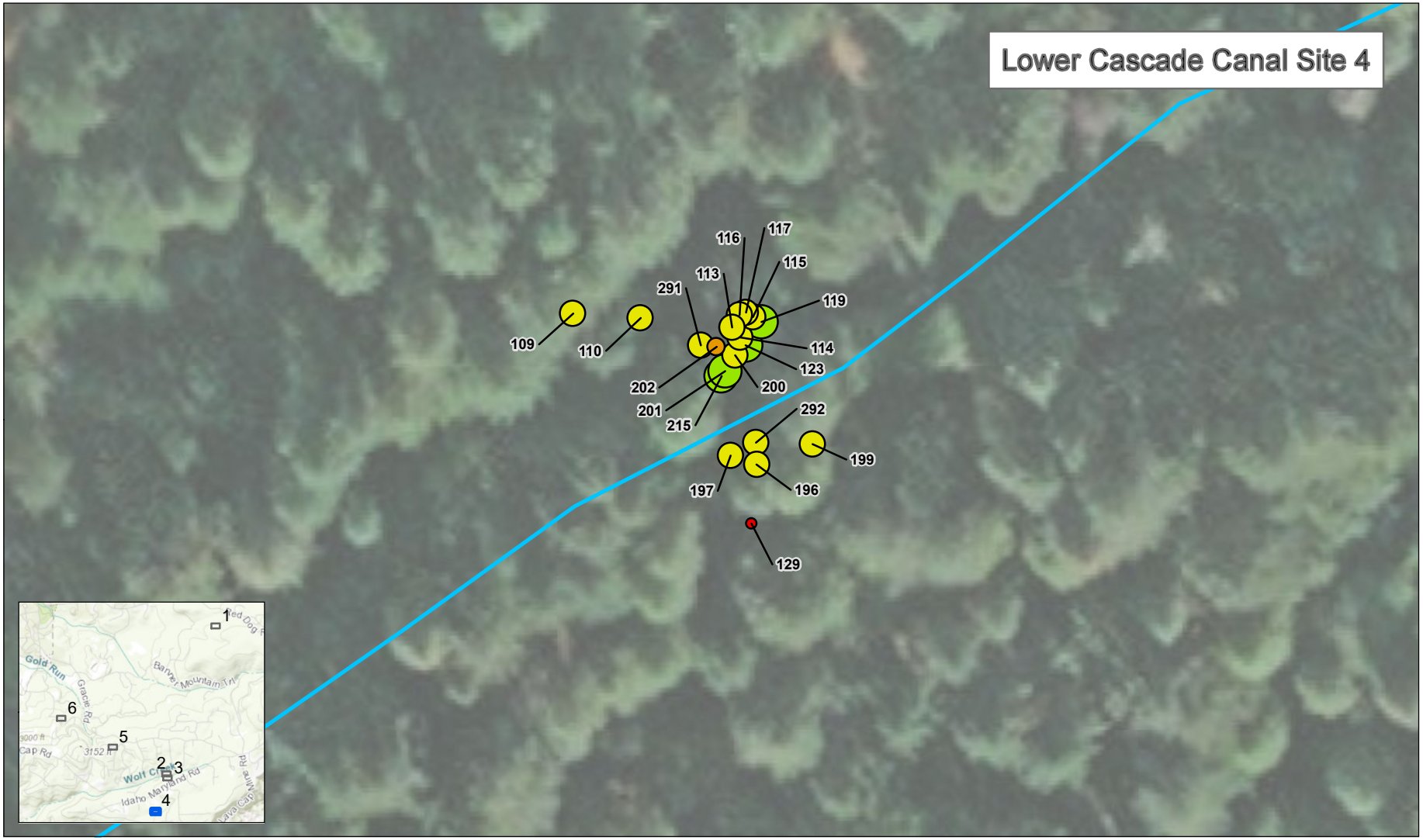
Lower Cascade Canal Site 4



NID Canal

Tree Health Assessment Collection

Overall Health Score

- 1 - 4 (Poor Health)
- 5 - 7 (Fair Health)
- 8 - 11 (Good Health)
- 12 - 14 (Excellent Health)

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Notes

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2. Data Sources:

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure No.

2

Title

Tree Health Assessment Results

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Upper Grass Valley Canal Site 5

NID Canal

Tree Health Assessment Collection

Overall Health Score

- 1 - 4 (Poor Health)
- 5 - 7 (Fair Health)
- 8 - 11 (Good Health)
- 12 - 14 (Excellent Health)

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Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

2. Data Sources:

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Title

Tree Health Assessment Results

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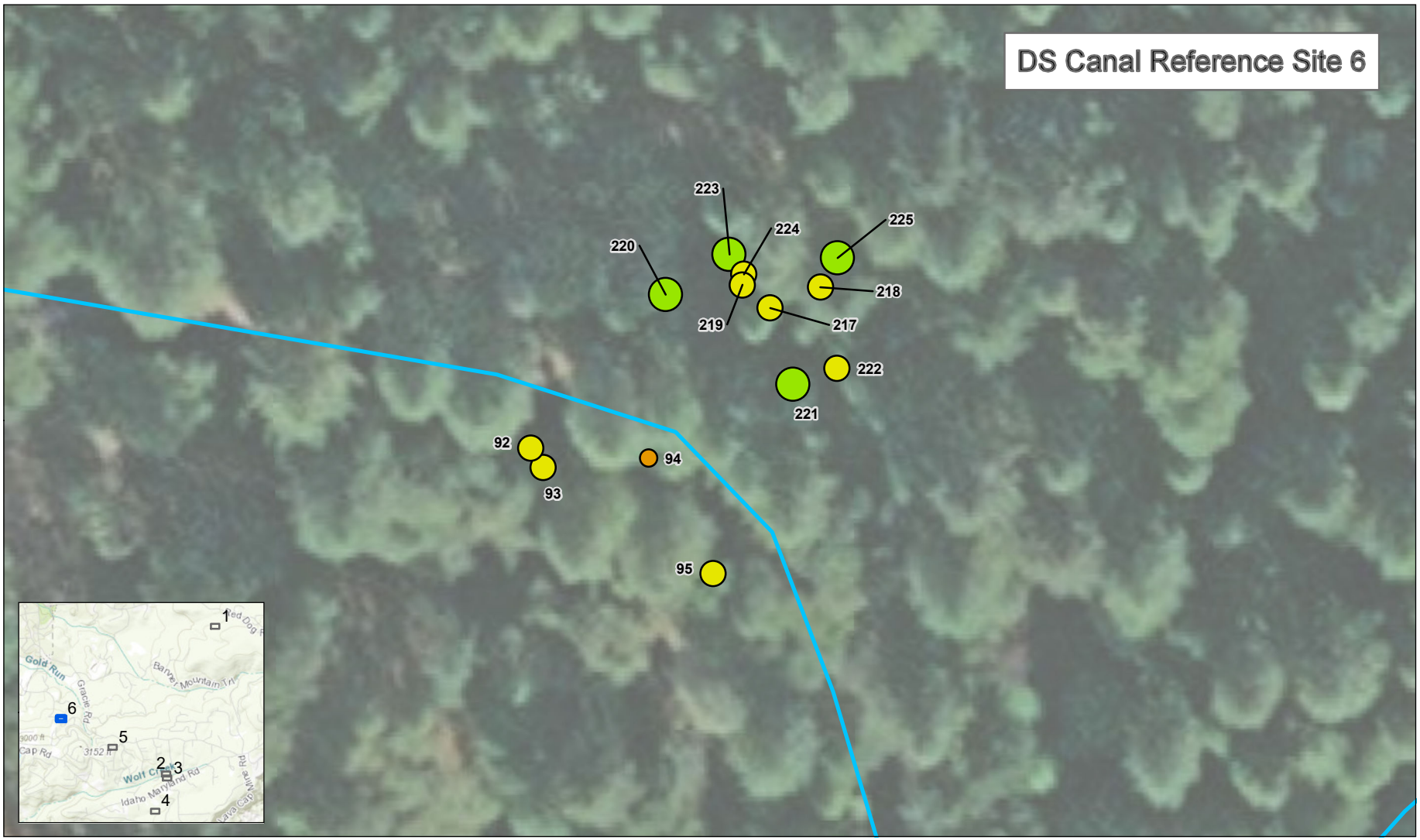

NID Canal

Tree Health Assessment Collection

Overall Health Score

- 1 - 4 (Poor Health)
- 5 - 7 (Fair Health)
- 8 - 11 (Good Health)
- 12 - 14 (Excellent Health)

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Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

2. Data Sources:

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Project Location

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Figure No.

2

Title

Tree Health Assessment Results

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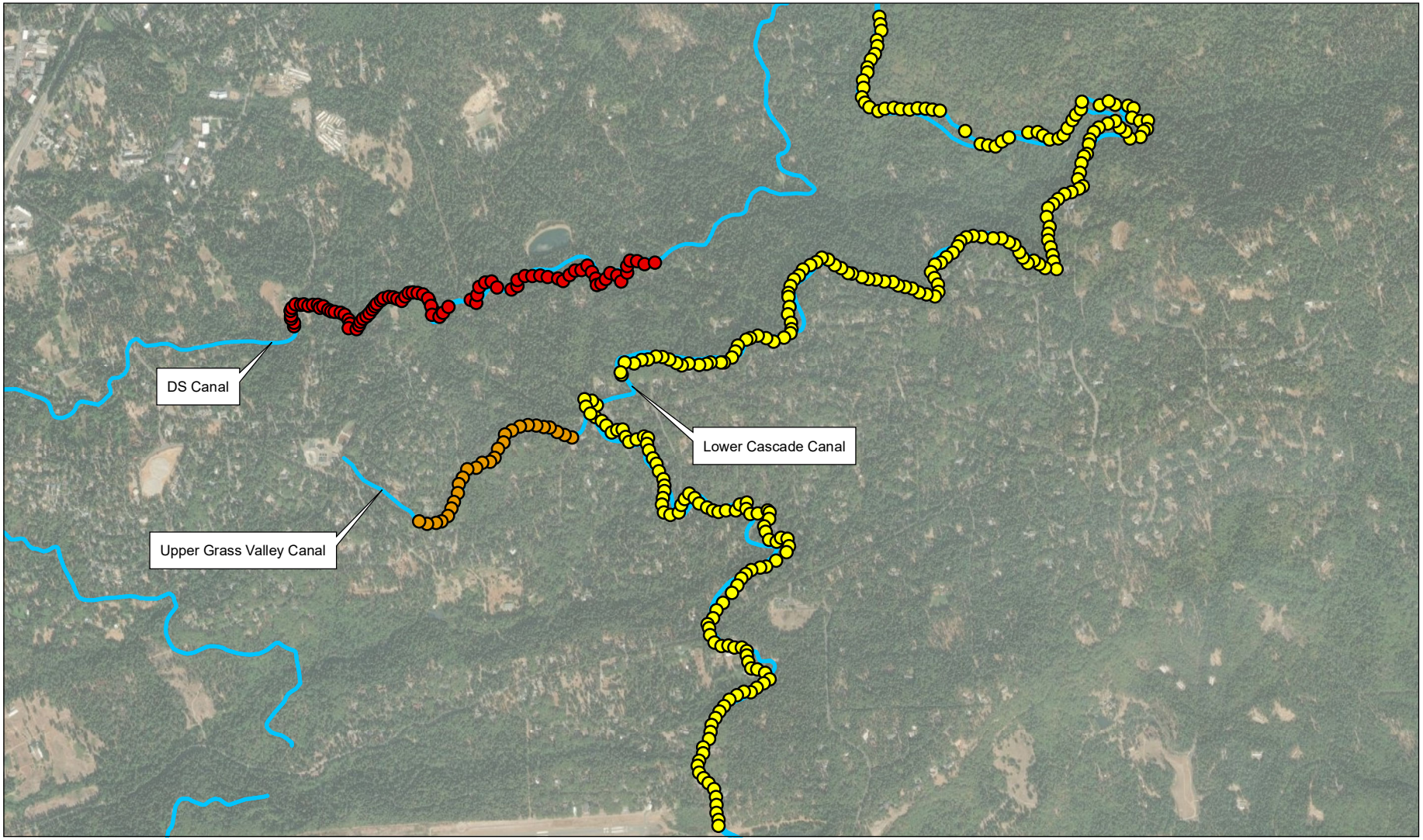

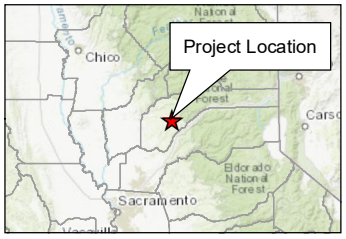

NID Canal

Canopy Cover Assessment

- DS
- LCC
- UGVC

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Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

2. Data Sources:

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3

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Canopy Cover Survey Points

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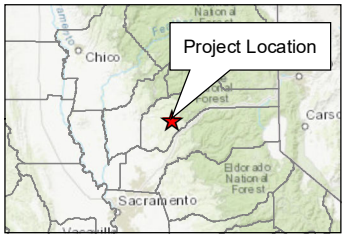
DS Canal Reference Pond



NID Canal

Pond 2021

Pond 2017

Pond 2013

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Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

2. Data Sources:

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Project Location

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Nevada Irrigation District
Banner Cascade Pipeline Project

Figure No.

4

Title

Pond Study Results

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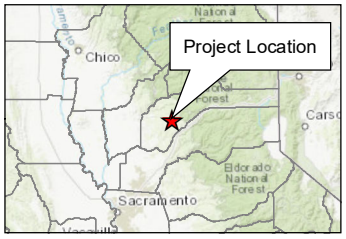

NID Canal

Pond 2021

Pond 2017

Pond 2013

N

0 20 40 Feet

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Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

2. Data Sources:

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Project Location

Nevada County, California

Client/Project 185705578

Nevada Irrigation District
Banner Cascade Pipeline Project

Figure No.

4

Title

Pond Study Results

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APPENDICES

Appendix A TEN-YEAR CANOPY COVER STUDY MONITORING PLAN

PURPOSE

The purpose of the Ten-Year Canopy Cover Study Monitoring Plan is to summarize and detail requirements for the future monitoring efforts for the Canopy Cover Study, and to comply with Mitigation Measure 3.8-1 defined in the Final EIR for the Lower Cascade Canal- Banner/Cascade Pipeline Project (NID 2006). The Canopy Cover Study is comprised of the Tree Health Assessment Study and the Canopy Cover Assessment for the Lower Cascade Canal, and Upper Grass Valley Canal, and DS Canal (reference site). This Ten-Year Canopy Cover Study Monitoring Plan is specific to a study timeline and data collection methods which are detailed below.

STUDY TIMELINE

- Tree Health Assessments – Assessment data will be collected over a period of ten years, at an interval of every two years, for a total of six surveys (i.e., 2013-2023; Years 0, 2, 4, 6, 8, 10). Surveys shall be conducted in the late summer (i.e., August to September/ October).
- Canopy Cover Assessments – Canopy cover data will be collected every four years, with one final assessment to conclude the study on Monitoring Year 10 (i.e., Years 0, 4, 8, and 10). Surveys shall be conducted in the late summer (i.e., August to September) and concurrent with the Tree Health Assessments.

Summary of Canopy Cover Studies and Monitoring Timeline Requirements

Canopy Cover Study	Monitoring Year & Requirement					
	2013 Year 0	2015 Year 2	2017 Year 4	2019 Year 6	2021 Year 8	2023 Year 10
Tree Health Assessment	X	X	X	X	X	X
Canopy Cover Assessment	X		X		X	X

X- Indicates a study year for monitoring to be completed

STUDY LOCATIONS

The study sites locations for the Tree Health Assessment, and Reach locations for the Canopy Cover Assessment are detailed below.

Tree Health Assessment

- Lower Cascade Canal
  Site 1: Latitude 39.257104, Longitude -120.978144
  Site 2: Latitude 39.234850, Longitude -120.987938
  Site 3: Latitude 39.234282, Longitude -120.987857
  Site 4: Latitude 39.229272, Longitude -120.990137
- Upper Grass Valley Canal
  Site 5: Latitude 39.238957, Longitude -120.9982466
- DS Canal (reference site)
  Site 6: Latitude 39.243292, Longitude -121.008359

Canopy Cover Assessment

Summary of Canopy Cover Assessment Locations and Reach Lengths

Canal	Lower Cascade Canal	Upper Grass Valley Canal	DS Canal (reference site)
Canal Reach Length (miles)	7	0.5	1
Reach Start Coordinate (North)	39.259642872, -120.966559692	39.238985195, -120.998306278	39.245783455, -120.992624265
Reach End Coordinates (South)	39.225052309, -120.990948424	39.23597992, -121.005289880	39.243120641, -121.010794363

DATA COLLECTION

Tree Health Assessments

Data should be recorded and assessed considering the following factors (Zobrist 2011):

- Presence of foliage decline or evidence of crown fading;
- Color of foliage: out of season discoloration of foliage; and
- Evidence of disease, parasite, and/or insect damage.

To capture the data above, visual inspections of each tagged tree at each of the six Tree Health Assessment study sites should be made using the criteria listed in the table below. Each tree should be assigned a score for each category or criteria using the Project specific datasheets associated with this Monitoring Plan.[8] Data shall be documented with a Trimble Series 6000 GeoXH GPS, and post-processed in GIS.

[8] The Tree Health Assessment data collection form was updated in 2015, Year 2 Monitoring, to be consistent with study requisites and ongoing monitoring efforts.

Tree Health Assessment Data Criteria

Assessment Type	Assessment Description	Assessment Score
Canopy Cover	Canopy cover die-back by a percentage based on density and presence of foliage at the crown of the tree.	1- None: no canopy present, 0% 2- Sparse: most canopy absent, 0-25% 3- Partial: canopy 25-50% 4- Medium: canopy 50-75% 5- Full: canopy 75-100%
Bark Health	Bark health is assessed through the absence/ sluffing of bark on the bole and limbs of the tree.	1- Dead: 100% sluffing off, extensive damage 2- Poor: decaying or dead; 75-100% bark absent from bole and limbs of tree; abundant root rot; extensive insect damage; overall discoloration and bark shape irregularities; abundant surface growth 3- Fair: 50-75% bark absence; some root rot and insect damage; discoloration and bark shape irregularities; bark sluffing 4- Good: 25-50% bark absence; some root or heart rot present; bark only missing from tree limbs 5- Excellent: 0-25% bark absence. Present bark generally intact and of high vigor
Leaf Color	Leaf color is assessed based on abnormal colorations that are not typical for the species or season, uniform throughout all present foliage, etc.	1- Normal: no abnormalities present, color normal 0- Abnormal: abnormal color present (e.g., spotting, insect tracks, necrotic tips, etc.)
New Growth Presence	“New growth" is any new vascular growth including leaf buds, basal sprouts, epicormic stems, and saplings.	0- Present 1- Not present
Surface Growth Presence	Surface growth on trunk and stems includes lichen, moss, and all other normal terrestrial algal plants (i.e., non-vascular plants, bryophytes).	0- Present 1- Not present
Disease	Disease includes fungal/mold presence and other pathogens, tubers, cankers, structural decay (e.g., basal decay, irregular growth pattern of tree), root and heart rot, etc.	0- Present 1- Not present
Parasites	Parasites can include, but are not limited to, the presence of mistletoe, red pustules, etc.	0- Present 1- Not present
Insect Infestation	Signs of insects include burrowing/bore holes; frass, larvae or larva galleries, or insect presence; leaf notching; epicormics stems, galls, etc.	0- Present 1- Not present

Assessment Type	Assessment Description	Assessment Score
Overall Tree Health	Overall tree health was assessed through leaf/ foliage health and other associated physical leaf characteristics, the amount of canopy foliage present, stem, and bark health (e.g., decay), abnormal tree shape, and/or increased presence of disease, parasites, and insect infestations. Normal seasonal variations were considered in overall health scoring.	1- Dead Overall 2- Poor Overall: partial-full discoloration; severe insect damage; disease presence; tissue damage 3- Fair Overall: partial discoloration; some insect damage, heart rot 4- Good Overall: some discoloration 5- Excellent Overall: no physical abnormalities

Canopy Cover Assessment

The Canopy Cover Assessment data will be collected along each canal study Reach using a densiometer following the methods described in The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment State Water Resources Control Board Standard Operating Procedure for Measuring Canopy Cover Using a Seventeen Point Spherical Convex Densiometer (Burres 2010; Ode 2007). Field data for each site will be collected on the datasheet within this Monitoring Plan as well as using a sub-meter Trimble GPS.[9] Post-processed will be completed using GIS. The analysis will average the overall canopy cover data collected based on densiometer readings along each canal Reach. Results will then be synthesized from the canopy cover data. Data collection and canopy density percentages will be calculated based on methods and formulas described in Use of the Densiometer to Estimate Density of Forest Canopy on Permanent Sample Plots (Strickler 1959).

STUDY REPORTING

Reporting shall be completed at the end of each monitoring year and will be drafted to summarize the Canopy Cover Study findings (i.e., Tree Health and Canopy Assessment data and results) for that year. The data for the study year will also be discussed in conjunction with previous monitoring years and California's water year data and NID LCC and the UGVC flow data. Each report will include adaptive management recommendations, if necessary. NID is not required to adhere to any interim recommendations but may want to take them into consideration when reducing or limiting flow that may have canopy impacts, should they be documented. On the last year of study (i.e., Year 10, 2023) a comprehensive final report will be compiled summarizing data collection methods, results, analysis as well as make findings and recommendations.

[9] The Canopy Cover Assessment data collection form was updated in 2017, Year 4 Monitoring, to be consistent with study requisites and ongoing monitoring efforts.

Appendix B TEN-YEAR POND STUDY MONITORING PLAN

PURPOSE

The purpose of the Ten-Year Pond Study Monitoring Plan is to summarize and detail requirements for the future monitoring efforts for the Pond Studies and to comply with Mitigation Measure 3.8-2 defined in the Final EIR for the Lower Cascade Canal- Banner/Cascade Pipeline Project (NID 2006). The Pond Study is comprised of study sites on the Lower Cascade Canal, and DS canal (reference site). There are no Pond Study sites located on the Upper Grass Valley Canal.[10] This Ten-Year Pond Study Monitoring Plan is specific to a study timeline and data collection methods which are detailed below.

STUDY TIMELINE

Pond data will be collected every four years, with one final assessment to conclude the study on Monitoring Year 10 (i.e., Years 0, 4, 8, and 10). Surveys shall be conducted in the late summer (i.e., August to September) and concurrent with the Canopy Cover Assessment portion of the Canopy Cover Study.

Summary of the Pond Study and Monitoring Timeline Requirements

Pond Study (all sites)	Monitoring Year and Requirement					
	2013- Year 0	2015- Year 2	2017- Year 4	2019- Year 6	2021- Year 8	2023- Year 10
	X		X		X	X

X- Indicates a study year for monitoring to be completed

STUDY LOCATIONS

The study sites locations for the Pond Study are detailed below.

- Lower Cascade Canal
  Pond 1: 39.235710, -120.988615
  Pond 2: 39.235182, -120.989522
- DS Canal (reference site)
  Pond 3: 39.240913, -121.020355

DATA COLLECTION

As part of the Pond Study, wildlife and habitat suitability assessments will be conducted. At each of the three Pond Study sites, the following data will be collected and assessed:

- Delineation of inundated area/ soil saturation;
- Hydrology pattern(s);
- Range of water depths;
- Soil type(s);

[10] No ponds were identified along the UGVC; therefore, no Pond Study sites are located along the UGVC.

- Vegetation observed and overarching vegetation community type;
- Wildlife species observed;
- California red-legged frog habitat assessment; and
- Site photos.

Each pond assessment will include a GPS delineation, and information on hydrology, soils, and vegetation, in accordance with U.S. Army Corps of Engineers Guidelines for Wetland Delineations (Environmental Library 1987). Each Pond Study site should be assessed for the presence of potential CRLF habitat, and other associated special status species, based on the Revised Guidance on Site Assessments and Field Surveys for the CRLF (USFWS 2005). Pond Study data will be recorded on the Project specific datasheet associated with this Monitoring Plan.[11] Data shall also be documented with a Trimble Series 6000 GeoXH GPS, and post-processed in GIS

STUDY REPORTING

Reporting shall be completed at the end of each monitoring year, and will be drafted to summarize the Pond Study findings for that year. The data for the study year will also be discussed in conjunction with previous monitoring years and California's water year data and NID LCC and the UGVC flow data. Each report will include adaptive management recommendations, if necessary. NID is not required to adhere to any interim recommendations, but may want to take them into consideration when reducing or limiting flow that may have canopy impacts, should they be documented. On the last year of study (i.e., Year 10, 2023), a comprehensive final report will be compiled summarizing data collection methods, results, analysis as well as make findings and recommendations.

[11] The Pond Study data collection form was updated in 2017, Year 4 Monitoring, to be consistent with study requisites and ongoing monitoring efforts.

Appendix C TREE HEALTH ASSESSMENT CRITERIA

The following table of Tree Health Assessment Criteria was updated in Monitoring Year 4 (2017) to be consistent with study requisites and on-going monitoring efforts.

Table C.1 Summary of Tree Health Assessment Parameters

Assessment Type	Assessment Description	Assessment Score
Canopy Cover	Canopy cover is based on the density and presence of foliage.	1- None 2- Sparse 3- Partial 4- Full
Bark Health	Bark health is based on the integrity and vigor of bark on the bole and limbs of the tree; abnormalities include bark discoloration, damage, sluffing, or absence.	1- Dead 2- Poor 3- Fair 4- Good
New Growth	New growth is any new vascular growth, including leaf buds, basal sprouts, or epicormic stems.	0- Not present 1- Present
Abnormal Leaf Color	Abnormal leaf color includes spotting, insect tracks, necrotic tips, etc., that are not typical for the species or season and are present throughout most foliage.	0- Abnormal 1- Normal
Surface Growth	Surface growth on the trunk and stems includes lichen, moss, and all other normal terrestrial algal plants (i.e., non-vascular plants, bryophytes).	0- Present 1- Not present
Disease	Disease includes fungal/mold presence and other pathogens, tubers, cankers, basal decay, root and heart rot, etc.	0- Present 1- Not present
Parasites	Parasites include mistletoe, honeysuckle, red pustules, etc.	0- Present 1- Not present
Insects	Signs of insects include burrowing/bore holes, leaf notching, frass, larvae or larva galleries, galls, insect presence, etc.	0- Present 1- Not present
Overall Tree Health	Overall tree health was calculated as the sum of all the tree health characteristics above.	0-4- Poor 5-9- Fair 10-14- Good
DBH Growth	DBH growth is based on the increase in DBH measurements, or lack thereof, from previous survey efforts. This metric was not used to calculate Overall Tree Health.	0- No growth 1- Growth

Appendix C Tree Health Assessment Criteria

Table C-2. Overall Tree Health Score Descriptions

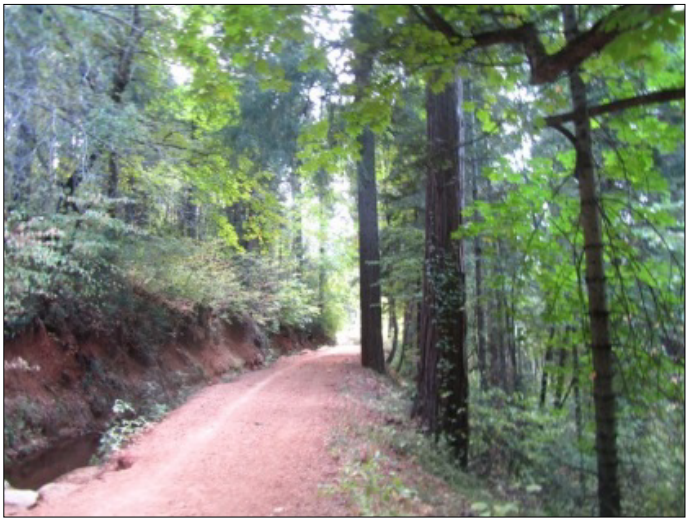
Overall Score	Score Type	Score Description
1 to 4	poor health	Absent to little canopy cover (<25%), no new growth, bark damaged or absent, surface growth present, foliage present is discolored and/or damaged
5 to 7	fair health	Sparse to partial canopy cover (25-50%), minimal to no new growth present specifically in the canopy, bark sluffing off or damaged yet intact in some places, abnormal surface growths, potential disease presence, some parasite and/or insect damage and/or infestation
8 to 11	good health	partial to intact canopy cover (50-75%), new growth present, minimal bark and leaf discoloration, no significant disease, normal surface growth, minimal insect infestations/damage
12 to 14	excellent health	Intact to full canopy cover, new growth present, no surface growth, excellent bark and leaf health, no disease present

Appendix D PHOTO RECORD

The following photographs present an overall representation of site conditions present during the Canopy Cover Study and the Pond Study conducted in 2021 within the Lower Cascade Canal (LCC), Upper Grass Valley Canal (UGVC), and the DS Canal (reference site). This photographic record also provides a visual comparison for studies including the baseline assessment conducted in 2013 as well as subsequent monitoring years including 2015[12], 2017, 2019, and 2021.

Canopy Cover Study: Tree Health Assessment (2013, 2015, 2017, 2019, and 2021)

Photograph 1: 2013: LCC Site 1. East facing aspect.



Photograph 2: 2015. LCC Site 1. West facing aspect.

Photograph 3: 2017: LCC Site 1. Near upslope location. Northwest facing aspect.

Photograph 4: 2019: LCC Site 1. Downslope location.

[12] Tree Health Assessment only conducted in 2015 and 2019.

Appendix D Photo Record

<table>
<tr><td> 
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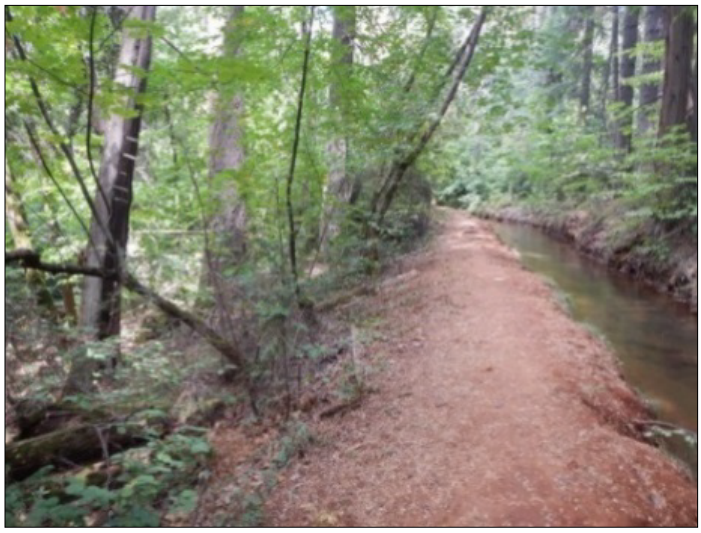
<tr><td>Photograph 5: 2021: LCC Site 1. Downslope location.</td><td>Photograph 6: 2013: LCC Site 2. Southwest facing aspect.</td></tr>
<tr><td>  </td><td> 
</td></tr>
<tr><td>Photograph 7: 2015: LCC Site 2. East facing aspect.</td><td>Photograph 8: 9/8/2017. LCC Site 2. Downslope location. West facing aspect.</td></tr>
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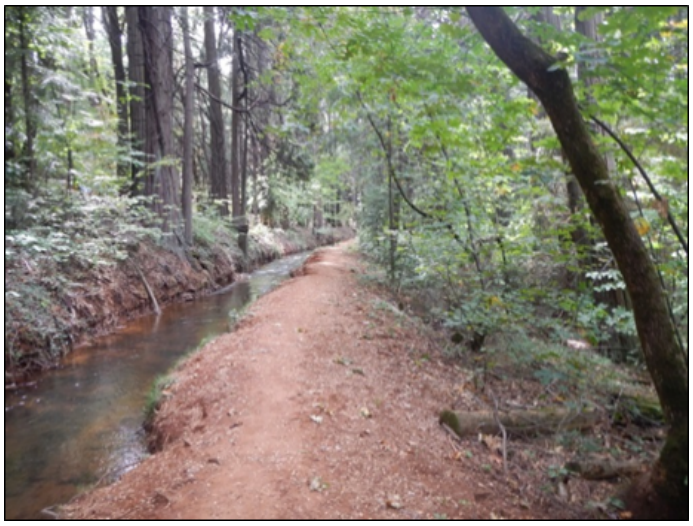
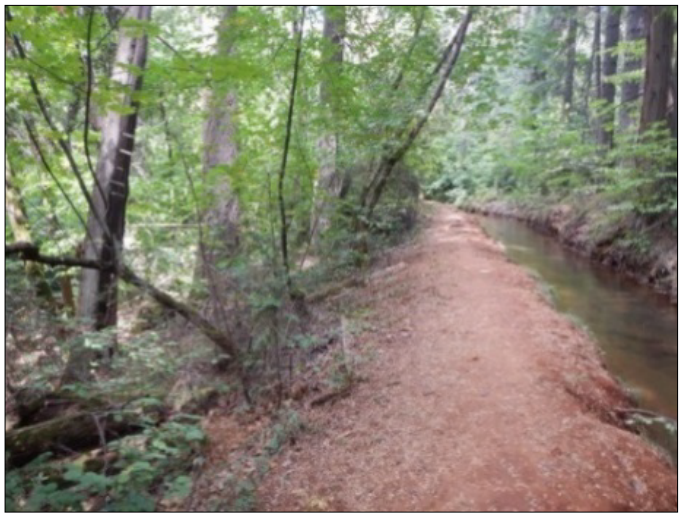
Appendix D Photo Record

Photograph 9: 2019: LCC Site 2. Downslope location.

Photograph 10: 2021: LCC Site 2. Downslope location.



Photograph 11: 2013: LCC Site 3. East facing aspect.



Photograph 12: 2015: LCC Site 3. West facing aspect.

Appendix D Photo Record

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<tr>
<td>Photograph 13: 2017: LCC Site 3. Downslope location. Southwest facing aspect.</td>
<td>Photograph 14: 2019: LCC Site 3. Downslope location.</td>
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<tr>
<td>Photograph 15: 2021: LCC Site 3. Upslope location.</td>
<td>Photograph 16: 2013. LCC Site 4. Southwest facing aspect.</td>
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</table>

Appendix D Photo Record

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<tr><td>  </td><td> 
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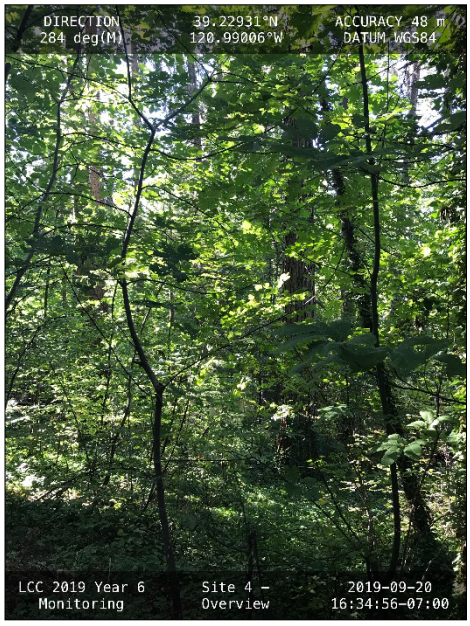
<tr><td>Photograph 17: 2015: LCC Site 4. Northeast facing aspect.</td><td>Photograph 18: 2017: LCC Site 4. Downslope location. Northeastern facing aspect.</td></tr>
<tr><td> 
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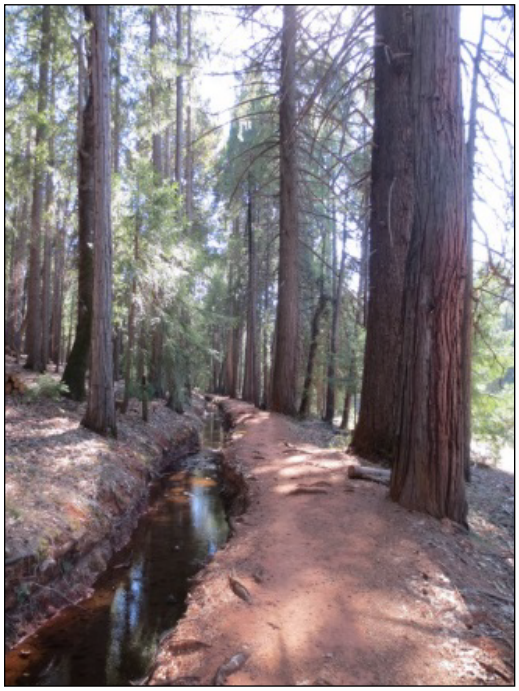
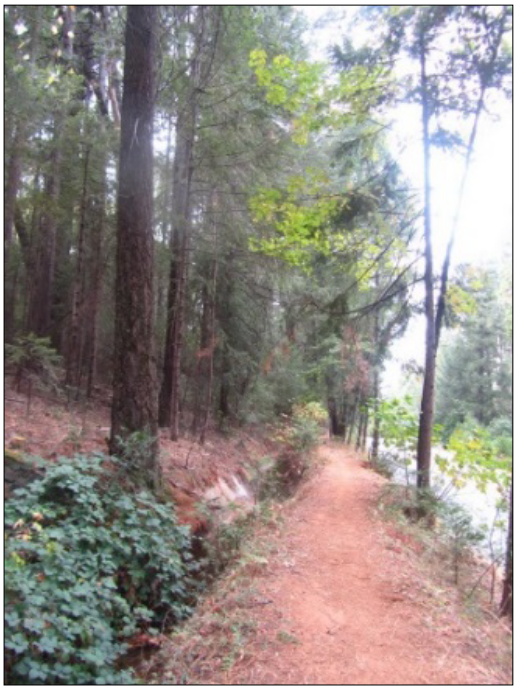
<tr><td>Photograph 19: 2019: LCC Site 4. Downslope location.</td><td>Photograph 20: 2021. LCC Site 4. Upslope location.</td></tr>
</table>

Appendix D Photo Record



Photograph 21: 2013. UGVC Site 5. West facing aspect.



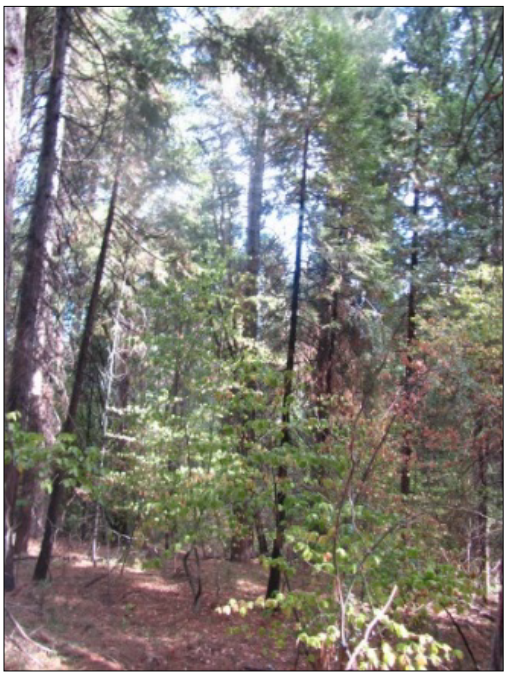
Photograph 22: 2015. UGVC Site 5. West facing aspect.

Photograph 23: 2017. UGVC Site 5. Downslope location. North facing aspect.

Photograph 24: 2019. UGVC Site 5. Downslope location.

Photograph 25: 2021. UGVC Site 5. Downslope location.

Photograph 26: 2013. DS Canal Site 6 (reference site).



Photograph 27: 2015: DS Canal Site 6 (reference site).

Photograph 28: 2017. DS Canal Site 6 (reference site). Southeast facing aspect.

	
Photograph 29: 2019. DS Canal Site 6 (reference site). Downslope location.	**Photograph 30:** 2021. DS Canal Site 6 (reference site).

Canopy Cover Study: Canopy Cover Assessment (2013, 2017, and 2021)

Photograph 31: 2013: LCC Reach. Southwest facing aspect.

Photograph 32: 2017. LCC Reach. North facing aspect.

Photograph 33: 2021: LCC Reach. West facing aspect.

Photograph 34: 2021: LCC Reach. North facing aspect.

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<tr><td>  </td><td> 
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<tr><td>Photograph 35: 2013: UGVC Reach. Northwest facing aspect.</td><td>Photograph 36: 2021: UGVC Reach. Southeast facing aspect.</td></tr>
<tr><td> 
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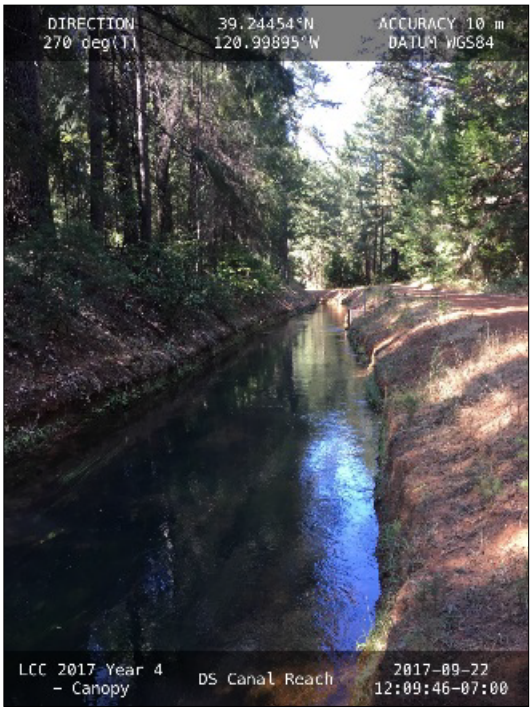
<tr><td>Photograph 37: 2021: UGVC Reach. Northeast facing aspect.</td><td>Photograph 38: 2021. UGVC Reach. Southwest facing aspect.</td></tr>
</table>

Photograph 39: 2013: DS Canal Reach (reference site). General west facing aspect.



Photograph 40: 2017: DS Canal Reach (reference site). West facing aspect.

Photograph 41: 2021: DS Canal Reach (reference site). South facing aspect.

Photograph 42: DS Canal Reach (reference site). West facing aspect.

Pond Study (2013, 2017, and 2021)

<table>
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<tr>
<td>Photograph 43: 2013. LCC Pond 1. Southwest facing aspect.</td>
<td>Photograph 44: 9/5/2017. LCC Pond 1. Southwest facing aspect. Sedimentation present from inlet.</td>
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<tr>
<td>Photograph 45: 2021: LCC Pond 1. North facing aspect.</td>
<td>Photograph 46: 2021: LCC Pond 1. Southwest facing aspect. Red arrow indicates the location of the 6-inch culvert connecting Pond 1 and Pond 2 during higher water levels.</td>
</tr>
</table>

Appendix D Photo Record

Photograph 47: 2021: Culvert between LCC Pond 1 and Pond 2. Photo taken from the Pond 1 side located in the southern corner of Pond 1.

Photograph 48: 2021: Culvert between LCC Pond 1 and Pond 2. Photo taken from the Pond 2 side located in the northern corner of Pond 2.

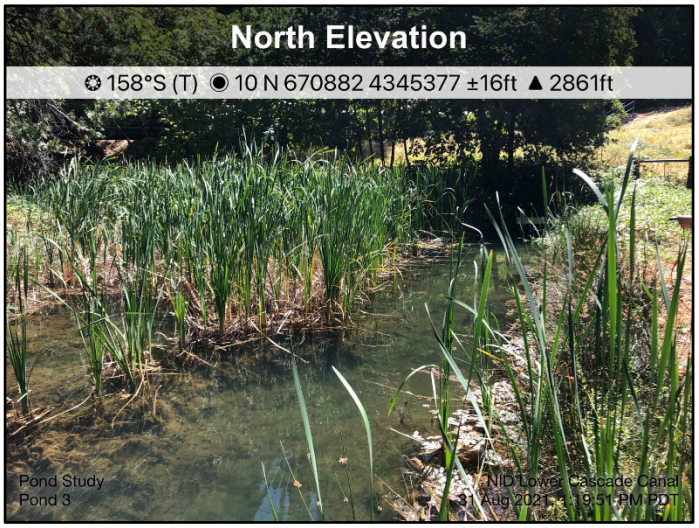
Photograph 49: 2021: LCC Pond 2. Southwest facing aspect.

Photograph 50: 2021. LCC Pond 2. Northeast facing aspect looking towards Pond 1.

Photograph 51: 2013: DS Canal Pond 3 (reference site). Northeast facing aspect.

Photograph 52: 2017: DS Canal Reach (reference site).

Photograph 53: 2021: DS Canal Pond 3 (reference site). Southwest facing aspect.



Photograph 54: 2021: DS Canal Pond 3 (reference site). Southeast facing aspect.

	
Photograph 53: 2021: DS Canal Pond 3 (reference site). West facing aspect.	**Photograph 54:** 2021: DS Canal Pond 3 (reference site). West facing aspect. Water outlet that flows down to a lower pond not included in the Pond Study.

Appendix E FIELD DATASHEETS

Tree Health Assessment

Canopy Cover Study

Pond Study

Baseline Arborist Survey Datasheet

Project LCC - 2021 Monitoring (Year 5) **Site** LCC 8TH #1, Red Dog Rd. (TREE HEALTH ASSESSMENT)

Client Nevada Irrigation District **Date** Sept 14, 2021

Weather 75°F, sunny **Observer(s)** Meghan Oates, Laurel Hoffman

Site Conditions

Notes leaf miner damage observed on all CONU; lots of recently fallen snags

Baseline Data				Tree Health Assessment									
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	Notes
180	D	ALIN	N/A	—	—	—	—	—	—	—	—		Dead. Completely uprooted/fallen
185	D	CONU	N/A	—	—	—	—	—	—	—	—		Dead.
184	D	CONU	5.0	4	2	1	1	0	1	1	0	10	split trunk due to broken crown
183	D	CONU	3.7	4	4	1	1	0	1	1	0	12	leaning downslope, otherwise healthy
186	D	ACMA	*see below	4	3	1	0	0	1	1	0	10	moderate insect damage, 2 stems broken/dead
187	D	ALIN	N/A	—	—	—	—	—	—	—	—		Rooted, but dead.
182	D	ACMA	7.5, 7.4, 9.0 2.8, 8.1	2	3	1	0	0	1	1	0	8	Insect LF damage, 3/5 trunks dying
181	D	ALIN	2.0	2	4	0	1	0	1	1	0	9	Being crushed by dead branch, leaning downslope, shaded out
178	D	ACMA	6.5, 7.7, 7.3	2	4	1	0	0	1	1	0	9	1/4 trunks dead, sparse leaf density
176	D	CONU	N/A	—	—	—	—	—	—	—	—		Dead, fallen
177	D	CONU	N/A	—	—	—	—	—	—	—	—		Dead, fallen
175	D	CONU	2.5	4	4	1	1	0	1	1	0	12	Leaning downslope but healthy
179	D	CONU	6.3	4	4	1	1	1	1	1	0	13	Healthy except leafminers
174	D	CONU	2.0	3	4	1	1	0	1	1	0	11	Healthy but shaded out + leaning downslope
188	D	CONU	5.4	4	4	1	1	0	1	1	0	12	Healthy
173	D	CONU	6.4, 2.4	4	4	1	1	0	1	1	0	12	Healthy

*186 DBH: 9, 8.2, 5.5, 8.6, 5.3, 5.1, 5.3, 7.7, 6.3, 6.5, 6.4, 4.7, 5.0, 9.3, 7.7, 5.8

Project _____ Site _____ Date _____ Tree Health Assessment Datasheet pg 2 of 2

Baseline Data				Tree Health Assessment									Notes
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	
210	D	CONU	1.3	2	4	1	1	0	1	1	0	10	leaning downslope, shaded out
189	D	CONU	3.1	4	4	1	1	1	1	1	1	14	Healthy
194	U	CONU	6.1	4	4	1	1	0	1	1	0	12	Healthy, missed last year
193	U	CONU	2.2	4	4	1	1	0	1	1	0	12	Healthy, leaning downslope
191	U	CONU	5.0, 4.3	4	4	1	1	0	1	1	0	12	Healthy
195	U	ACMA	3.8, 2, 3, 1.8	4	4	1	1	1	1	1	0	13	Healthy (stems counted as trunks last year)
190	U	CONU	6.2	4	4	1	1	0	1	1	1	13	Healthy
192	U	ACMA	2.4	2	4	1	0	1	1	1	0	10	sparse canopy, shaded out

ASSESSMENT KEY

Canopy Cover	1- Sparse to full die-back (0-25%); 2- Partial (25-50%); 3- Medium (50-75%); 4- Full (75-100%)
Bark Health	1- Poor to No bark (75-100%); 2- Fair (50-75%); 3-Good (25-50%); 4- Excellent (0-25%)
New Growth	1- Present; 0- Not present
Leaf Color	1- Normal; 0- Abnormal
Surface Growth	1- Not Present; 0- Present
Disease	1- Not Present; 0- Present
Parasites	1- Not Present; 0- Present
Insects	1- Not Present; 0- Present
Overall Tree Health	1-3 Poor Health/Dead; 4-7 Fair Health; 7-10 Good Health; 11-14 Excellent Health

TREE SPECIES REFERENCE KEY

Baseline Arborist Survey Datasheet pg 1 of _

Project LCC-2021 Monitoring (year 8) **Site** LCC Site #2, Tree Health Assessment

Client Nevada Irrigation District **Date** Sept 15, 2021

Weather 70°, Sunny with smoke **Observer(s)** Meghan Oats, Laurel Hoffman

Site Conditions Normal; Dense understory, cutleaf blackberry

Notes

Baseline Data				Tree Health Assessment									
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	Notes
212	D	CONU	1.8, 2.2, 3.9, 4	4	3	1	1	0	1	1	0	11	Trunks from 1 root crown, gnarled but healthy
213	D	CONU	*	4	2	1	1	0	1	1	0	10	3 dead trunks, All from root crown
143	D	ALIN	5.1	2	3	1	1	0	1	1	1	10	Adjacent to ephemeral stream, competing w/ CONU
144	D	ALIN	6.1	1	3	1	1	0	1	1	1	9	Adjacent to stream, competing w/ other trees
205	D	ACMA	10.2	3	3	1	1	0	1	1	0	10	round knobby base w/epicormal sprouts, Tag fallen
299	D	ACMA	4.8	3	3	1	0	0	1	1	0	9	Missing tag, leaning downhill
136	D	ACMA	2.8	3	4	1	0	1	1	1	0	11	Healthy
140	D	ACMA	4.9	2	3	1	1	0	1	1	0	9	Very top is dead, leaning downslope
139	D	ACMA	3.1	3	3	1	1	0	0	1	0	9	unknown leaf disease (yellowing), against bis fir
138	D	ACMA	11.6, 7.3	4	3	1	1	0	1	1	0	11	very leaned over + mechanically Damaged but OK
141	D	CONU	2.4	4	4	1	1	1	1	1	0	13	Tag being engulfed, Healthy
209	D	ACMA	13.2	4	3	1	1	0	1	1	0	11	large bulbous base, on trail, Healthy
300	D	ACMA	11.3, 9.8	4	3	1	0	0	1	1	0	10	2 trunks, healthy, on trail

*213 DBH: 4.4, 2.2, 1.7, 3.7, 2.3, 4.7, 4.2, 3.4, 5.0, 4.6

Baseline Arborist Survey Datasheet

Project LCC-2021 Monitoring (year 8) **Site** LCC Site #3 - Tree Health assessment

Client Nevada Irrigation District **Date** 09/15/2021

Weather 65°F, Sunny w/ smoke **Observer(s)** Meghan Oats, Laurel Hoffman

Site Conditions Ivy + CA Wild Grape present; lots of branches + logs on ground

Notes

Baseline Data				Tree Health Assessment									
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	Notes
376	D	ALIN	2.0	4	2	1	1	1	0	1	0	10	competing w/ neighbor cedar; Wounded @ Nail for tag
157	D	ALIN	2.3	3	3	1	1	1	1	1	1	11	Fallen over but still alive
158	D	ACMA	9.9	1	1	1	0	0	1	0	0	4	3/4 dead from base, likely strangled by Ivy
159	D	CONU	2.9	3	4	1	1	1	1	1	0	12	Tag being engulfed, Tree leaning downhill
160	D	ACMA	9.4	3	3	1	0	0	0	0	0	7	Ivy @ base, lots of insect leaf dmg
162	D	ACMA	9.8	1	1	1	1	0	0	1	0	5	Trunk decaying longitudinally, dead crown + rust
163	D	ACMA	6.2	1	2	1	1	0	0	1	0	6	Crown dead above 6 feet, unknown leaf disease
164	D	ACMA	4.7	2	2	1	1	0	1	1	0	8	Bent over downslope w/ dead trees on it.
166	D	ACMA	7.1	4	3	1	1	0	0	1	0	10	Tag being engulfed; unknown leaf disease + rust spots
165	D	ACMA	5.0	3	3	1	1	0	0	1	0	9	very bent over, main leader dead @ tip
167	D	ACMA	3.8	4	4	1	1	0	1	1	0	12	Healthy except for leaf insect damage
154	D	ACMA	2.3	3	4	1	1	0	0	1	0	10	Tag being engulfed, but OK ✓
153	D	ACMA	2.1, 2.6	3	3	1	1	0	1	1	0	10	Two main trunks w/ 1 split + dead Tag engulfed completely
152	D	ACMA	8.1, 6.8, 7.1	4	3	1	1	0	1	1	0	11	Healthy but insect leaf damage
214	D	ACMA	7.5	4	3	1	1	0	0	0	0	9	2nd trunk dead; grape + Ivy on trunk
155	D	ACMA	9.8	3	3	1	1	0	1	1	0	10	leaf insect damage but OK ✓

Project LCC-2021 Monitoring (year 8) Site LCCsite#3 Date 09/15/2021 Tree Health Assessment Datasheet pg 2 of 2

Baseline Data				Tree Health Assessment									
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	Notes
171	4	ACMA	*4.2	3	4	1	0	1	1	1	0	11	leaves yellowing, competing w/ CONU
172	4	CONU	*5.4	4	4	1	1	1	1	1	1	14	Healthy, leaning upslope
168	4	CONU	*3.9	4	4	1	1	0	1	1	1	13	Healthy
169	4	CONU	*4.9	4	4	1	1	1	1	1	1	14	Healthy, engulfing tree

ASSESSMENT KEY

Canopy Cover	1- Sparse to full die-back (0-25%); 2- Partial (25-50%); 3- Medium (50-75%); 4- Full (75-100%)
Bark Health	1- Poor to No bark (75-100%); 2- Fair (50-75%); 3-Good (25-50%); 4- Excellent (0-25%)
New Growth	1- Present; 0- Not present
Leaf Color	1- Normal; 0- Abnormal
Surface Growth	1- Not Present; 0- Present
Disease	1- Not Present; 0- Present
Parasites	1- Not Present; 0- Present
Insects	1- Not Present; 0- Present
Overall Tree Health	1-3 Poor Health/Dead; 4-7 Fair Health; 7-10 Good Health; 11-14 Excellent Health

*estimated DBH due to access difficulty

TREE SPECIES REFERENCE KEY

Baseline Arborist Survey Datasheet

Project LCC - 2021 Monitoring Year 8 **Site** LCC Site #4 TREE HEALTH ASSESSMENT

Client Nevada Irrigation District **Date** 9/14/2021

Weather 90°, sunny **Observer(s)** Meg Hawkins, Laurel Hoffman

Site Conditions ground cover (English ivy) downslope.

Notes

Baseline Data				Tree Health Assessment									
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	Notes
116	D	ACMA	1.6, 1.1	1	4	1	1	1	1	0	0	9	shaded, has ivy growing up trunk
117	D	ALIN	1.3	2	3	0	0	1	1	1	1	9	shaded, slight, crushed canopy
115	D	ALIN	1.8	2	4	0	0	1	1	1	0	9	shaded, being crushed by fallen log
119	D	ALIN	2.4	3	4	1	1	1	1	1	0	12	Shaded, healthy, BIG log has fallen on it
113	D	ACMA	1.9	1	4	1	0	1	1	1	0	9	very shaded
114	D	ACMA	2.3	2	4	1	0	1	1	1	0	10	sparse canopy
123	D	ALIN	3.3	4	4	1	1	1	1	1	0	13	healthy
201	D	*FRLA(?)	2.0	4	3	1	1	1	1	1	0	12	Healthy
215	D	ACMA	3.1	4	4	1	1	1	1	1	0	13	Healthy
291	D	ALIN	1.8	4	3	1	1	1	1	1	0	12	healthy, tag fallen off
110	D	ACMA	2.9	1	2	1	1	1	1	1	0	8	Heavily damaged by fallen log
109	D	ACMA	5.3	3	4	1	1	1	1	0	0	11	tag being obscured by bark; Ivy on tree
200	D	ACMA	1.8	4	4	1	1	1	1	0	0	12	Tag Missing, one broken leader; IVY
202	D	ALIN	1.1	2	3	0	0	1	1	0	0	7	Tag Missing; wrapped with vine
129	U	ACMA	X, 3.1, 4.8	1	2	0	0	0	0	1	0	4	Tagged trunk is dead, other 2 are weak
196	U	ACMA	6.7	2	3	1	0	0	1	1	0	8	2nd trunk is dead; weak tree

*Walnut tree?

Project _____ Site _____ Date 09/14/21 Tree Health Assessment Datasheet pg 2 of 2

Baseline Data				Tree Health Assessment									
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	Notes
197	U	ACMA	4.7	4	2	1	0	0	0	1	0	8	nail wound infected, tag on ground
292	U	ACMA	7.9	4	3	1	0	0	1	1	0	10	looks ok
199	U	ACMA	9.7	4	4	1	0	0	1	1	0	11	Healthy

ASSESSMENT KEY

Canopy Cover	1- Sparse to full die-back (0-25%); 2- Partial (25-50%); 3- Medium (50-75%); 4- Full (75-100%)
Bark Health	1- Poor to No bark (75-100%); 2- Fair (50-75%); 3-Good (25-50%); 4- Excellent (0-25%)
New Growth	1- Present; 0- Not present
Leaf Color	1- Normal; 0- Abnormal
Surface Growth	1- Not Present; 0- Present
Disease	1- Not Present; 0- Present
Parasites	1- Not Present; 0- Present
Insects	1- Not Present; 0- Present
Overall Tree Health	1-3 Poor Health/Dead; 4-7 Fair Health; 7-10 Good Health; 11-14 Excellent Health

TREE SPECIES REFERENCE KEY

Baseline Arborist Survey Datasheet

Project LCC-2021 Monitoring (year 8) **Site** UGVC Site #5 Tree Health Assessment

Client Nevada Irrigation District **Date** September 15, 2021

Weather 80°F, Sunny w/ smoke **Observer(s)** Meghan Oerts, Laurel Hoffman

Site Conditions Roadside

Notes

Baseline Data				Tree Health Assessment									
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	Notes
99	D	CONU	8.1	4	4	1	1	0	1	1	0	12	Healthy
98	D	CONU	N/A	—	—	—	—	—	—	—	—	—	No longer present, cut down
100	D	ALIN	9.8	1	3	1	1	0	1	1	0	8	Main leader dead, Bare branches
101	D	ALIN	N/A	—	—	—	—	—	—	—	—	—	Dead, Cut down
103	D	ACMA	6.6	4	4	1	0	0	1	1	0	11	Doing well w/ cedar competition
105	U	ALIN	2.3	3	3	1	0	0	1	1	0	9	leaning downslope

Baseline Arborist Survey Datasheet

pg 1 of _

Project Banner Cascade 2021 monitoring **Site** Reference site - DS Canal Site #6

Client Nevada Irrigation District **Date** Sept 16, 2021

Weather 70°, sunny AQI 89 **Observer(s)** Meghan Oats, Laurel Hoffman

Site Conditions Ground covered in honeysuckle, many CONU look slightly wilted

Notes

Baseline Data				Tree Health Assessment									
Tree Number	Tree Location	Species	DBH	Canopy Cover	Bark Health	New Growth	Leaf Color	Surface Growth	Disease	Parasites	Insects	Overall Health Score	Notes
223	D	CONU	2.9	3	4	1	1	1	1	1	0	12	drooping/wilting leaves, appears healthy otherwise
220	D	CONU	2.5	4	4	1	1	1	1	1	0	13	Tag missing, leaning downslope, lots of insect leaf damage
224	D	CONU	2.0	3	3	1	1	1	1	1	0	11	almost horizontal, tag missing
219	D	CONU	2.5, 3.5	3	3	1	1	1	1	1	0	11	Bark looks scratched; Healthy +/- wilty
217	D	CONU	2.6	3	2	1	1	1	1	1	0	10	Bark looks scratched; but healthy, +/- wilty
216	D	CONU	N/A	—	—	—	—	—	—	—	—		Dead. No tag. Bark sloughing
221	D	CONU	1.9	4	3	1	1	1	1	1	0	12	leaf insect dmg but ok ✓
222	D	CONU	6.5, 4.4	2	3	1	1	0	1	1	0	9	2/3 Main trunks dead @ tips, epicormal sprouting
225	D	CONU	2.6	4	3	1	1	1	1	1	0	13	Healthy but leaves drooping; dead tree leaning; tag falling off
218	D	CONU	1.7, 1.3	3	3	1	1	1	1	1	0	11	tag missing, one branch crushed by fallen tree
93	U	ACMA	4.1	3	3	1	0	0	1	1	0	9	looks ok
92	U	ALIN	7.2	1	4	0	0	0	1	1	1	8	All branch tips dying, dead @ top. no clear reason
96	U	ACMA	—	—	—	—	—	—	—	—	—		Dead
95	U	ACMA	0.9, 3.5	4	4	1	0	0	1	1	0	11	Looks ok, 1/3 Main branches dead
94	U	ACMA	0.7, 0.6, 0.7, 2.9 ≈ 11.4	3	1	1	0	0	0	1	0	6	Tag is 6ft up & facing water
													≈ Many dead trunks, One partially alive with 4 branches @ DBH

Canopy Cover Study: Assessment via Densiometer

Project	LCC Mon Year 8 (2021)	Date	9/10/2021
Client/Owner	Nevada Irrigation District	Surveyor(s)	Meahan Ontis
Reach ID	LCC1	Reach Length	Total LCC - 7.10 miles
Reach Location	Lower Cascade Canal (Red Dog Rd)		
Reach Start Coordinates	39.254190°, -120.982888°		
Reach End Coordinates	39.239470°, -120.991791°		
NOTES	LCC1 - Red Dog Rd. to Banner Lava Cap Rd. North to South, NDF occupied		

Direction (Facing)	North		South		East		West	
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
LCC1-1	349	36	171	33	87	34	267	10
LCC1-2	345	22	163	10	89	6	247	10
LCC1-3	358	19	150	17	69	3	273	26
LCC1-4	357	30	178	29	89	28	246	36
LCC1-5	0	32	191	20	95	15	285	20
LCC1-6	8	32	196	21	111	12	274	33
LCC1-7	8	7	182	1	95	1	281	16
LCC1-8	355	5	196	3	108	2	271	1
LCC1-9	348	10	186	14	110	3	255	4
LCC1-10	2	22	195	27	105	5	281	1
LCC1-11	17	37	188	21	108	0	294	8
LCC1-12	340	16	160	21	75	1	242	5
LCC1-13	291	13	111	29	31	3	218	2
LCC1-14	273	22	118	18	30	4	215	13
LCC1-15	280	27	84	34	2	11	190	2
LCC1-16	257	25	76	21	34	14	165	5
LCC1-17	249	21	70	16	353	2	173	14
-18	276	30	90	31	6	0	181	19
-19	278	28	56	9	345	12	162	2
-20	265	22	85	24	3	1	172	5
21	274	8	104	14	13	5	182	6
22	270	32	91	23	358	3	180	24
23	206	34	97	27	2	3	169	6
24	350	12	178	25	85	2	231	3
25	327	28	143	15	54	7	233	33
26	301	7	104	14	17	19	192	2
27	297	13	111	6	28	2	207	14
28	310	10	134	6	46	0	215	1
29	306	9	109	17	15	0	213	2
30	302	16	113	18	30	3	189	2
31	268	28	85	34	2	6	210	26
32	260	22	101	33	347	7	148	28
33	238	27	46	8	323	18	143	3
34	218	13	43	12	316	9	138	3
35	241	24	84	28	1	12	168	34
36	270	17	100	2	18	2	184	13
37	258	15	68	25	357	12	160	41
38	261	34	76	23	350	7	165	5
39	354	15	123	8	39	18	218	4
40	270	12	95	35	4	5	187	3
41	238	41	57	32	342	24	146	22
42	206	22	29	34	304	7	111	2
43	206	25	31	26	305	0	114	21
44	198	14	25	41	299	25	133	2
45	205	37	43	27	319	24	130	16
46	198	40	11	35	286	20	100	13
47	184	20	8	21	285	20	102	3

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
48	267	17	80	19	35	2	171	19
49	49	23	9	10	0	0	174	2
5	6		85	19	350	7	173	2
51	3	9	14	2	20	5	220	3
2	333	2	1	21	81	2	263	2
53	32	2	131	14	4	2	224	1
4	279	9	95	8	5	2	185	8
	48	7	88	22	11	6	195	4
	32	0	2	3	13	4	313	4
57	51	4	9	8	8	8	331	2
58	107	16	2	5	165	2	349	16
59	1	9	8	11	8	4	12	0
60	17	15	309	7	16	5	310	0
61	137	1	326	8	233	3	43	2
62	120	10	83	5	170	5	60	28
63	70	10	264	15	165	6	340	8
64	158	12	346	12	250	11	32	0
65	91	13	77	2	185	3	10	16
66	31	8	165	18	81	3	260	18
67	330	32	155			4	210	15
68	20	2	200	1	1	4	290	19
0	20	8	200	2	1	6	290	24
70	20	8		2	10	2	290	1
1	4		187	1	100	2	280	0
7	338	7	156	6	113	1	286	7
73	32	17	15	7	60	2	230	27
74	4	9	264	18	170	2	340	16
75	7	12	2	9	102	6	343	2
0	4	7	210	3	130	8	300	2
77	10	4	195	2	106	2	290	0
78	2	6	206	13	118	16	298	1
79	9	14	188	18	106	5	277	7
80	316	12	174		87	20	266	2
81	39	2	189	9	93	11	273	1
82	36	1	17	17	9	1	275	1
83	36	14	12	12	7	2	245	38
84	318	24	148	9	8	2	238	11
5	314	19	111	9	48	1	248	26
86	332	14	160	5	68	0	269	28
87	301	36	130	18	28	3	241	21
88	115	9	341	1	252	2	71	8
89	128	81	324	2	186	0	25	4
90	50	1	24	10	148	4	328	2
91	32	11	211	9	109	2	352	2
92	102	7	347	4	258	3	45	2
93	126	0	316	10	224	0	50	2
94	158	5	341	3	22	4	37	1
95	138	9	311	15	219	2	30	1
96	100	0	283	6	184	6	0	0
97	90		89	4	189	2	10	0
98	116	8	294	15	191	1	13	1
99	62	16	250	11	171	0	357	1
10	45	8	237	8	141	2	338	1
101	13	19	209	8	109	3	307	3
1	26	8	198	3	102	0	300	10
103	23	13	11	15	111	0	313	3

Pg 2
LCC1

Canopy Cover Study: Assessment via Densiometer

Project _____ Date _____

Client/Owner _____ Surveyor(s) _____

Reach ID _____ Reach Length _____

Reach Location _____

Reach Start Coordinates _____

Reach End Coordinates _____

NOTES _____

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
LCC1 – 104	26	1	239	12	146	0	327	7
105	59	2	243	14	162	0	343	7
106	45	43	264	28	175	44	353	27
107	343	2	162	7	74	0	243	0
108	322	14	150	5	57	2	241	3
109	325	11	161	14	64	0	243	0
110	333	24	167	30	165	2	249	19
111	72	0	256	5	182	0	337	1
112	90	2	283	4	174	0	0	33
113	79	4	261	2	160	2	342	19
114	79	6	261	3	144	2	345	3
115	72	2	260	16	200	0	17	4
116	105	19	275	4	183	3	346	8
117	125	8	306	7	215	1	34	0
118	120	7	270	14	178	0	9	33
119	90	21	271	7	179	1	0	11
120	82	4	270	13	174	0	0	1
121	87	14	275	16	183	1	4	0
122	80	11	263	16	180	0	357	9
123	110	25	308	20	210	2	35	1
124	130	0	318	16	226	0	47	6
125	106	13	291	3	198	0	23	36
126	90	2	270	6	194	3	14	2
127	93	0	283	7	133	2	343	0
128	12	10	203	5	110	1	312	0
129	30	17	228	8	107	3	300	10
130	40	15	226	14	141	3	317	32
131	22	6	200	2	164	10	335	7
132	5	1	180	7	95	0	271	3
133	24	3	201	2	114	1	279	8
134	20	9	172	9	78	1	269	27
135	3	3	183	3	92	2	277	3
136	3	4	188	8	99	5	260	2
137	7	11	196	3	100	0	286	4
138	0	1	180	7	91	0	241	2
139	346	4	157	12	73	1	230	3
140	75	1	221	5	133	0	351	37
141	83	0	254	1	164	0	346	0
142	88	3	271	3	180	5	8	5
143	100	6	284	2	190	0	10	11
144	70	3	227	6	134	0	315	23
145	68	7	200	2	110	2	297	5
146	62	3	212	0	114	0	302	4
147	344	11	173	0	108	0	314	10
148	12	0	202	1	95	0	277	2
149	0	24	183	2	93	1	295	41
150	75	0	260	20	175	0	8	1

(3)

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
151	96	0	300	1	202	2	22	2
152	85	8	270	3	340	1	158	0
153	220	9	80	33	351	2	172	19
154	340	36	158	32	74	9	253	7
155	17	8	255	12	106	0	346	14
156	37	6	230	23	149	2	333	22
157	102	21	284	23	198	9	11	0
158	88	13	268	26	170	15	5	2
159	87	18	272	11	176	2	353	7
160	49	2	232	2	142	8	317	1
161	43	6	220	13	137	9	318	18
162	67	11	255	5	168	1	344	8
163	80	4	205	10	178	2	358	1
164	69	5	243	0	154	3	314	0
166	290	10	123	11	34	12	21	0
165	307	13	128	2	17	2	198	7
166	117	20	297	14	207	5	07	13
167	132	7	312	5	222	2	42	14
168	58	16	238	2	148	5	328	11
169	305	10	125	22	35	11	215	0
170	291	27	111	4	21	8	201	15
171	261	15	120	12	18	3	222	16

Canopy Cover Study: Assessment via Densiometer YRP

Project	LC Monitoring 2021	Date	09/15/2021
Client/Owner	Nevada Irrigation District	Surveyor(s)	Meghan Oats, Laurel Hoffman
Reach ID	UGVC	Reach Length	0.5miles
Reach Location	UGVC		
Reach Start Coordinates	39.238786, -120.997674		
Reach End Coordinates	39.235750, -121.004963°		
NOTES			

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
UGVC-1	83°	36	278°	2	189°	4	10°	34
UGVC-2	131°	4	321°	6	229°	2	47°	5
UGVC-3	172°	9	357°	2	267°	Ø	95°	28
UGVC-4	95°	Ø	283°	5	192°	Ø	12°	2
UGVC-5	65°	2	250°	5	157°	Ø	338°	20
UGVC-6	67°	Ø	250	1	157°	3	337°	1
UGVC-7	195°	3	28°	2	290°	4	117°	3
UGVC-8	133°	11	322°	1	231°	8	51°	14
UGVC-9	31°	6	221°	7	139	6	315°	17
UGVC-10	19°	2	200°	Ø	110°	4	294°	11
UGVC-11	25°	2	212	6	120	2	305	2
UGVC-12	0°	4	195°	3	107°	Ø	284°	1
UGVC-13	8°	2	194°	4	101°	3	287°	1
UGVC-14	46°	2	220°	Ø	133°	1	310°	Ø
UGVC-15	46°	2	219°	3	127°	2	316°	Ø
UGVC-16	0°	1	180°	5	90°	Ø	270°	6
UGVC-17	353°	38	174°	35	86°	8	263°	21
UGVC-18	11°	4	191°	Ø	101°	5	281°	16
UGVC-19	22°	1	206°	20	118°	Ø	298°	7
UGVC-20	18°	6	198°	4	110°	Ø	289°	41
UGVC-21	28°	5	200°	2	113°	1	290°	8
UGVC-22	60°	2	235°	6	145°	Ø	325°	12
UGVC-23	40°	2	220°	Ø	125°	Ø	310°	5
UGVC-24	60°	1	240°	2	148°	12	330°	15
UGVC-25	75°	1	252°	2	161°	20	340°	20
UGVC-26	85°	2	265°	1	175°	Ø	355°	10
UGVC-27	107	Ø	287°	4	196°	Ø	17°	3

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total

Canopy Cover Study: Assessment via Densiometer YKR

Project	Lec Canopy Monitoring '21	Date	9/16/21
Client/Owner	Nevada Irrigation District	Surveyor(s)	Meghan Oats, Laurel Hoffman
Reach ID	DS Canal	Reach Length	0
Reach Location			
Reach Start Coordinates	39.243050, -121.010756		
Reach End Coordinates	39.245210, -120.993649		
NOTES			

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
DS-1	3°	32	183°	37	93°	15	273°	10
DS-2	316°	17	142°	29	70°	27	257°	31
DS-3	326°	22	146°	21	61°	6	246°	22
DS-4	337°	15	167°	24	76°	21	250°	19
DS-5	346°	24	166°	27	86°	23	266°	1
DS-6	0°	43	180°	17	90°	11	270°	33
DS-7	40°	13	230°	0	140°	12	330°	2
DS-8	70°	22	250°	32	160°	15	345°	8
DS-9	80°	18	270°	22	170°	32	350°	2
DS-10	75°	2	265°	34	173°	22	350°	0
DS-11	70°	1	250°	15	170°	7	340°	26
DS-12	85°	12	265°	5	195°	6	5°	2
DS-13	82°	14	262°	15	192°	7	2°	2
DS-14	90°	10	270°	18	180°	10	0°	0
DS-15	90°	10	270°	14	180°	40	0°	0
DS-16	83°	19	276°	25	182°	31	1°	2
DS-17	78°	4	258°	28	178°	18	358°	9
DS-18	75°	9	255°	9	175°	6	355°	2
DS-19	98°	1	278°	3	188°	2	18°	1
DS-20	140°	0	320°	2	230°	1	50°	2
DS-21	150°	13	330°	2	240°	8	60°	1
DS-22	163°	16	343°	12	263°	0	73°	0
DS-23	110°	13	290°	0	200°	1	10°	15
DS-24	15°	5	195°	7	100°	2	280°	0
DS-25	353°	10	174°	7	78°	7	255°	0
DS-26	10°	1	200°	12	100°	4	290°	1
DS-27	8°	4	219°	6	83°	4	258°	0
DS-28	16°	9	236°	9	86°	0	263°	0
DS-29	14°	12	221°	5	79°	0	257°	0
DS-30	10°	9	190°	11	100°	3	280°	0
DS-31	26°	6	226°	22	102°	0	286°	2
DS-32	28°	5	215°	4	114°	6	288°	0
DS-33	24°	2	234°	20	144°	8	324°	2
DS-34	23°	2	213°	23	130°	33	280°	6
DS-35	20°	0	220°	5	110°	6	290°	0
DS-36	46°	0	226°	13	156°	6	326°	2
DS-37	90°	2	270°	18	180°	38	0°	1
DS-38	31°	21	201°	4	121°	9	301°	9
DS-39	5°	1	195°	4	95°	4	275°	1
DS-40	28°	7	218°	20	101°	18	287°	2
DS-41	37°	6	227°	17	147°	6	317°	0
DS-42	42°	6	222°	11	172°	11	332°	1
DS-43	95°	3	275°	0	185°	5	5°	4
DS-44	146°	0	326°	11	241°	5	61°	0
DS-45	186°	0	6°	4	266°	5	76°	0
DS-46	190°	0	10°	14	280°	3	100°	1
DS-47	200°	0	90°	11	260°	8	70	1

Recently logged on private property side

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
DS_48	173°	3	13°	2	293°	5	103°	0
DS_49	70°	24	250°	28	160°	16	350°	26
DS_50	22°	15	202°	31	121°	8	292°	1
DS_51	354°	8	193°	15	106°	2	285°	0
DS_52	108°	36	288°	18	198°	18	8°	4
DS_53	21°	28	203°	21	113°	11	288°	37
DS_54	18°	26	208°	17	118°	2	288°	0
DS_55	12°	33	195°	19	115°	2	290°	6
DS_56	55°	25	240°	22	154°	7	330°	26
DS_57	90°	9	270°	16	180°	10	0°	10
DS_58	80°	25	260°	7	170°	10	350°	32
DS_59	85°	21	240°	25	180°	12	0°	8
DS_60	22°	20	202°	11	122°	4	312°	13
DS_61	18°	14	198°	17	114°	4	308°	2
DS_62	80°	10	260°	21	170°	2	350°	2
DS_63	83°	6	263°	19	183°	2	3°	1
DS_64	70°	13	250°	22	170°	3	350°	2
DS_65	82°	11	262°	28	185°	0	5°	2
DS_66	87°	2	267°	17	185°	6	5°	0
DS_67	17°	20	197°	19	117°	10	307°	22
DS_8	32°	10	212°	2	122°	14	312°	0
DS_69	58°	24	248°	18	158°	2	338°	12
DS_70	40°	6	220°	17	140°	10	330°	5
DS_71	85°	10	265°	19	185°	6	5°	1
DS_72	145°	3	325°	11	245°	9	65°	0
DS_73	133°	6	303°	16	223°	19	43°	0
DS_74	148°	13	338°	22	248°	0	68°	28
DS_75	32°	2	217°	24	139	0	319°	16
DS_76	28°	2	208°	1	128	6	298°	0
DS_77	60°	11	240°	12	150	10	330°	0
DS_78	105°	2	285°	11	195°	8	15°	0
DS_79	73°	31	254°	7	184°	2	4°	29
DS_80	5°	10	185°	21	95°	10	275°	3
DS_81	0°	12	180°	8	90°	2	270°	9
DS_82	53°	0	233°	4	153°	2	333°	1
DS_83	98°	2	278°	20	188°	11	8°	0
DS_84	62°	2	242°	10	152°	0	332°	5
DS_85	48°	14	218°	26	140°	14	320°	9

Canopy Cover Study: Assessment via Densiometer

Project	LCC 2021 Monitoring (year 8)	Date	09/17/2021
Client/Owner	Nevada Irrigation District	Surveyor(s)	Meghan Oats, Laurel Hoffman
Reach ID	LCC2	Reach Length	~7.8 miles
Reach Location	LCC2		
Reach Start Coordinates	39.239529, -120.996557		
Reach End Coordinates	39.224407, -120.990925		
NOTES			

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
LCC2_1	302	35	120	13	21	42	203	1
LCC2_2	290	12	110	2	30	11	200	0
LCC2_3	287	14	117	2	27	2	200	1
LCC2_4	304	32	124	3	34	1	214	44
LCC2_5	188	2	18	12	290	1	110	5
LCC2_6	313	6	132	9	42	3	212	0
LCC2_7	333	5	153	1	65	1	245	5
LCC2_8	284	0	104	2	14	2	194	0
LCC2_9	230	4	50	4	330	0	150	3
LCC2_10	228	2	38	8	308	1	128	2
LCC2_11	0	6	180	8	90	4	270	2
LCC2_12	350	2	165	2	90	4	270	1
LCC2_13	316	0	136	2	46	7	226	2
LCC2_14	317	2	137	1	57	0	237	2
LCC2_15	322	11	142	2	62	2	242	0
LCC2_16	315	5	135	3	45	2	225	4
LCC2_17	330	4	160	4	70	0	250	5
LCC2_18	338	4	158	6	68	2	248	3
LCC2_19	0	16	180	4	90	2	270	9
LCC2_20	10	9	190	4	100	2	280	4
LCC2_21	350	2	170	4	80	2	260	1
LCC2_22	292	2	100	3	12	5	202	0
LCC2_23	282	0	92	6	352	7	212	0
LCC2_24	228	5	48	3	328	5	138	2
LCC2_25	176	2	356	3	266	1	96	8
LCC2_26	196	0	16	2	286	0	106	0
LCC2_27	194	1	50	7	311	0	131	2
LCC2_28	328	6	148	3	58	2	238	4
LCC2_29	286	0	106	1	26	6	206	2
LCC2_30	272	6	92	9	2	12	182	9
LCC2_31	280	10	100	0	10	0	190	16
LCC2_32	252	2	72	5	342	2	162	0
LCC2_33	243	0	63	14	343	0	163	3
LCC2_34	226	6	46	11	326	7	146	35
LCC2_35	192	15	12	1	292	0	112	9
LCC2_36	257	2	102	14	12	0	187	3
LCC2_37	351	0	171	5	61	3	241	0
LCC2_38	280	2	100	2	10	4	190	2
LCC2_39	229	2	49	15	329	0	149	0
LCC2_40	226	2	46	8	316	2	126	4
LCC2_41	15	1	375	2	105	4	285	0
LCC2_42	217	17	37	5	307	4	127	0
LCC2_43	164	27	354	8	254	10	84	16
LCC2_44	138	3	318	3	228	11	48	2
LCC2_45	285	0	105	4	15	13	195	0
LCC2_46	200	0	20	0	340	4	160	1
LCC2_47	214	1	34	10	304	11	124	10

Direction (Facing)								
Data Point ID#	Upstream		Downstream		Left Bank		Right Bank	
	Direction	Total	Direction	Total	Direction	Total	Direction	Total
LCC2_48	338	2	158	0	68	0	258	1
LCC2_49	327	6	147	0	57	2	237	0
LCC2_50	30	5	215	3	125	0	305	0
LCC2_51	40	2	220	6	130	2	310	5
LCC2_52	62	0	242	7	352	3	172	1
LCC2_53	57	2	237	2	147	0	327	4
LCC2_54	42	0	222	0	132	1	312	5
LCC2_55	28	2	208	8	118	0	298	0
LCC2_56	16	9	196	0	116	0	286	5
LCC2_57	10	3	190	4	100	5	280	0
LCC2_58	25	0	205	9	115	0	295	0
LCC2_59	30	2	210	9	180	6	300	7
LCC2_60	28	0	208	0	118	5	298	0
LCC2_61	15	14	195	11	105	4	285	28
LCC2_62	27	9	207	4	117	3	297	4
LCC2_63	18	0	198	1	108	1	288	1
LCC2_64	326	2	146	18	56	3	236	12
LCC2_65	320	23	140	5	50	20	230	0
LCC2_66	323	7	133	2	53	6	233	20
LCC2_67	260	8	80	4	350	0	170	1
LCC2_68	262	0	82	0	352	5	172	0
LCC2_69	312	2	132	0	42	2	222	0
LCC2_70	228	1	48	14	318	8	138	0
LCC2_71	350	0	170	3	80	5	260	2
LCC2_72	337	32	157	6	67	10	247	38
LCC2_73	0	3	180	1	90	0	270	1
LCC2_74	300	0	120	10	30	0	210	0
LCC2_75	238	11	58	12	338	3	158	28
LCC2_76	338	44	158	3	68	4	248	42
LCC2_77	60	31	240	18	151	23	331	28
LCC2_78	45	1	225	2	135	3	305	0
LCC2_79	43	5	220	0	130	1	310	12
LCC2_80	70	4	250	0	160	0	340	0
LCC2_81	62	27	242	1	152	0	332	7
LCC2_82	45	19	225	0	135	0	315	0
LCC2_83	33	2	213	4	123	0	303	2
LCC2_84	28	2	208	4	118	0	298	0
LCC2_85	17	4	197	4	107	0	287	1
LCC2_86	24	5	194	3	114	0	284	3
LCC2_87	0	39	180	7	90	0	270	48
LCC2_88	10	12	190	3	100	0	280	0
LCC2_89	42	1	222	1	132	0	322	0
LCC2_90	38	0	218	13	138	0	308	2
LCC2_91	0	0	180	9	90	7	270	2
LCC2_92	20	0	200	0	110	0	290	0
LCC2_93	0	20	180	34	90	0	270	28
LCC2_94	350	21	170	27	80	42	260	0
LCC2_95	287	8	107	15	17	11	197	0
LCC2_96	318	32	132	22	42	15	222	12
LCC2_97	340	11	160	8	70	14	250	16
LCC2_98	335	9	155	20	65	21	245	0
LCC2_99	350	32	170	42	80	7	260	48
LCC2_100	345	48	165	39	85	32	265	48
LCC2_101	350	48	170	38	80	32	260	48
LCC2_102	355	48	175	48	85	48	265	48

Pond / Wetland General Assessment Datasheet updated 9/1/2017

Project LCC Date 8/31/21

Client / Owner NID Surveyors E. Eppinger, M. Oats

Latitude 39.23571 Longitude -120.988615 Datum WGS 1984

Site ID Pond #1

Site Location Spring Street, private residence (upper pond) connected to Pond #2 with culvert - water too low currently (therefore, not connected) [end of survey]

Site Description pond within forest - cedar, oak - black, few incense alder/dogwood, few ponderosa, 1 doug fir [connected to Pond #2 w/ culvert, but water was too low (pic)]

NWI Classification PUB Fh

Area of Inundation Description inundation only within pond - smaller area than previous surveys

Water Depth Range (Feet) Visual estimation ~24" max depth (from edge pond)

Soil Map Unit Name / Source (many types in this area) AFB - USDA/NCSS - Aiken loam, 2-9 percent slopes, N. low-mod moisture

Area of Soil Saturation Description ~24" up from inundated area (pic)

Is site within current and/or historic range of CRLF? (yes) no

Are there any known records of CRLF within 1 mile of site? yes (no)

CRLF Habitat Assessment Remarks emergent veg present

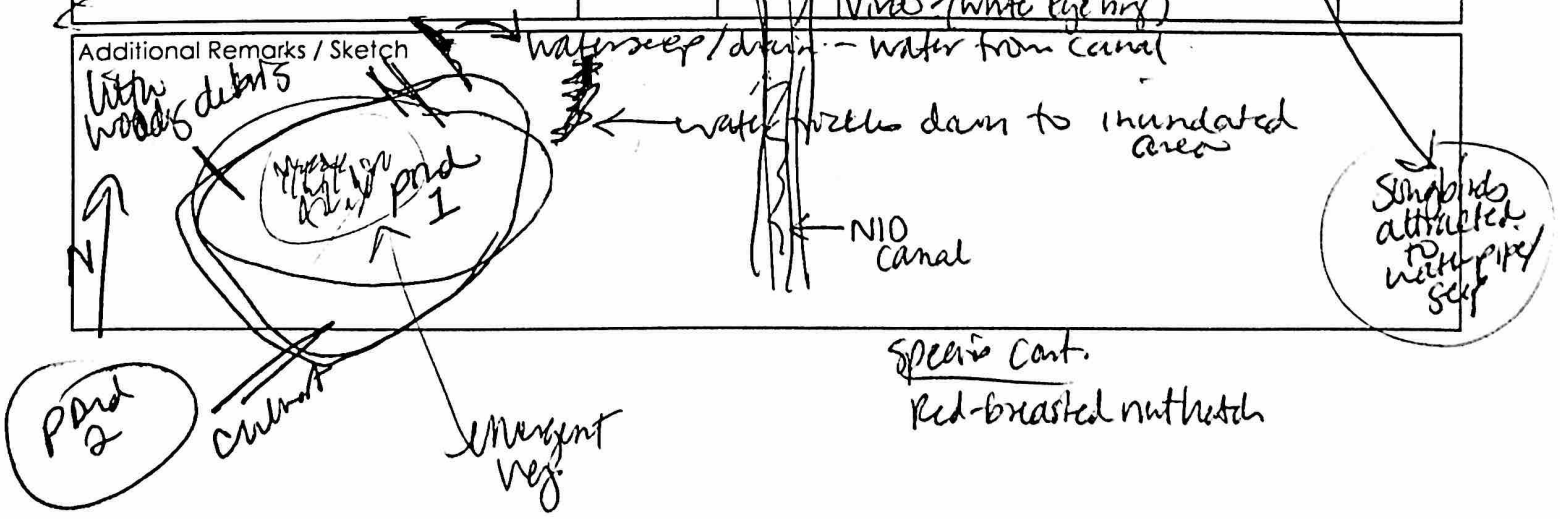
(Meghan Oats) Observed Vegetation

	Hydrophytic	Status
see notes		
AFD canal		

Observed Wildlife

	Status
- Stellers Jay	
- Red shouldered hawk - vocal	
- American Robin distant	
- Wilson's warblers	
treefrog adult tadpoles/metamorph	
- brown creeper	
water strider	
Vireo? (white eye nrg)	

Additional Remarks / Sketch



Water relatively clear – lots algae

pond gets
"Miners Drek" from canal?

- little woody debris within pond
- tree frog larvae observed in pond
- water beetles.
- culvert connecting two ponds approx. couple feet above current water depth.

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by _____ _____ _____
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 8/31/21 ~11am
(mm/dd/yyyy)

Site Assessment Biologists: Eppinger Emily (Last name) (first name) _____ (Last name) (first name)

Oats Meghan (Last name) (first name) _____ (Last name) (first name)

Site Location: Nevada County, Lower Cascade Canal - Pond #1
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).
Lat. 39.23571, -120.980615 Datum WGS 1984

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: Lower Cascade Canal Pond Study
Brief description of proposed action:
Lowering/decommissioning of Lower Cascade Canal nearby
- monitor effects 0-10 years post.

Evaluate ponds every 4 years

1) Is this site within the current or historic range of the CRF (circle one)? (YES) NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES (NO)
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:
Size: Acres Maximum depth: ~34" (visual estimation)

Vegetation: emergent, overhanging, dominant species: emergent, no overhang.
Alisma sp.
algae

Substrate: unconsolidated silt/muddy

(Perennial) or Ephemeral *(circle one)*. If ephemeral, date it goes dry: _____
↓ levels largely dictated by NID canal flows/allowance

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM:

Bank full width: _____

Depth at bank full: _____

Stream gradient: _____

Are there pools (circle one)? YES NO

If yes,

Size of stream pools: _____

Maximum depth of stream pools: _____

Characterize non-pool habitat: run, riffle, glide, other: _____

_____

_____

Vegetation: emergent, overhanging, dominant species: _____

_____

_____

Substrate: _____

_____

Bank description: _____

_____

_____

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: _____

Other aquatic habitat characteristics, species observations, drawings, or comments:

- No predatory species observed
- tree frog ~~tadpoles~~ larvae observed in water.

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species location

Pond / Wetland General Assessment Datasheet updated 9/1/2017

Project LCC Date 8/31/21

Client / Owner NID Surveyors

Latitude 39.235182 Longitude -120.909522 Datum WGS 1984

Site ID Pond #2 LLC

Site Location Spring Street, private residence (lower pond) connected to Pond #1 via culvert - but 2021 - too low, therefore not hydrologically connected

Site Description pond of upland forest - perennial pond, NID canal to east

NWI Classification PUB Fh

Area of Inundation Description surface of water ~5' lower than high water line on north banks, looks lower (~2 feet) than 2017 photos.

Water Depth Range (Feet) ~4' max - hard to see - lots emergent veg

Soil Map Unit Name / Source (may types in this area) AFB-USDA/NCSS - Aiken loam, 2-9% slopes N low-mid mountane

Area of Soil Saturation Description ~1' up from water line/perimeter

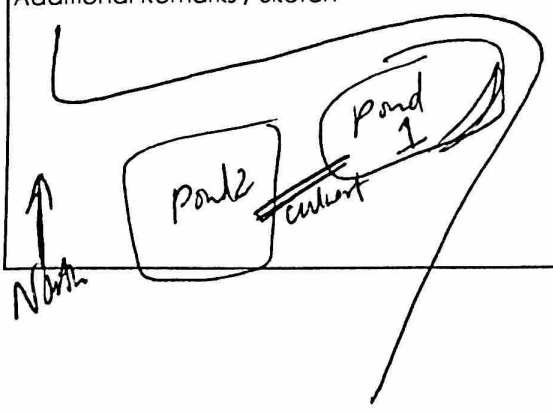
Is site within current and/or historic range of CRLF? (yes) no

Are there any known records of CRLF within 1 mile of site? yes (no)

CRLF Habitat Assessment Remarks lots emergent veg - dominated plantain

Observed Vegetation	Hydrophytic	Status	Observed Wildlife	Status
See Meghan Data Notes			Steller's jay	
			red-breasted nuthatch	
			A. Robin	
			TONS of baby (YOY) treefrog	
			~~Crayfish~~ Mosquito fish?	
			TVS	
			C. Raven	

Additional Remarks / Sketch



Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by _____ _____ _____
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 8/31/21 ~12pm
(mm/dd/yyyy)

Site Assessment Biologists: Eppinger Emily _____
(Last name) (first name) (Last name) (first name)

Oats Meghan _____
(Last name) (first name) (Last name) (first name)

Site Location: Nevada County, Lower Cascade Canal
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).
Lat. 39.235182 Long -120.989522 WGS84

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: Lower Cascade Canal
Brief description of proposed action:
10-year pond study post canal decommissioning/lowering of water levels
evaluate ponds every 4 years

1) Is this site within the current or historic range of the CRF (circle one)? (YES) NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES (NO)
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:
Size: acres Maximum depth: ~4' (visual estimate)

Vegetation: emergent, overhanging, dominant species: plantain (species)
Alisma sp. - Plantain
Cattails on west side pond in riparian
Oenothera (water primrose) below emergent?

Substrate: silt/muddy, unconsolidated

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: _____

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM:

Bank full width: _____
Depth at bank full: _____
Stream gradient: _____

Are there pools (circle one)? YES NO

If yes,

Size of stream pools: _____
Maximum depth of stream pools: _____

Characterize non-pool habitat: run, riffle, glide, other: _____

Vegetation: emergent, overhanging, dominant species: _____

Substrate: _____

Bank description: _____

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: _____

Other aquatic habitat characteristics, species observations, drawings, or comments:

- Many many tree frog YOY along edge & in water
- fish observed - maybe mosquito fish.

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species location

(3)

Pond / Wetland General Assessment Datasheet updated 9/1/2017

Project LCC-pond Study Year 8 -NID Date 8/31/21 Keppinger M. Oats

Client / Owner MD Surveyors

Latitude 39.24093 Longitude -121.020355 Datum ~~WGS84~~ WGS84

Site ID Pond #3

Site Location Off Pitsburg Mine Road (Upper pond) (along DS canal)

Site Description pond ~~confined~~ highest of 3-tiered into slope-receiving water from pipe from DS canal

NWI Classification PUB K

Area of Inundation Description Confined to Ordinary high water mark (OHWM)

Water Depth Range (Feet) ~5' max (estimated from edge pond)

Soil Map Unit Name / Source AFD - USDA/NCSS - Aiken loam 15-30% slopes NWI mid montane shrub

Area of Soil Saturation Description - up to OHWM - pipe/culvert through edge & water flows down into lower tiered pond

Is site within current and/or historic range of CRLF? (yes) no

Are there any known records of CRLF within 1 mile of site? yes (no)

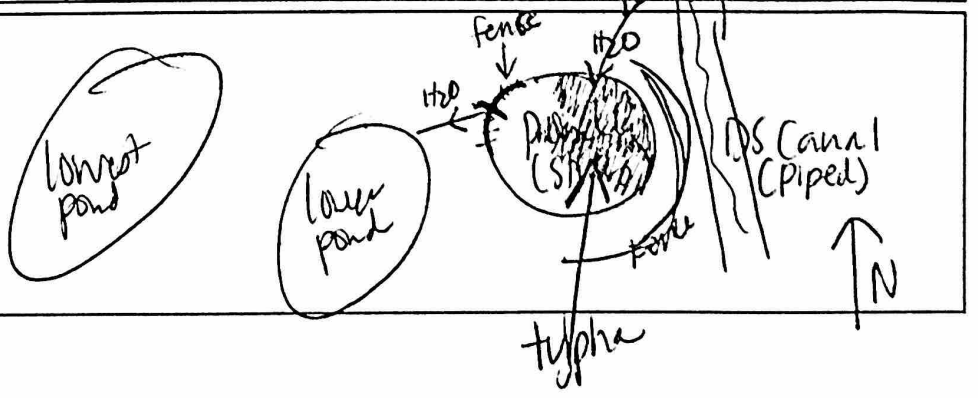
CRLF Habitat Assessment Remarks Bullfrog & fish present, lots typha ~65% pond choked with veg & remains is open

Observed Vegetation (See M. Oats notes)	Hydrophytic	Status

Observed Wildlife	Status
California towhee	
CA goose-nearby	
Gray squirrel	
Hummingbird sp.	
Bullfrog adult/juv.	
Fish sp.	
red-breasted nuthatch	
Black phoebe	

Additional Remarks / Sketch

- Wildlife nearby & close to/next to lower ponds



(3)

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by _____ _____ _____
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 8/31/2021
(mm/dd/yyyy)

Site Assessment Biologists: Ettinger Emily
(Last name) (first name)
Dats Meghan
(Last name) (first name)
(Last name) (first name)
(Last name) (first name)

Site Location: Nevada County, DS Canal - 39.24093, -121.020355
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: Lower Cascade Pond Study - year 8
Brief description of proposed action:
Y 8- pond study - control pond #3
Monitor post decommissioning LCC - 10 year study - check out ponds every 4 year to evaluate the effects, if any, of the decommissioned canal.

1) Is this site within the current or historic range of the CRF (circle one)? (YES) NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES (NO)
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:
Size: ~ acre Maximum depth: ~5' max

Vegetation: emergent, ~~overhanging~~, dominant species: typha, ~~rushes~~ juncus on edges

Substrate: silty, sandy, mucky - in bare areas, otherwise choked w/ typha

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: _____

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM:

Bank full width: _____

Depth at bank full: _____

Stream gradient: _____

Are there pools (circle one)? YES NO

If yes,

Size of stream pools: _____

Maximum depth of stream pools: _____

Characterize non-pool habitat: run, riffle, glide, other: _____

_____

_____

Vegetation: emergent, overhanging, dominant species: _____

_____

_____

Substrate: _____

_____

Bank description: _____

_____

_____

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: _____

Other aquatic habitat characteristics, species observations, drawings, or comments:

Bullfrog - adult or juv.
Fish sp. present as well

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species location

Appendix F OBSERVED SPECIES

Vegetation and wildlife species observed during Year 8 monitoring (2021) for the Tree Health Assessments in September 2021, Nevada County, California. Species observed, or not observed, in previous monitoring years (i.e., 2013, 2015, 2017, and 2019) are also noted.

Common name	Scientific Name	Lifeform	Nativity	Observation Location								
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Pond 1	Pond 2	Pond 3
Plants												
annual dogtail species	*Cynosurus echinatus*	Annual grass	Non-native invasive								X	
apple species*	*Malus* sp.	Tree	Non-native									X
bigleaf maple	*Acer macrophyllum*	Tree	Native	X	X	X	X	X	X			
black oak	*Quercus kelloggii*	Tree	Native	X	X	X	X	X	X	X	X	X
Bamboo species*	*Phyllostachys* sp.	Vine/Shrub	Non-native							X		
California man-root	*Marah watsonii*	Perennial herb/Vine	Native								X	
canyon live oak	*Quercus chrysolepis*	Tree	Native	X	X				X			
common cattail	*Typha latifolia*	Perennial herb	Native						X	X		X
common ladyfern	*Athyrium filix-femina*	Fern	Native	X	X	X	X	X	X			
common wooly mullein	*Verbascum Thapsus*	Perennial herb	Non-native Invasive								X	
coyote brush	*Baccharis pilularis*	Shrub	Native	X					X			
cutleaf blackberry	*Rubus laciantus*	Shrub	Non-native	X	X	X	X	X	X	X	X	
dandelion species**	*Agoseris* sp.	Perennial herb	Native									
dock species	*Rumex* spp.	Perennial herb	Non-native				X					X

Appendix F Observed Specles

Common name	Scientific Name	Lifeform	Nativity	Observation Location								
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Pond 1	Pond 2	Pond 3
Douglas-fir	*Pseudotsuga menziesii*	Tree	Native	X	X	X	X	X	X			
duckweed species*	*Lemna* sp.	Perennial herb	Native								X	
English ivy *	*Hedera helix*	Vine	Non-native invasive	X	X	X	X					
Fremont's cottonwood*	*Populus fremontii*	Tree	Native								X	
gray alder	*Alnus incana*	Tree	Native	X	X	X	X	X	X	X		
Hazelnut	*Corylus cornuta*	Tree	Native	X								
hedge nettle species	*Stachys* sp.	Perennial herb	Native	X								
henbit dead-nettle	*Lamium* amplexicaule	Annual herb	Non-native								X	
Himalayan blackberry	*Rubus armeniacus*	Shrub	Non-native invasive	X	X	X	X	X	X	X	X	X
incense cedar	*Calocedrus decurrens*	Tree	Native	X			X	X	X	X	X	X
interior live oak*	*Quercus wislizeni*	Tree	Native	X			X					
mountain grape	*Berberis aquifolium*	Shrub	Native	X	X							
mountain maple	*Acer glabrum*	Tree	Native								X	
mustard species*	*Brassica* sp.	Annual herb	Non-native invasive									X
narrowleaf cattail*	*Typha angustifolia*	Perennial herb	Non-native								X	
narrowleaf plantain*	*Plantago lanceolata*	Perennial herb	Non-native invasive									X
Oregon ash	*Fraxinus latifolia*	Tree	Native				X					
Pacific dogwood	*Cornus nutallii*	Tree	Native	X	X	X		X	X		X	
Pacific madrone	*Arbutus menziesii*	Tree	Native	X	X	X	X	X	X	X	X	
pink honeysuckle	*Lonicera hispidula*	Vine	Native	X	X	X	X		X	X	X	

Appendix F Observed Species

Common name	Scientific Name	Lifeform	Nativity	Observation Location								
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Pond 1	Pond 2	Pond 3
pea species*	*Lathyrus* sp.	Perennial herb	—							X		
periwinkle species*	*Vinca* sp.	Perennial herb	Non-native invasive								X	
poison hemlock	*Conium maculatum*	Perennial herb	Non-native invasive		X	X	X					
poison oak*	*Toxicodendron diversilobum*	Vine/Shrub	Native	X	X	X	X	X	X			
Ponderosa pine	*Pinus ponderosa*	Tree	Native	X	X	X	X	X	X		X	X
Queen Anne's lace, wild carrot*	*Daucus carota*	Perennial herb	Non-native									X
quillwort species	*Isoetes* sp.	Fern	Native	X	X		X		X			
rush species	*Juncus* spp.	Perennial grass	Native								X	X
Scotch broom*	*Cytisus scoparius*	Shrub	Non-native invasive							X		X
sedge species*	*Carex* sp.	Perennial herb	Non-native								X	
Solomon's seal species *	*Maianthemum* sp.	Perennial herb	Native							X		
sorrel species	*Oxalis* sp.	Perennial herb	Non-native	X								
sugar pine*	*Pinus lambertiana*	Tree	Native	X	X	X	X	X	X			
sweet cicely species*	*Osmorhiza* sp.	Perennial herb	Native									X
sword fern*	*Polystichum munitum*	Fern	Native							X	X	
tanoak	*Notholithocarpus densiflorus*	Tree	Native	X			X					
thimbleberry*	*Rubus parviflorus*	Vine/Shrub	Native							X		
trail plant*	*Adenocaulon bicolor*	Perennial herb	Native	X	X		X	X				

Appendix F Observed Specles

Common name	Scientific Name	Lifeform	Nativity	Observation Location								
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Pond 1	Pond 2	Pond 3
tree of heaven*	*Ailanthus altissima*	Tree	Non-native invasive						X			
water parsnip**	*Berula erecta*	Perennial herb	Native									
western goldenrod*	*Euthamia occidentalis*	Perennial herb	Native	X					X			
western raspberry*	*Rubus leucodermis*	Shrub	Native	X		X	X					
white alder	*Alnus rhombifolia*	Tree	Native	X		X		X	X			
Wildlife												
American bullfrog*	*Lithobates catesbeianus*	Frog	Non-native invasive							X	X	X
Anna's hummingbird*	*Calypte anna*	Bird	Native									X
black phoebe*	*Sayornis nigricans*	Bird	Native								X	
brown creeper*	*Certhia americana*	Bird	Native								X	
brown trout species*	*Salmo trutta sp.*	Fish	Non-native								X	
California scrub jay	*Aphelocoma californica*	Bird	Native	X			X		X			
California sister*	*Adelpha californica*	Insect	Native									
damselfly species*	Zygoptera sp.	Insect	—							X		
deer species	*Odocoileus* sp.	Mammal	Native								X	
dragonfly species*	Anisoptera sp.	Insect	—							X		
flame skimmer*	*Libellula saturata*	Insect	Native									X
hummingbird species*	*Calypte*, *Selasphorus* sp.	Bird	Native									
lesser goldfinch*	*Spinus psaltria*	Bird	Native								X	
mosquitofish*	*Gambusia affinis*	Fish	Native							X		

0

Common name	Scientific Name	Lifeform	Nativity	Observation Location								
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Pond 1	Pond 2	Pond 3
mountain chickadee	*Poecile gambeli*	Bird	Native						X			
northern flicker	*Colaptes auratus*	Bird	Native	X	X	X						
orange-crowned warbler*	*Oreothlypis celata*	Bird	Native							X		
owl species*	Strigidae sp.	Bird	Native								X	
Pacific tree frog	*Pseudacris regilla*	Frog	Native								X	
red-breasted nuthatch*	*Sitta canadensis*	Bird	Native							X	X	
red-eared slider*	*Trachemys scripta elegans*	Turtle	Non-native invasive								X	
red-tailed hawk*	*Buteo jamaicensis*	Bird	Native									X
spotted towhee*	*Pipilo maculatus*	Bird	Native							X		
Steller's jay	*Cyanocitta stelleri*	Bird	Native		X					X		
western gray squirrel*	*Sciurus griseus*	Mammal	Native									X

Note: The Canopy Cover Assessment is not included in this observed species tables, as data metrics are consistent with only densiometer data collection.
Tree Health Assessment Sites = Lower Cascade Canal (LCC) Sites 1, 2, 3, 4; Upper Grass Valley Canal (UGVC) Site 5; DS Canal (reference site) Site 6
Pond Study = LCC Ponds 1, 2; DS Canal (reference site) Pond 3
* = Notes species observed during Year 4 (2017) field surveys, however not previously observed in monitoring Year 1 (2013) and/or monitoring Year 2 (2015)
** = Notes species observed in monitoring Year 1 (2013) and/or monitoring Year 2 (2015), however not observed during Year 4 (2017) monitoring

Stantec

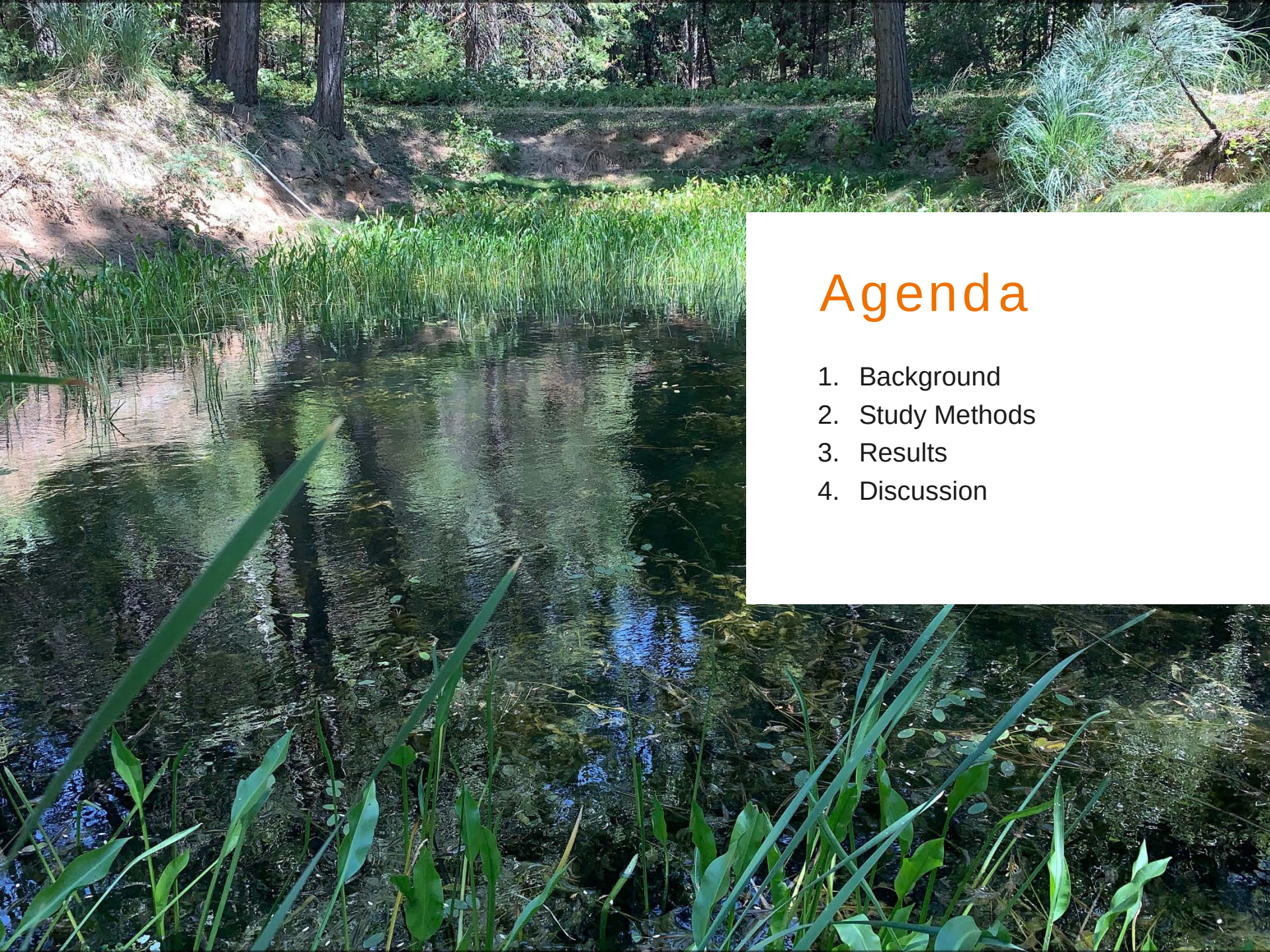
Nevada Irrigation District

Banner Cascade Pipeline Project

Long Term Canopy Cover Study:

Lower Cascade and Upper Grass Valley Canals

Meghan Oats, Botanist / Project Manager
Bernadette Bezy, Biologist / Principal



Agenda

1. Background
2. Study Methods
3. Results
4. Discussion

1 Background and Introduction

Banner Cascade Pipeline Project

- NID constructed the Banner Cascade Pipeline to be the primary means for water delivery to areas of Grass Valley and Nevada City, California.
- Lower Cascade Canal (LCC) and the Upper Grass Valley Canal (UGVC) remain in use with reduced flows.

California Environmental Quality Act Compliance

Final Environmental Impact Report [FEIR] (ICF 2007)

- **Potential Impact 3.8.1**: Flow reduction in the LCC could result in impacts to vegetation.
- **Mitigation Measure 3.8-1:** NID committed to “Prepare and Implement a Long-Term Monitoring Program”
  - **Purpose**: Monitor for evidence of dewatering impacts to vegetation surrounding the canals (ICF 2007).
  - **Duration**: The monitoring commitment is to study the potential impacts over a 10-year period (2013-2023).

Project Studies

1) Long-Term Canopy Cover Study (FEIR MM 3.8-1):
   a) Tree Health Assessment
   b) Canopy Cover Study – via Densiometer Analysis (Canopy Cover Study)

Canopy Cover Study	Study Year					
	2013 Year 0	2015 Year 2	2017 Year 4	2019 Year 6	2021 Year 8	2023 Year 10
Tree Health Assessment	x	x	x	x	x	x
Canopy Cover Assessment	x		x		x	x

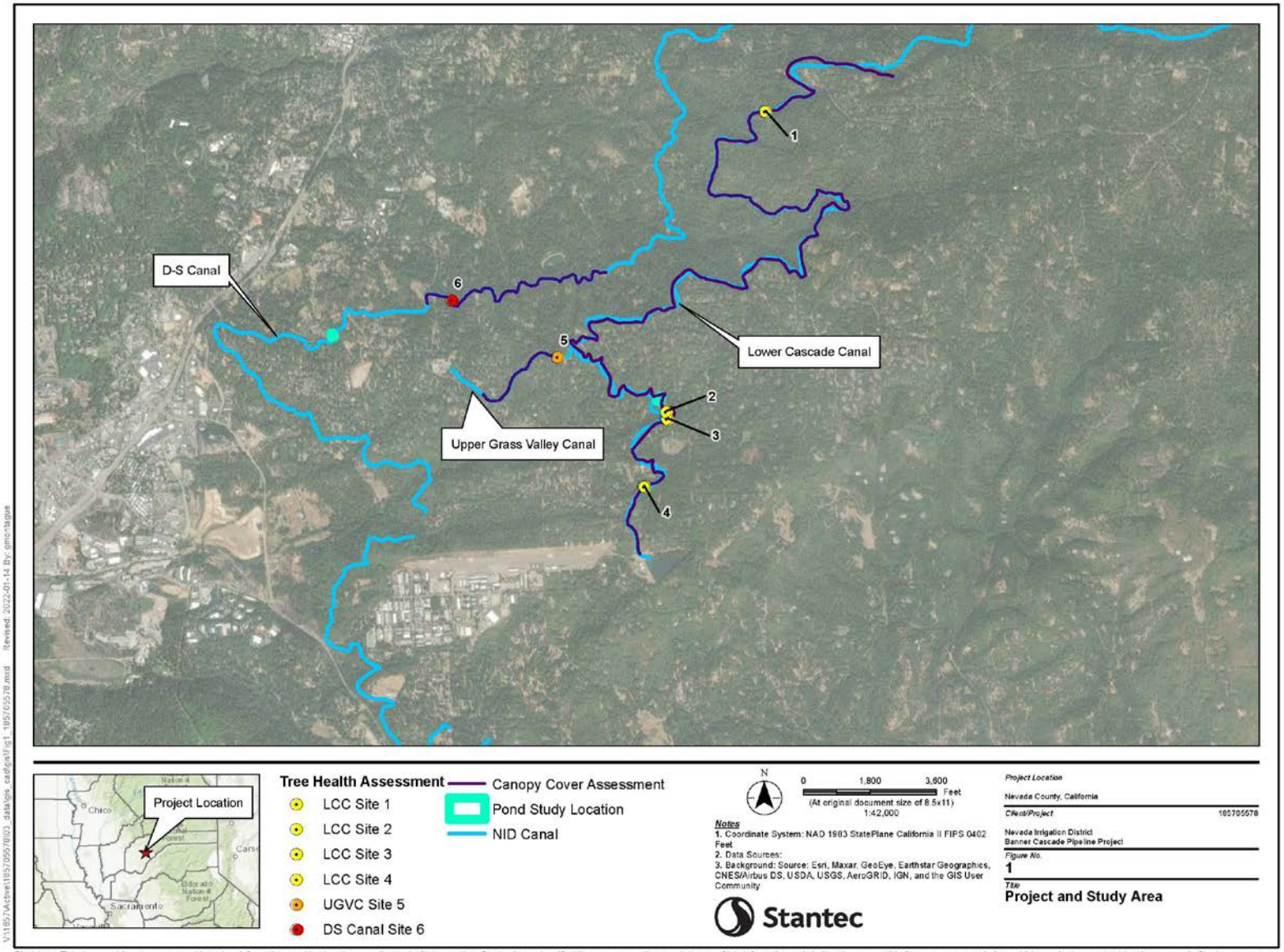
2) Seep Wetland, Pond, & Associated Potential Endangered Species Act Species Habitat Study (Pond Study) (FEIR MM 3.8-2)

Pond Study	Study Year					
	2013 Year 0	2015 Year 2	2017 Year 4	2019 Year 6	2021 Year 8	2023 Year 10
	x		x		x	x

2 Study Methods

- Assess impacts from flow reductions through spatial & temporal comparisons.
- Applied a mixed-method qualitative & quantitative approach for documenting conditions and changes over time.

Study Site Overview



Tree Health Assessment

A total of 6 sites continue to be studied:

- 4 sites on the LCC
- 1 site on the UGVC
- 1 site on the DS Canal (Reference Site)

Up to 20 trees were studied at each site.

The following data was assessed:

- Growth monitoring
- Foliage cover and coloration
- Bark health
- New growth
- Evidence of disease, parasites, insect damage

Canopy Cover Study

Sites are along the same canal reaches as the Tree Health Assessment sites; however, sites extend along the entire length of each established reach.

Reach data was collected along approximately:

- **7 miles** of the LCC (273 readings)
- **0.5 mile** of the UGVC (27 readings)
- **1 mile** of the DS Canal [Reference Site] (85 readings)

A total of 385 densiometer readings were taken.

Pond Study

Two sites along the LCC & 1 along the DS Canal (Reference Site)

Wildlife & habitat suitability assessments

Following data recorded:

- Delineation of inundated area / soil saturation
- Hydrology pattern
- Range of water depths
- Soil type
- Vegetation present
- Wildlife species observed
- California red-legged frog habitat assessment
- Site photographs

3 Results

- All three study components were required in 2021.
- Tree health data from the LCC, UGVC, and DS Canal (Reference Site) has been compared for the following years:
  - 2013
  - 2015
  - 2017
  - 2019
  - 2021
- Canopy Cover and Pond Study has been compared for the following years:
  - 2013
  - 2017
  - 2021

Results

Tree Health Assessment

Site 1 LCC					
Monitoring Year	2013	2015	2017	2019	2021
Survey Date	9/12	10/7	9/12	9/20	9/14
Trees Surveyed[1]	23	23	21	21	19
Tree Death[2]	0	1	1	0	3
Canopy Cover[3]	2	3	3	3	3
Bark Health	3	3	3	3	3
Overall Tree Health	10	10	8	9	11

Site 2 LCC					
Monitoring Year	2013	2015	2017	2019	2021
Survey Date	9/11	10/6	9/8	10/17	9/15
Trees Surveyed[1]	20	21	20	12	13
Tree Death[2]	0	1	0	0	0
Canopy Cover[3]	3	3	3	3	3
Bark Health	3	3	3	2	3
Overall Tree Health	10	10	9	8	10

Site 3 LCC					
Monitoring Year	2013	2015	2017	2019	2021
Survey Date	9/11	10/8	9/8	10/17	9/15
Trees Surveyed[1]	21	19	20	20	20
Tree Death[2]	0	0	0	0	0
Canopy Cover[3]	2	3	3	3	3
Bark Health	2	3	3	3	3
Overall Tree Health	9	9	9	8	10

Site 4 LCC					
Monitoring Year	2013	2015	2017	2019	2021
Survey Date	9/11	10/6	9/12	9/20	9/14
Trees Surveyed[1]	18	21	19	18	19
Tree Death[2]	0	0	0	1	0
Canopy Cover[3]	3	3	3	3	3
Bark Health	3	3	3	3	3
Overall Tree Health	12	11	9	9	10

Site 5 UGVC					
Monitoring Year	2013	2015	2017	2019	2021
Survey Date	9/10	10/7	9/7	10/17	9/15
Trees Surveyed[1]	8	7	6	6	4
Tree Death[2]	0	1	0	0	2
Canopy Cover[3]	2	3	4	3	3
Bark Health	2	3	4	3	4
Overall Tree Health	9	8	11	10	10

Site 6 DS Canal					
Monitoring Year	2013	2015	2017	2019	2021
Survey Date	9/10	10/7	9/15	10/18	9/16
Trees Surveyed[1]	22	20	14	13	13
Tree Death[2]	0	3	2	1	0
Canopy Cover[3]	2	3	4	3	3
Bark Health	2	3	3	3	3
Overall Tree Health	10	10	8	10	10

Notes

- Individual tree foliage cover values, not total canopy cover was assessed in the canopy cover study.
- Canopy Cover and Bark Health: Based on a scale of 1-4.
- Overall Tree Health: Based on a scale of 1-14.

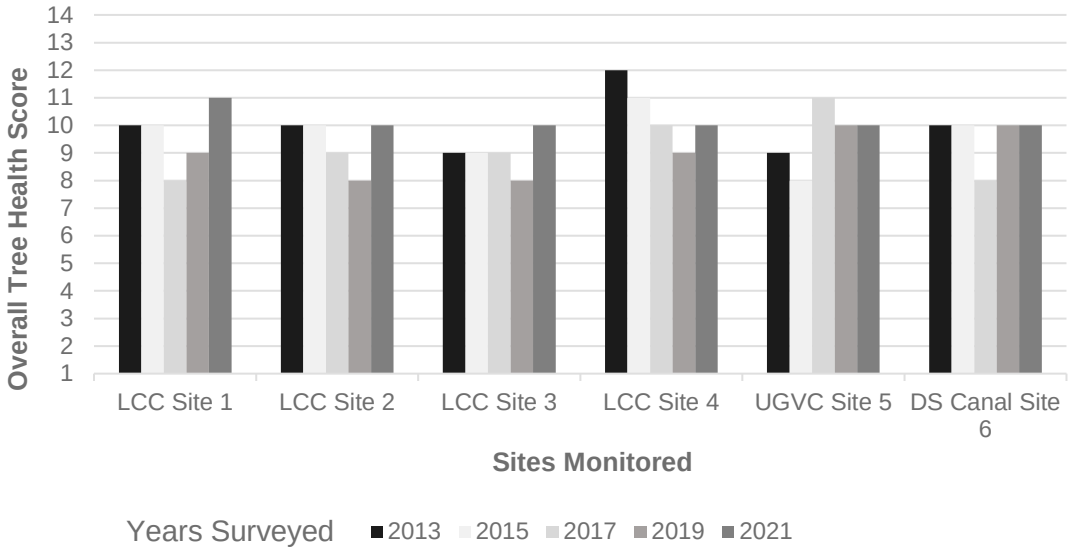
Overall Tree Health scores

- 1 - 4: poor health
- 5 - 7: fair health
- 8 - 11: good health
- 12 - 14: excellent health

Results

Tree Health Assessment

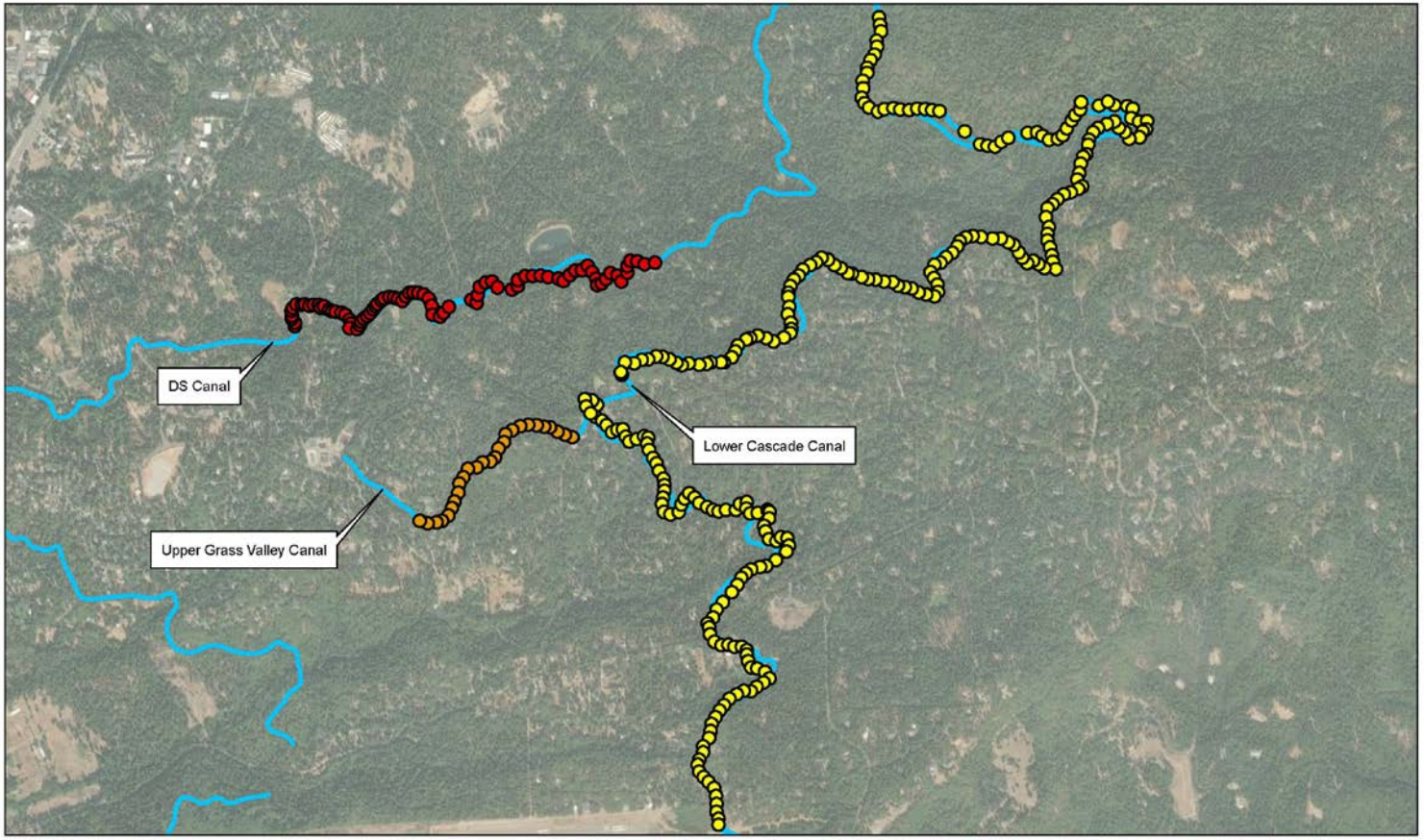
- Tree health score remains above 10 at all sites = “good health”
- Temporal year over year variation noted. In 2021, tree health improved (had a higher score) at four LCC sites, while sites along the UGVC and DS Canal (reference site) remained consistent with previous years’ results.
  Contributing Factors
    - Increases noted in new growth
    - Overall decrease of insect infestation
    - Disease and parasites limited



Overall Tree Health scores

- 1-4: poor health
- 5-7: fair health
- 8-11: good health
- 12-14: excellent health

Canopy Cover Study



NID Canal

Canopy Cover Assessment

- DS
- LCC
- UGVC

N

0 1,000 2,000 Feet

(At original document size of 8.5x11)

1:24,000

Notes

1. Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet
2. Data Sources:
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Stantec

Project Location

Nevada County, California

Client/Project 185705578

Nevada Irrigation District
Banner Cascade Pipeline Project

Figure No.

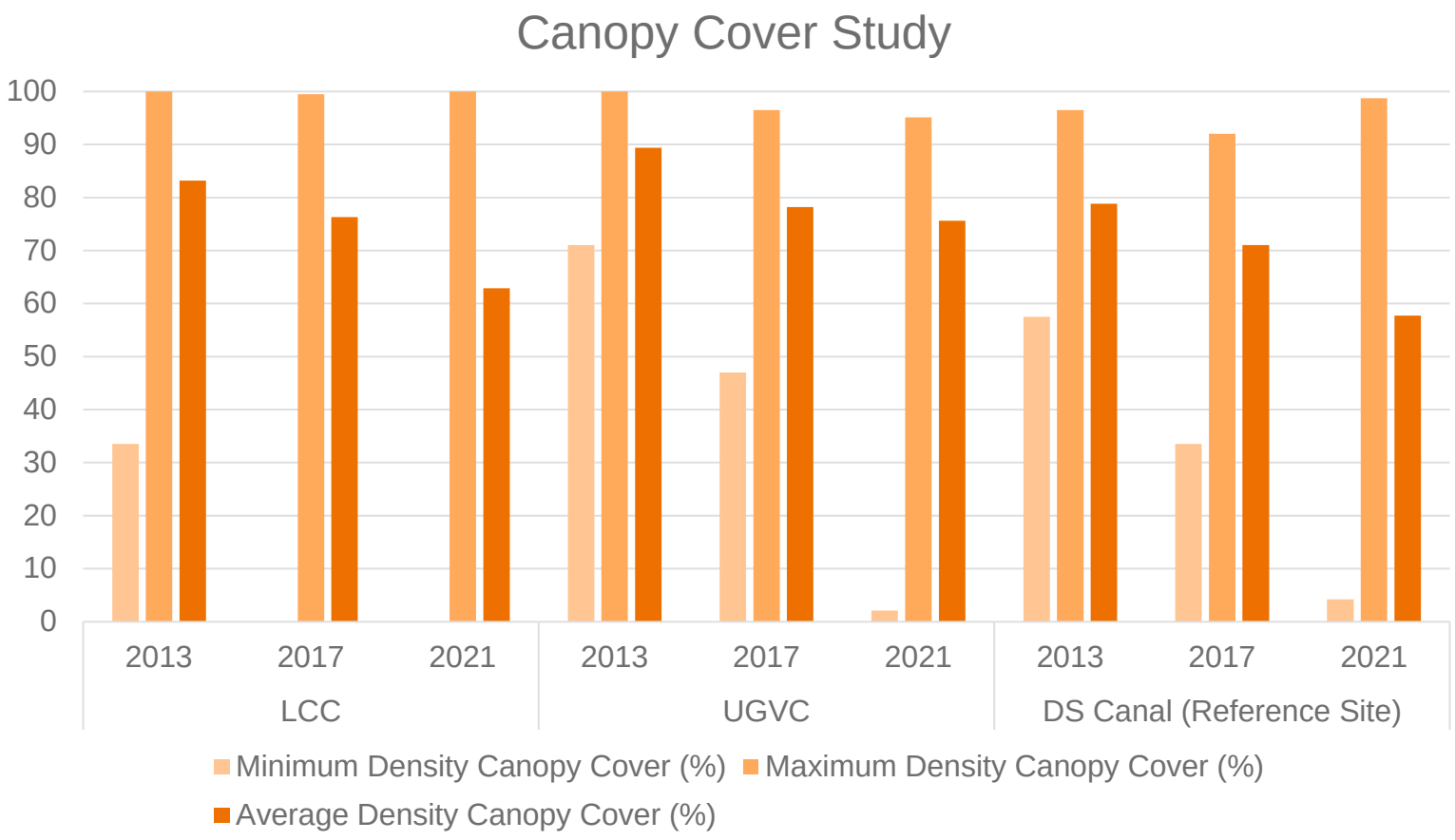
3

Title

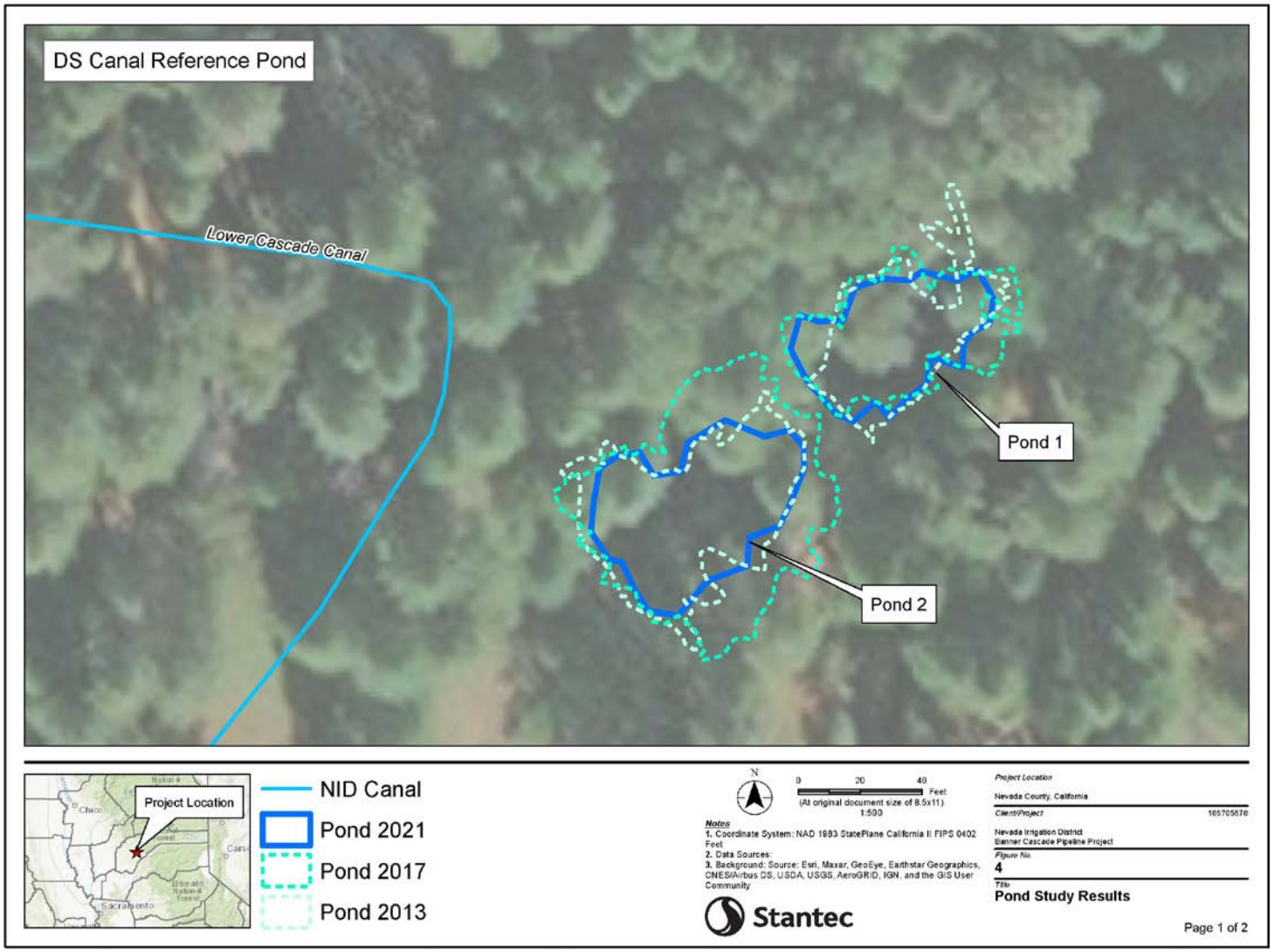
Canopy Cover Survey Points

Results

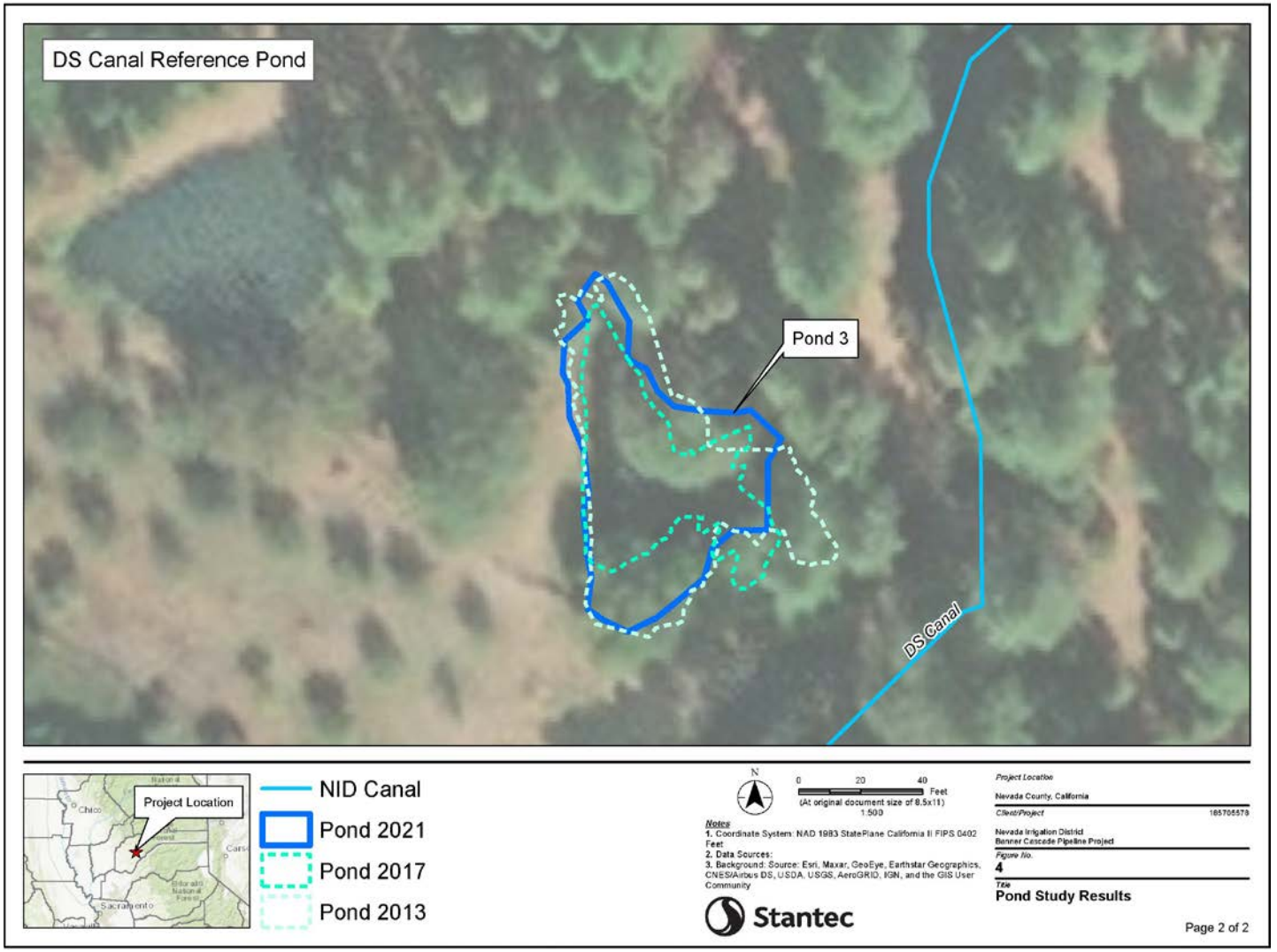
Canopy Cover Study



Pond Study – LCC Sites



Pond Study – DS Canal Site



4 Discussion

- Some annual weather variability may influence results.
- To date, tree health remains relatively constant on both spatial and temporal scales.
- Sites have similar tree health trends to those of baseline conditions and remain in “good” health.
- Pond study results indicate little to no variability in ponded habitat
- Continued monitoring (final year)
  - 2023 – Tree Health Assessment, Canopy Cover Assessment, and Pond Study

Questions?

Contact Info:

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- Bernadette Bezy, bernadette.bezy@stantec.com; (530) 575-6508