Lower Cascade Canal and Upper Grass Valley Canal Long Term Canopy Cover Study, Tree Health Assessment Report - Monitoring Year 2

Banner Cascade Pipeline Project

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Sign-off Sheet

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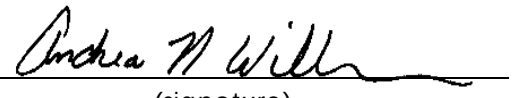
Reviewed by 
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1.0 INTRODUCTION

This Lower Cascade Canal (LCC) and the Upper Grass Valley Canal (UGVC) Long Term Canopy Cover Study, Monitoring Year 2-Tree Assessment Report (Report) provides data for monitoring Year 2 for the Nevada Irrigation District (NID) LCC and the UGVC Ten Year Canopy Cover Study Monitoring Plan (Monitoring Plan); developed to facilitate environmental compliance with the Banner Cascade Pipeline Project (Project) California Environmental Quality Act (CEQA) Mitigation Monitoring and Reporting Program (MMRP) Measure 3.8-1: Monitor for Evidence of Dewatering Impacts to Riparian Habitats. Specifically, this Report fulfills the requirements for the Tree Health Assessment (Assessment) component of the Monitoring Plan[1]. This Report also provides future implementation and adaptive management monitoring strategies.

1.1 PROJECT DESCRIPTION

NID constructed the Banner Cascade Pipeline to ensure reliable water deliveries to the areas of Grass Valley and Nevada City, Nevada County, California (Figure 1.1 Study Location Overview). These pipelines also serve as the primary means of conveying raw water to Grass Valley and Nevada City and the Loma Rica and Elizabeth George Wastewater Treatment Plants (WTP). The Banner Cascade Pipeline replaced both the LCC and the UGVC, which had reached capacity and no longer met the needs of the area. NID will keep both the LCC and UGVC canals in service, as a historical, cultural, scenic, and recreational amenity. However flows will be reduced. The DS Canal, another NID canal, will not experience flow reductions, and thus, will act a control to base LCC and UGVC study results.

1.2 PROJECT SETTING

The LCC and the UGVC are located on Banner Mountain in Nevada County, California. The LCC begins near Pasquale Road and meanders south crossing Banner Lava Cap Road and Idaho Maryland Road, and ends at the Loma Rica WTP in Grass Valley. The UGVC branches westward to the Elizabeth George WTP at the junction of Banner Lava Cap Road and Gracie Road in Nevada City. The elevation of this area ranges from approximately 3,150 to 3,325 feet (960 to1, 010 meters) Above Mean Sea Level (AMSL). The LCC is approximately 7.4 miles long and 100 years of age. The UGVC, a branch from the LCC, is approximately 0.5 mile in length. The water in the LCC is diverted from Deer Creek above Scotts Flat Reservoir (Figure 1.1).

The vegetation communities surrounding the canals are typical of those found in the western foothills of the northern Sierra Nevada range. There are many areas immediately adjacent to the LCC and the UGVC that are also urban (NID 2012). The overarching vegetation community present at the LCC, the UGVC, and the DS Canal can be classified as Sierran Mixed Conifer-

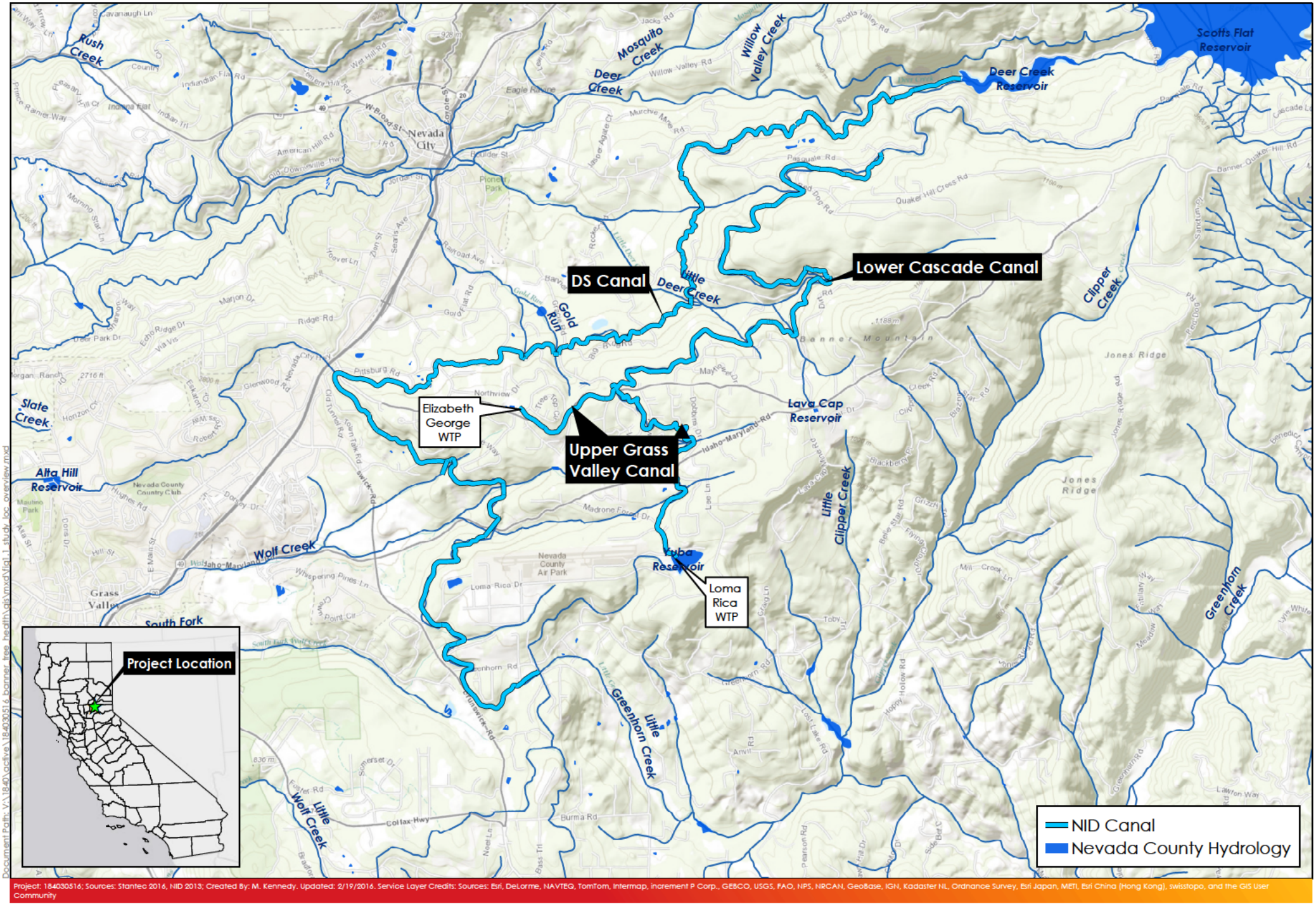
[1] Note that the Canopy Cover Study- Canopy Cover Assessment and the Pond Study data collection are not triggered again until Year 4 of the Ten Year Monitoring Plan(s).

Hardwood Forest. This forest type is comprised of both upland and riparian species. At the LCC, the UGVC, and the DS Canal study site locations, observed upland over-story species include black oak (*Quercus kelloggii*), canyon live oak (*Quercus chrysolepis*), Douglas-fir (*Pseudotsuga menziesii*), hazelnut (*Corylus cornuta*), incense cedar (*Calocedrus decurrens*), Pacific madrone (*Arbutus menziesii*), Ponderosa pine (*Pinus ponderosa*), and tanoak (*Notholithocarpus densiflorus*). Upland shrub species include coyote brush (*Baccharis pilularis*), and Himalayan blackberry (*Rubus armeniacus*). Intermixed within this Sierran Mixed Conifer-Hardwood Forest are also riparian species including bigleaf maple (*Acer macrophylum*), Pacific dogwood (*Cornus nuttallii*), mountain maple (*Acer glabrum*), Oregon ash (*Fraxinus latifolia*), gray alder (*Alnus incana*) and white alder (*Alnus rhombifolia*). Riparian shrub and herbaceous species include common cattail (*Typha latifolia*), dock species (*Rumex* spp.), Harding grass (*Phalaris aquatica*), plantain species (*Plantago* spp.) and various rushes (*Juncus* spp.). At lower elevations along the LCC, closer to the Loma Rica WTP, oak species are more common and thus fewer coniferous trees are present. In areas where urban encroachment has not occurred, vegetation communities are intact and provide suitable habitat for vegetative and wildlife species alike.

1.3 PROJECT PURPOSE

Reducing the flows and water levels in these two canals will reduce the wetted perimeter in each canal and the head on the remaining wetted perimeter. This change in hydraulic conditions will reduce the amount of leakage from the canals, which has the potential to impact the environment created by canal leakage over the years (NID 2006).

Potential impacts were identified in the Project's Draft Environmental Impact Report (EIR) that could result from the canal flow reductions (NID 2004). These include the potential reduction in canopy cover due to reduced flows and seepage that supports the growth of riparian, or wet-adapted (i.e., emergent, hydrophytic, mesic) riparian-type species. The impact analysis in the EIR found that the possible stress from the flow reduction could also lead to increased susceptibility to disease, parasitism, and possibly death of plants, including special status plant species. This, in turn, could result in loss of trees and associated shade canopy, reductions in seepage flows to ponds, and the reduction of habitat for common and special status wildlife species (e.g., California red-legged frog [*Rana draytonii*]) (NID 2004). As such, the EIR deemed it necessary to study the potential for reduced flow to affect canal area vegetation (NID 2004).



Project: 184030516; Sources: Stantec 2016, NID 2013; Created By: M. Kennedy. Updated: 2/19/2016. Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

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1 inch = 4,219 feet

Nevada

Figure 1.1
Study Location Overview
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project

2.0 METHODS

Methods for the Tree Health Assessment component of the Canopy Cover Study were developed as part of the MMRP Wetland Impact Assessment Workplan (Workplan) (NID 2012). The methods address flow reductions through spatial and temporal comparisons. A mixed-method qualitative and quantitative approach for documenting changes along the LCC and the UGVC as flows are reduced has been implemented for the Assessment and is further defined in the Methods section below. The Assessment is comprised of the following parameters:

- Evaluating progressive changes in downstream flora patterns over time along the impacted canal areas and comparable control sites;
- Data collection will occur within each of the appropriate study years in the late summer, typically August through September, when the trees are most water stressed, but prior to leaf shedding (i.e., abscission); and
- Surveys will be completed by a qualified botanist or biologist (NID 2012).

2.1 SITE SELECTION

A total of six representative Assessment study sites were selected (Figure 2.1 Study Areas) for parameters defined in the Workplan. The Assessment study site selections occurred in May 2013 (i.e., baseline Year 0). The six Assessment sites are comprised of- 1) four study sites along the LCC, 2) one study site along the UGVC[2], and 3) one Control Site along the DS Canal[3].

Representative sites were specifically selected based on vegetation type, areas suspected of maximum leakage (i.e., unlined stretches of the canal), and other associated flora that has the greatest potential to be adversely impacted by reductions in canal leakage. Each study site is approximately 20 meters in length, centered within riparian vegetation, and includes individual trees on both the downslope and upslope of the canal. Each study site is, at least, one meter from the downslope toe of the canal and one meter from the upslope side of the canal. Also, note that site-specific dimensions were initially adjusted based on biological assessments of apparent canal seepage-dependent areas.

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

[3] Due to the varying conditions and lack of historical data along both the LCC and UGVC prior to the Banner Cascade Pipeline, and the pipelines reduction in flows, certain spatial and temporal comparisons were not appropriate nor could be used in assessing the impacts of flow reductions along the canals. At the time of the study in 2013, both the LCC and UGVC were experiencing reduced flows, and therefore an upstream location on each of the canals under study could not be used as a control site, where the downstream would then be considered the area of impact. Thus, one control study site was established along the DS canal.

2.2 DATA COLLECTION

Assessment data for Monitoring Year 2 was collected on October 6, 7, and 8, 2015 by Stantec biologists at the six study site locations (Figure 2.1)[4]. At each of the six study sites, approximately 25 previously tagged trees were evaluated for tree health. Trees were located on both the downslope (approximately 75 percent of the site trees) and the upslope (approximately 25 percent of the site trees). Assessment data was collected, recorded, and assessed by considering the following factors (Zobrist 2011):

- Presence of foliage decline or evidence of crown fading;
- Color of foliage;
- Evidence of disease, parasite, or insect damage; and
- Diameter at Breast Height (DBH).

To capture the data above, visual inspections of tagged trees at the six study sites were made using the criteria listed below (Table 2.0) to determine overall tree health. Data was documented with a Trimble Series 6000 GeoXH Global Positioning System (GPS).

Table 2.0 Tree Health Assessment Data Collection 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 on 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

[4] Tree Health Assessment baseline data (Monitoring Year 0) was collected by Stantec biologists at the six study sites on September 10 and 11, 2013.

Methods
March 3, 2016

Assessment Type	Assessment Description	Assessment Score
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 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, 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**
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

In addition to the data collection during baseline studies in 2013 (Monitoring Year 0), and 2015 (Monitoring Year 2), Tree Health Assessment data is required to continue to be collected for a total of ten years, at two-year intervals. Therefore, four remaining surveys will be conducted in years 2017, 2019, 2021, and 2023. Data collection will occur during each study year in the late summer or early fall (August through September) when the trees are most water stressed. Surveys will be completed by a qualified biologist or botanist (NID 2012).

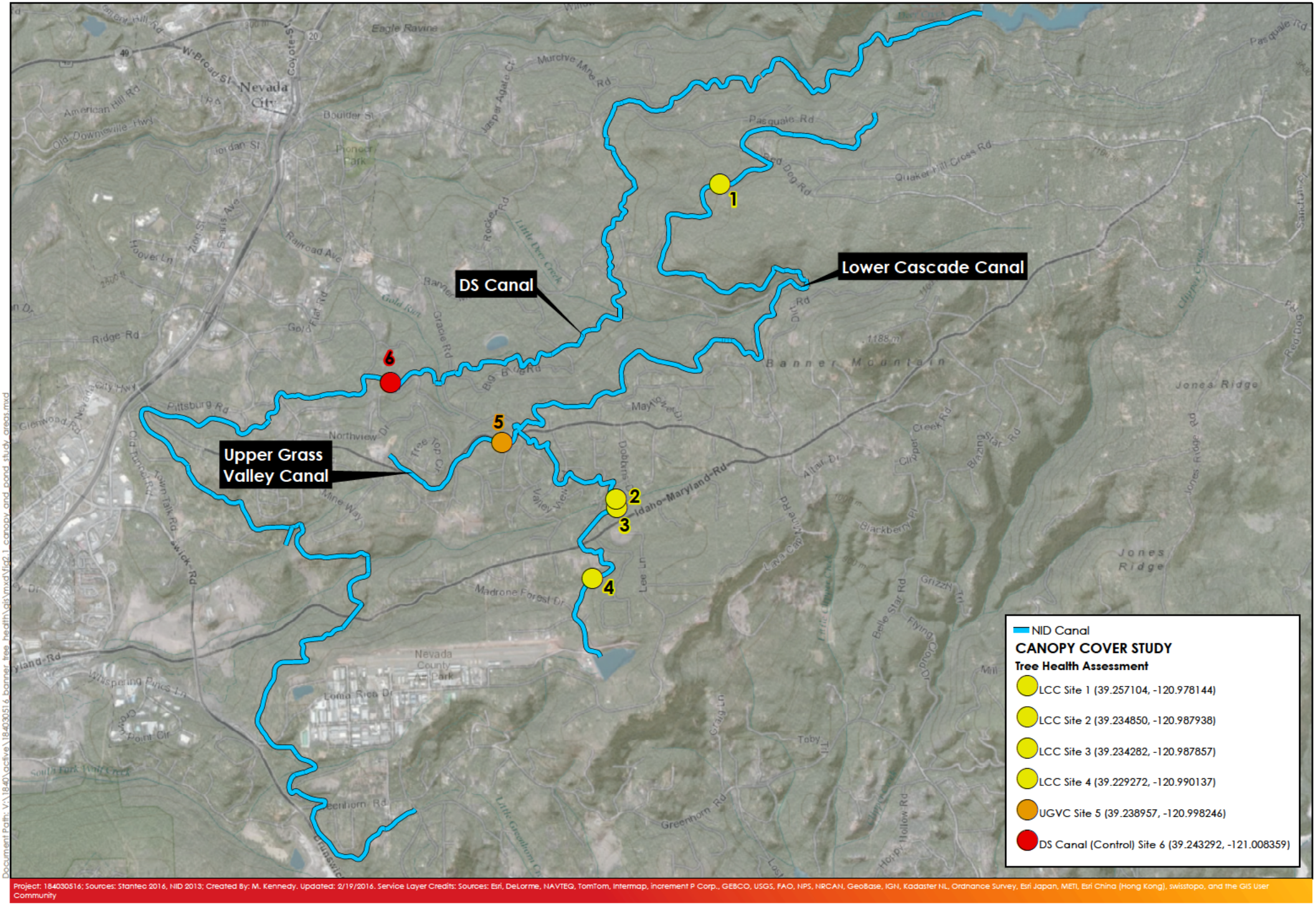

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Figure 2.1
Study Areas
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project

3.0 RESULTS

Assessment data was collected on October 6, 7, and 8, 2015 by Stantec biologists. Data for each site was post-processed using Geographic Information Systems (GIS) ESRI ArcView 10.1 technologies. Geographical data and associated attribute information was compiled into a central database using Microsoft Excel. The following section outlines specific findings for each Assessment study site along the LCC, the UGVC, and the DS Canal (Control Site).

3.1 SITE 1 LOWER CASCADE CANAL

Twenty-three riparian tree species were surveyed at Site 1 on the LCC (Appendix A. Photo Record, Photos 1-4). Tree species surveyed include bigleaf maple, Pacific dogwood, and white alder. Of the surveyed trees, Pacific dogwood is the dominant riparian tree species. Other upland species are present at Site 1 including Douglas-fir, hazelnut, incense cedar, and Pacific madrone; however they were not surveyed due to their upland status. The DBH for the surveyed trees ranged from 1.1 to 9.3 inches, including trees with multiple stems. The overall health of trees at Site 1 is fair (score of 3), with foliage discoloration (13.0 percent of trees), insect damage to the leaves and tree bark, and potential disease presence. Surface growth is present on the trunks and/or foliage of 19 of the 23 trees surveyed (82.6 percent). Bark health for the trees surveyed is fair (score of 3), with 50 to 75 percent bark absence, some bark/root rot, and other irregularities. No disease was noted on any of the trees surveyed at Site 1. Insect infestation and/or damage were noted on 18 of the 23 trees surveyed at Site 1 (78.3 percent). Insect damage includes burrowing, frass, epicormic sprouting, and insect presence. No parasitic presence was observed on the trees surveyed at Site 1.

Other observed general site conditions include on both the up and downslope (southeast and northwest) side of Site 1 many saplings (i.e., new growth) of gray alder and Pacific dogwood, all under 1.0-inch DBH.

3.2 SITE 2 LOWER CASCADE CANAL

Twenty-two riparian tree species were surveyed at Site 2 on the LCC (Appendix A, Photos 5-10). Tree species surveyed include bigleaf maple, gray alder, Oregon ash, and Pacific dogwood. Of the surveyed trees, Pacific dogwood is the dominant riparian tree species (ten individuals surveyed), while bigleaf maple is the co-dominant (eight individuals surveyed). Other upland species are present at Site 2 including black oak, hazelnut, and incense cedar however, were not surveyed due to their upland status. The DBH for the surveyed trees ranged from 1.0 to 13.0 inches, including trees with multiple stems. Overall health of trees at Site 2 is fair to good (score of 3 to 4), with some foliage discoloration (45 percent of trees). Surface growth is present on on the trunk and/or foliage of 17 of the 22 trees surveyed (77.2 percent). Bark health for the trees surveyed is fair (score of 3), with 50 to 75 percent bark absence, some bark/ root rot, and other irregularities. Disease was observed on nine of the surveyed trees (40.9 percent), including some

fungal presence, the structural decay of the trees, and other pathogen indicators. Insect infestation and/or damage were noted on 11 of the 22 trees surveyed at Site 2 (50.0 percent). Insect damage includes burrowing, frass, epicormics sprouting, and insect presence. Parasitic presence was observed on two trees (9.0 percent) at Site 2 (tags 139 and 146) including mistletoe.

Other observed general site conditions include encroachment by non-native species, specifically Himalayan blackberry in the understory. Encroachment by non-natives invasive plant species decreases the overall cover of other native riparian herbaceous and shrub species at Site 2, such as California blackberry (*Rubus ursinus*). Site 2 also contains an abundance of upland (i.e., non-riparian) conifer species in the over-story that lead to increased shading of sub-strata over-story riparian tree species. Lastly, Site 2 has a significant amount of down woody debris both the up and downslope (east and west) side of the canal.

3.3 SITE 3 LOWER CASCADE CANAL

Nineteen riparian tree species were surveyed at Site 3 on the LCC (Appendix A, Photos 11-14). Tree species surveyed include bigleaf maple, gray alder, and Pacific dogwood. Of the surveyed trees, bigleaf maple is the dominant riparian tree species (14 individuals surveyed). Other upland species are present at Site 3 including Douglas-fir and incense cedar; however they were not surveyed due to their upland status. The DBH for the surveyed trees ranged from 1.0 to 24.0 inches. Overall health of trees at Site 3 is fair (score of 3), with foliage discoloration (26.3 percent of trees), insect damage to the leaves and tree bark, and potential disease presence. Surface growth is present on trunk and/or foliage of 16 of the 19 trees surveyed (72.7 percent), including mostly biological growth such as moss and lichen. Bark health for the trees surveyed is poor to fair (score of 2 to 3), with 50 up to 100 percent bark absence, decay, and or general abundant abnormalities. Disease was observed on six of the surveyed trees (21.5 percent), specifically noted and concentrated on the tree limbs and foliage. Insect infestation and/or damage was noted on ten of the 19 trees surveyed at Site 3 (52.6 percent). Insect damage includes burrowing, frass, epicormics sprouting, and insect presence. No parasitic presence was observed on the trees surveyed at Site 3.

Other observed general site conditions include encroachment by non-native species, specifically English ivy (*Hedera helix*) in the understory. Encroachment by non-native invasive plant species decreases the overall cover of other native riparian herbaceous species at Site 3, such as nettle (*Urtica dioica*) and false Solomon's seal (*Maianthemum racemosum*). In addition, Site 3 has a significant amount on down woody debris on the downslope (west) side of the canal. Lastly, on both the up and downslope (east and west) side of Site 3, there are many saplings (i.e., new growth) of gray alder and Pacific dogwood, all under 1.0-inch DBH.

3.4 SITE 4 LOWER CASCADE CANAL

Twenty riparian tree species were surveyed at Site 4 on the LCC (Appendix A, Photos 15-20). Tree species surveyed include bigleaf maple, gray alder, and Oregon ash. Of the surveyed trees, bigleaf maple is the dominant riparian tree species (14 individuals surveyed). Other upland species are present at Site 4 including black oak, Douglas-fir, incense cedar, and tanoak. Due to the upland status of the aforementioned trees, these species were not included in the riparian Assessment, with the exception of two tanoaks (tags 118 and 123). The DBH for the surveyed trees ranged from 1.0 to 7.75 inches. Overall health of trees at Site 4 is good (score of 4), with some foliage discoloration (15.0 percent of trees). Surface growth is present on the trunk and/ or foliage of eight of the 20 trees surveyed (40.0 percent), including mostly biological growth such as moss and English ivy. Bark health for the trees surveyed is fair to good (score of 3 to 4), with as little as 25 percent and up to 75 percent bark absence and/ or decay. Disease was observed on four of the surveyed trees (20.0 percent), specifically concentrated on the foliage. Insect infestation and/ or damage was noted on 12 of the 20 trees surveyed at Site 4 (60.0 percent). Insect damage includes burrowing, frass, epicormics sprouting, and insect presence. No parasitic presence was observed on the trees surveyed at Site 4.

Other observed general site conditions include encroachment by non-native species, specifically English ivy and Himalayan blackberry in the understory. Encroachment by non-natives invasive plant species decreases the overall cover of other native riparian herbaceous and shrub species at Site 4, such as hazelnut, thimbleberry (*Rubus parviflorus*), and various fern species. Site 4 also contains an abundance of upland (i.e., non-riparian) conifer species in the over-story that lead to increased shading of sub-strata over-story riparian tree species. Lastly, on both the downslope (southeast) side of Site 4, there are many saplings (i.e., new growth) of bigleaf maple and gray alder, all under 1.0-inch DBH.

3.5 SITE 5 UPPER GRASS VALLEY CANAL

Eight riparian tree species were surveyed at Site 5 on the UGVC (Appendix A, Photos 21-22). Tree species surveyed include bigleaf maple, Pacific dogwood, and white alder. Of the surveyed trees, Pacific dogwood (three individuals) and white alder (3 individuals) are the co-dominant riparian trees species. Other upland species are present at Site 5 including black oak and incense cedar; however they were not surveyed due to their upland status. The DBH for the surveyed trees ranged from 2.0 to 10.0 inches. Overall health of trees at Site 5 is fair (score of 3), with foliage discoloration (37.5 percent of trees), insect damage to the leaves and tree bark, and potential disease presence. No surface growth presence was observed on the trees surveyed at Site 5. Bark health for the trees surveyed is poor to fair (score of 2 to 3), with a little as 50 percent and up to 100 percent bark absence, decay, and/or abundant abnormalities. Disease was observed on two of the surveyed trees (25.0 percent), specifically on the bole (i.e., trunk) and branching limbs of the trees. Insect infestation and/or damage was not observed on any of the trees surveyed at Site 5. No parasitic presence was observed on the trees surveyed at Site 5.

Other observed general site conditions include tree trimming of the lower tree limbs on the downslope (north) side of the canal, running parallel to Banner Lava Cap Road.

3.6 SITE 6 DS CANAL (CONTROL SITE)

Twenty-three riparian tree species were surveyed at Site 6 (Control Site) on the DS Canal (Appendix A, Photos 23-26). Tree species surveyed include bigleaf maple, gray alder, and Pacific dogwood. Of the surveyed trees, Pacific dogwood (15 individuals) is the dominant riparian tree species. Other upland species are present at Site 6 Douglas-fir, incense cedar, and Ponderosa pine; however they were not surveyed due to their upland status. The DBH for the surveyed trees ranged from 1.0 to 11.2 inches. Overall health of trees at Site 6 is fair (score of 3), with foliage discoloration (34.8 percent of trees), insect damage to the leaves and tree bark, and potential disease presence. Surface growth was observed on 12 of the 23 trees surveyed at Site 6 (52.2 percent) including biological growth such as moss and fungal growth such as leaf and bark mildew. Bark health for the trees surveyed is poor to fair (score of 2 to 3), with a little as 50 percent and up to 100 percent bark absence, decay, and/or abundant abnormalities. Disease was observed on four of the surveyed trees (17.4 percent), specifically on the bole (i.e., trunk) of the trees at Site 6. Insect infestation and/or damage was observed on 13 of the trees at Site 6 (56.5 percent). No parasitic presence was observed on the trees surveyed at Site 6.

Other observed general site conditions include poor tree vigor and/or increased mortality on the upslope (south) side of the canal. Specifically, many of the riparian trees present (e.g., bigleaf maple), and other upland species (e.g., incense cedar) are dead or decaying, while encroachment by non-native species, specifically Himalayan blackberry exists in the understory. Encroachment by non-native invasive plant species decreases the overall cover of other native riparian herbaceous species at Site 6.

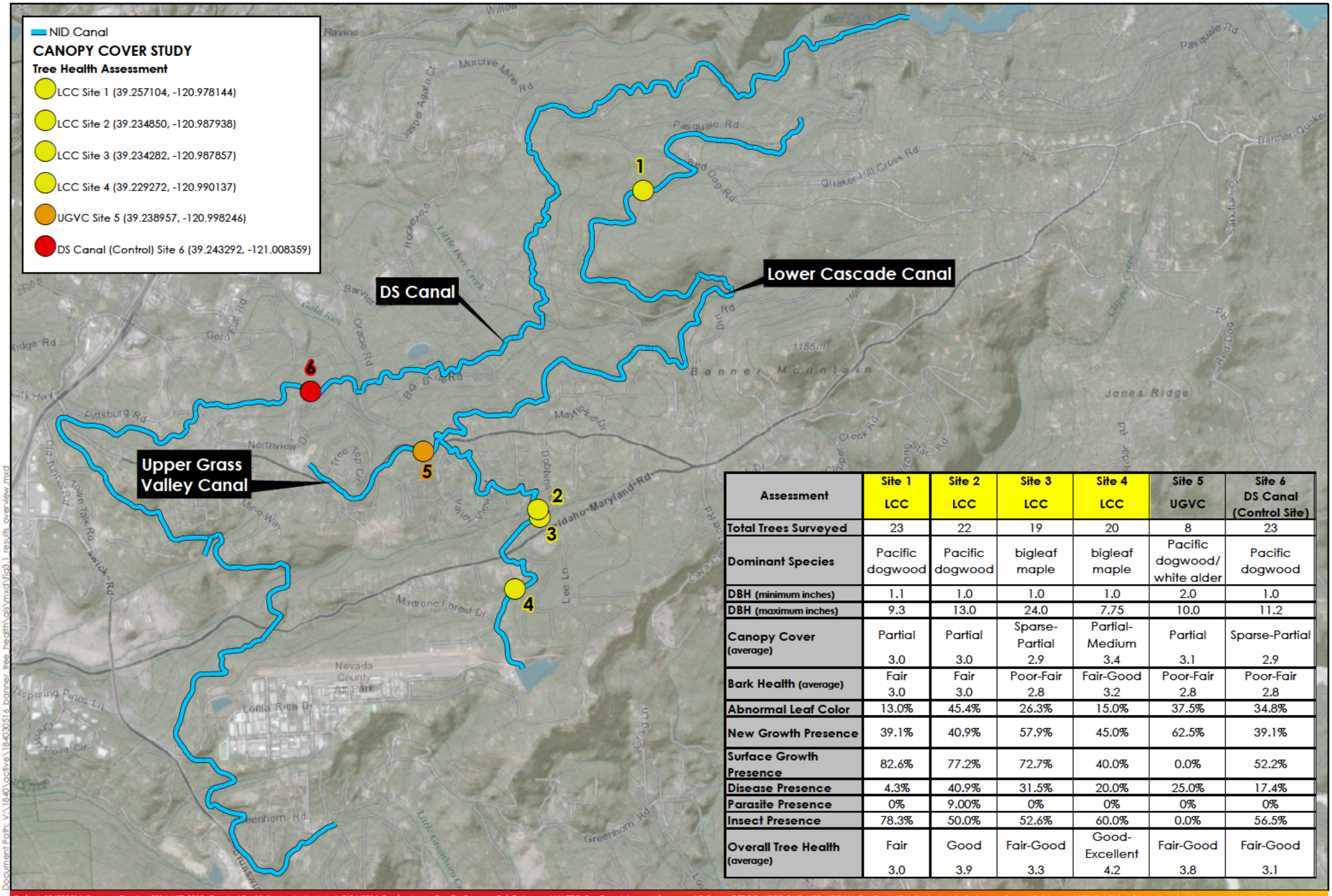
3.7 RESULTS SUMMARY

Assessments were conducted on October 6, 7, and 8, 2015 along the LCC (Sites 1-4), the UGVC (Site 5), and the DS Canal (Control Site) Site 6. The health of a total of 155 trees was assessed at all of the six study sites combined. For the Assessment study sites, the dominant species surveyed primarily included bigleaf maple and Pacific dogwood. At each of the sites, there were saplings (new growth) present, however, many were under 1.0 inch DBH, thus were not included in the overall Assessment. For trees included in the Assessment, the smallest tree was 1.0 inch DBH, with the largest being 24.0 inches (bigleaf maple at LCC Site 3). Other upland species such as Douglas-fir, hazelnut, incense cedar, Ponderosa pine, and tanoak were present at the Assessment sites, however, were not surveyed due to their upland status.

All sites exhibited foliage discoloration from normal seasonal changes and abscission (i.e., process of deciduous plants seasonally shedding leaves). Other observed foliage discolorations include spotting from potential disease (i.e., big leaf maple speckled tar spots), insect and herbivory damage (i.e., Erineum mites), drought stress, and other biological growths (e.g.,

powdery mildew). General canopy cover for the survey seasonal timing was normal to partial. In addition to the foliage discoloration and noted growths, other surface growths on the bark bole (i.e., trunk) and branch limbs was recorded. Surface growths were mostly biological (e.g., moss, lichen, and fungi). In some cases, biological growths were noted as invasive species (e.g., English Ivy or Himalayan blackberry) encroaching the tree and growing up the trunk into the tree canopy. There was very low to nil parasitism at the sites, with only 9.0 percent being documented at LCC Site 2 as mistletoe growth in the upper canopy. General bark health of existing trees was fair; with some trees exhibiting extensive heart rot (i.e., decay of the cambium/inner wood), and bark sluff (i.e., loss of the outer bark). In addition, some sights had extensive down woody debris within the riparian forest understory.

Further conclusions regarding tree health in relation to canal flows, environmental conditions, and comparison to the data collected during the baseline year of Assessments (i.e., 2013) is described in Section 4.0 Conclusions and Section 5.0 Discussion. A general summary of Assessment data for all trees surveyed at each study site is detailed in Figure 3.1 Tree Health Assessment Results.



Assessment	Site 1 LCC	Site 2 LCC	Site 3 LCC	Site 4 LCC	Site 5 UGVC	Site 6 DS Canal (Control Site)
Total Trees Surveyed	23	22	19	20	8	23
Dominant Species	Pacific dogwood	Pacific dogwood	bigleaf maple	bigleaf maple	Pacific dogwood/ white alder	Pacific dogwood
DBH (minimum inches)	1.1	1.0	1.0	1.0	2.0	1.0
DBH (maximum inches)	9.3	13.0	24.0	7.75	10.0	11.2
Canopy Cover (average)	Partial 3.0	Partial 3.0	Sparse-Partial 2.9	Partial-Medium 3.4	Partial 3.1	Sparse-Partial 2.9
Bark Health (average)	Fair 3.0	Fair 3.0	Poor-Fair 2.8	Fair-Good 3.2	Poor-Fair 2.8	Poor-Fair 2.8
Abnormal Leaf Color	13.0%	45.4%	26.3%	15.0%	37.5%	34.8%
New Growth Presence	39.1%	40.9%	57.9%	45.0%	62.5%	39.1%
Surface Growth Presence	82.6%	77.2%	72.7%	40.0%	0.0%	52.2%
Disease Presence	4.3%	40.9%	31.5%	20.0%	25.0%	17.4%
Parasite Presence	0%	9.00%	0%	0%	0%	0%
Insect Presence	78.3%	50.0%	52.6%	60.0%	0.0%	56.5%
Overall Tree Health (average)	Fair 3.0	Good 3.9	Fair-Good 3.3	Good-Excellent 4.2	Fair-Good 3.8	Fair-Good 3.1

Stantec

0 3,600 Feet

1 inch = 3,142 feet

Nevada

Figure 3.1
Results Overview
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project

4.0 CONCLUSIONS

The following section provides a comparison analysis for assessment data for Monitoring Year 2, collected on October 6, 7, and 8, 2015, and assessment data for the baseline Monitoring Year 0, collected on September 10 and 11, 2013[5]. LCC and the UGVC Assessment data was compared with DS Canal Control Site data results. The following conclusions analysis also interprets data against the backdrop of NID's LCC and the UGVC flow rates, loss rates, California's defined water years (i.e., October to April), and general botanical bloom period and abscission periods. Overall tree health by species for all sites can be referenced on Figures 4.1-4.6 Conclusions Analysis. Lastly, a complete compilation comparing Assessment data between Year 0 and Year 2 is outlined in Table 4.0 below.

4.1 SITE 1 LOWER CASCADE CANAL

Assessment surveys conducted in Monitoring Year 2 for LCC Site 1 evaluated 23 trees, one less tree than Monitoring Year 0, as one tree was observed dead as down woody debris. Monitoring Year 2 found Pacific dogwood to remain as the overall dominant species. Tree size (i.e., DBH) increased by 3.2 percent from Year 0 to Year 2. Leaf color observations improved from Monitoring Year 0 to Year 2, with a 77.5 percent increase in foliage health. New growth was recorded present on only 39.1 percent of the trees at Site 1, an overall 60.9 percent decrease from Year 0. Surface growth on the bole (i.e., trunk), branches, and foliage increased by 6.4 percent. Monitoring Year 2 also yielded a decrease in overall disease (0.5 percent) observations. Insect infestations and presence largely increased from monitoring Year 0, with a 68.8 percent increase in Year 2. Parasite presence remained as no observations were recorded. General overall canopy cover was more intact at the time of survey, and observed as Partial (average score of 3.0), an overall 10.0 percent increase from monitoring Year 0. Bark health also upgraded by 8.0 percent (average score of 3.0). Site 1 yielded overall improvements in foliage and canopy cover, as well as a decrease in tree disease presence; however, there was an overall increase in insect infestations and surface growths, with a decline in new growth/generation of the riparian forest. Thus the average overall tree health at Site 1 is Fair (average score of 3.0), a 12.0 percent decline from overall health observed during Year 0 (good, the average score of 4.1).

4.2 SITE 2 LOWER CASCADE CANAL

Assessment surveys conducted in Monitoring Year 2 for LCC Site 2 evaluated 21 trees, two more than Monitoring Year 0, as two trees previously recorded as saplings below 1.0-inch DBH were tagged and/or assessed as individuals. Monitoring Year 2 found Pacific dogwood to remain as the overall dominant species. Total tree size increased by 3.8 percent from Year 0 to Year 2. Leaf color observations improved from monitoring Year 0 to Year 2, with a 24.6 percent increase in

[5] Data collection dates based on regional annual rainfall and general botanical bloom periods.

foliage health. New growth was recorded present on only 40.9 percent of the trees at Site 2, an overall 54.3 percent decrease from Year 0. Surface growth ofn the bole, branches, and foliage increased by 12.2 percent. Monitoring Year 2 also yielded an increase in overall disease (40.9 percent) observations. Insect infestations increased from no observations in Year 0 to 50.0 percent presence in Year 2. Parasite presence also increased from no observations in Year 0 to 9.0 percent presence. General overall canopy cover was more intact at the time of the survey, and observed as Partial (average score of 3.0), an overall 8.0 percent increase from Monitoring Year 0. Bark health also improved by 10.0 percent (average score of 3.0). Site 2 yielded inclusive improvements in foliage and canopy cover, as well as bark health; however, there was an overall increase in insect infestations, disease presence, and parasitism, with a decline in new growth/generation of riparian forest. Thus, the average overall tree health for Site 2 was Fair to Good (average score of 3.9), the same overall health observed during Monitoring Year 0.

4.3 SITE 3 LOWER CASCADE CANAL

Assessment surveys conducted in Monitoring Year 2 for LCC Site 3 evaluated 19 trees, two less trees than Monitoring Year 0, as two trees were observed dead and/or as a multiple stems and treated as an individual. Monitoring Year 2 found bigleaf maple to remain as the overall dominant species. Total tree size increased by 12.5 percent from Year 0 to Year 2. Leaf color observations improved from Monitoring Year 0 to Year 2, with a 54.7 percent increase in foliage health. New growth was recorded present on only 57.9 percent of the trees at Site 3; an overall 42.1 percent decrease from Year 0. Surface growth on the bole, branches, and foliage decreased by 13.0 percent. Monitoring Year 2 also yielded an increase in overall disease (31.5 percent) observations. Insect infestations increased from 5.6 percent observations in Year 0 to 52.6 percent presence in Year 2. Parasite presence remained as no observations were recorded. General overall canopy cover was more intact at the time of Year 2 survey, and observed as sparse to partial (average score of 2.9), an overall 8.0 percent increase from Monitoring Year 0. Bark health also improved by 12.0 percent (average score of 2.8). Site 3 yielded improvements in canopy cover and foliage health; however, overall tree health (fair to good, average score of 3.3) at Site 3 declined by 26.0 percent due to increased disease, insect infestations, and no observed new growth.

4.4 SITE 4 LOWER CASCADE CANAL

Assessment surveys conducted in Monitoring Year 2 for LCC Site 4 evaluated 20 trees, two more than monitoring Year 0, as two trees previously recorded as saplings below 1.0-inch DBH were tagged and/or assessed as individuals. Monitoring Year 2 found big leaf maple to remain as the overall dominant species. Total tree size increased marginally by 0.9 percent from Year 0 to Year 2. Leaf color observations improved from Monitoring Year 0 to Year 2 with an 85.0 percent increase in foliage health. New growth was recorded present on only 45.0 percent of the trees at Site 4, an overall 55.0 percent decrease from Year 0. Surface growth on the bole, branches, and foliage increased by 28.9 percent. Monitoring Year 2 also yielded an increase in overall disease (20.0 percent) observations. Insect infestations increased from 5.6 percent observations

in Year 0 to 60.0 percent presence in Year 2. Parasite presence remained as no observations were recorded. General overall canopy cover was more intact at the time of Year 2 survey, and observed as partial to medium (average score of 3.4), an overall 10.0 percent increase from Monitoring Year 0. Bark health also improved by 4.0 percent (average score of 3.2). Site 4 yielded improvements in canopy cover, bark health, and foliage observations; however, overall tree health (good to excellent, average score of 4.2) at Site 4 marginally declined by 8.0 percent due to increased disease, insect infestations, and no observed new growth.

4.5 SITE 5 UPPER GRASS VALLEY CANAL

Assessment surveys conducted in Monitoring Year 2 for UGVC Site 5 evaluated 20 trees, two more than Monitoring Year 0, as two trees previously recorded as saplings below 1.0-inch DBH were tagged and/or assessed as individuals. Monitoring Year 2 found white alder to remain as the overall co-dominant species, with the addition of Pacific dogwood as the other co-dominant species due to the increase in the total number of survey trees at Site 5. Total tree size did not increase nor decrease in Year 2, with average DBH remaining at 10.0 inches for both Monitoring Years 0 and Year 2. Leaf color observations improved from Monitoring Year 0 to Year 2 with a 62.5 percent increase in foliage health. New growth was recorded present on only 62.5 percent of the trees at Site 5, an overall 37.5 percent decrease from Year 0. No surface growth was observed on the bole, branches, or foliage of the trees at Site 5. Monitoring Year 2 yielded an increase in overall disease (12.5 percent) observations. Insect infestations decreased from 37.5 percent observations in Year 0 to no observations observed in Year 2. Parasite presence remained as no observations recorded. General overall canopy cover was more intact at the time of survey, and observed as partial to medium (average score of 3.1), an overall 16.0 percent increase from Monitoring Year 0. Bark health also improved by 16.0 percent (average score of 2.8). Site 5 yielded improvements in canopy cover, bark health, foliage observations, and insect infestations/presence. Although trees at Site 5 did not have any observable surface or sapling growth (i.e., regeneration of riparian forest), the average overall tree health (fair to good, average score of 3.8) improved by 14.0 percent.

4.6 SITE 6 DS CANAL (CONTROL SITE)

Assessment surveys conducted in Monitoring Year 2 for the DS Canal (Control Site) Site 6 evaluated 23 trees, one more than Monitoring Year 0, as one tree was previously recorded as a sapling measuring below 1.0-inch DBH was tagged and/or assessed as an individual. Monitoring Year 2 found Pacific dogwood to remain as the overall dominant species at Site 6. Total tree size increased by 10.7% from Year 0 to Year 2. Leaf color observations improved from Monitoring Year 0 to Year 2, with a 60.7 percent increase in foliage health. New growth was recorded present on only 39.1 percent of the trees at Site 6, and overall 60.7 percent decrease from Year 0. Surface growth on the bole, branches and foliage increased by 38.6 percent. Monitoring Year 2 also yielded an increase in overall disease observations, from none in Year 0 to 17.4 percent in Year 2. Insect infestations decreased by 11.7 percent. Moreover, parasite presence remained as no observations were recorded. General overall canopy cover was more intact at the time of

the survey, and observed as sparse to partial (average score of 2.9), an overall 10.0 percent increase from Monitoring Year 0. Bark health also improved by 8.0 percent (average score of 2.8). Site 6 yielded improvements in canopy cover, bark health, foliage observations, and insect infestations/presence; however, overall tree health (fair to good, average score of 3.1) at Site 6 marginally declined due to increased disease and no observed new growth (i.e., riparian forest regeneration).

Table 4.0 Tree Health Assessment Comparative Results for Monitoring Year 0 (2103) and Year 2 (2015)

Assessment	Site 1 LCC		Site 2 LCC		Site 3 LCC		Site 4 LCC		Site 5 UGVC		Site 6 DS Canal (Control Site)	
	2013 (Year 0)	2015 (Year 2)	2013 (Year 0)	2015 (Year 2)	2013 (Year 0)	2015 (Year 2)	2013 (Year 0)	2015 (Year 2)	2013 (Year 0)	2015 (Year 2)	2013 (Year 0)	2015 (Year 2)
Total Trees Surveyed	24	23	20	22	21	19	18	20	8	8	22	23
Dominant Species	Pacific dogwood	Pacific dogwood	Pacific dogwood	Pacific dogwood	bigleaf maple	bigleaf maple	bigleaf maple	bigleaf maple	white alder	Pacific dogwood/ white alder	Pacific dogwood	Pacific dogwood
DBH (min. inches)	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	1.0
DBH (max. inches)	9.0	9.3	12.5	13.0	21.0	24.0	7.0	7.7	10.0	10.0	10.0	11.2
Canopy Cover[1]	2.5	3.0	2.6	3.0	2.5	2.9	2.9	3.4	2.3	3.1	2.3	2.9
Bark Health[1]	2.6	3.0	2.5	3.0	2.2	2.8	3.0	3.2	2.0	2.8	2.4	2.8
Abnormal Leaf Color	90.5%	13.0%	70.0%	45.4%	81.0%	26.3%	100.0%	15.0%	100.0%	37.5%	95.5%	34.8%
New Growth Presence	100.0%	39.1%	95.2%	40.9%	100.0%	57.9%	100.0%	45.0%	100.0%	62.5%	86.4%	39.1%
Surface Growth Presence	76.2%	82.6%	65.0%	77.2%	85.7%	72.7%	11.1%	40.0%	87.5%	0%	13.6%	52.2%
Disease Presence	4.8%	4.3%	14.3%	40.9%	0%	31.5%	0%	20.0%	12.5%	25.0%	0%	17.4%
Parasite Presence	0%	0%	0%	9.0%	0%	0%	0%	0%	0%	0%	0%	0%
Insect Presence	9.5%	78.3%	0%	50.0%	5.6%	52.6%	5.6%	60.0%	37.5%	0%	68.2%	56.5%
Overall Tree Health[1]	4.1	3.0	3.9	3.9	3.7	3.3	4.6	4.2	3.1	3.8	3.5	3.1

[1]Average of all survey values
Canopy Cover: 1- None (0%); 2- Sparse (0-25%); 3- Partial (25-50%); 4- Medium (50-75%); 5- Full (75-100%)
Bark Health: 1- Dead (100%); 2- Poor (75-100%); 3- Fair (50-75%); 4- Good (25-50%); 5- Excellent (0-25%)
Tree Health: 1- Dead; 2- Poor; 3- Fair; 4- Good; 5- Excellent

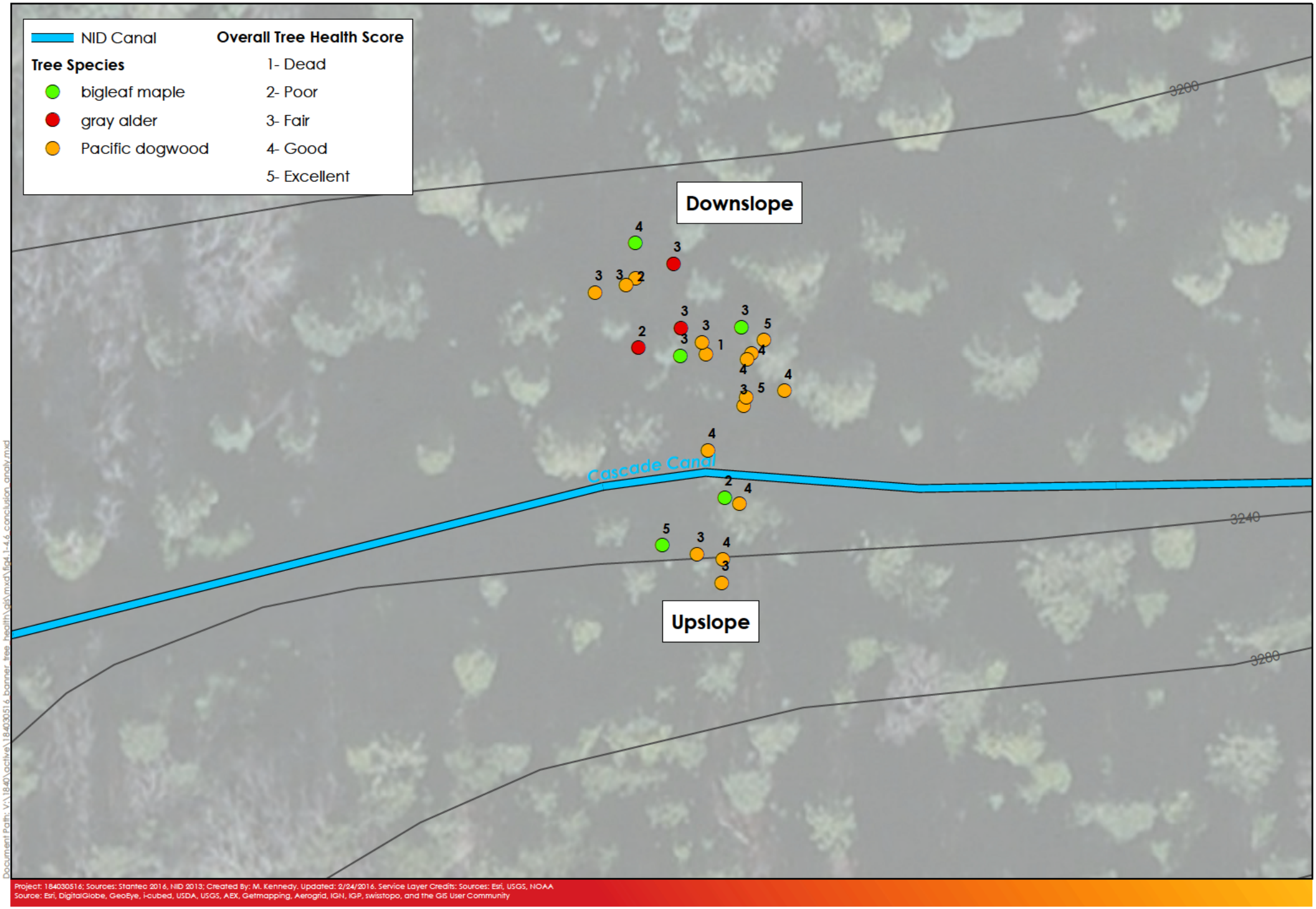
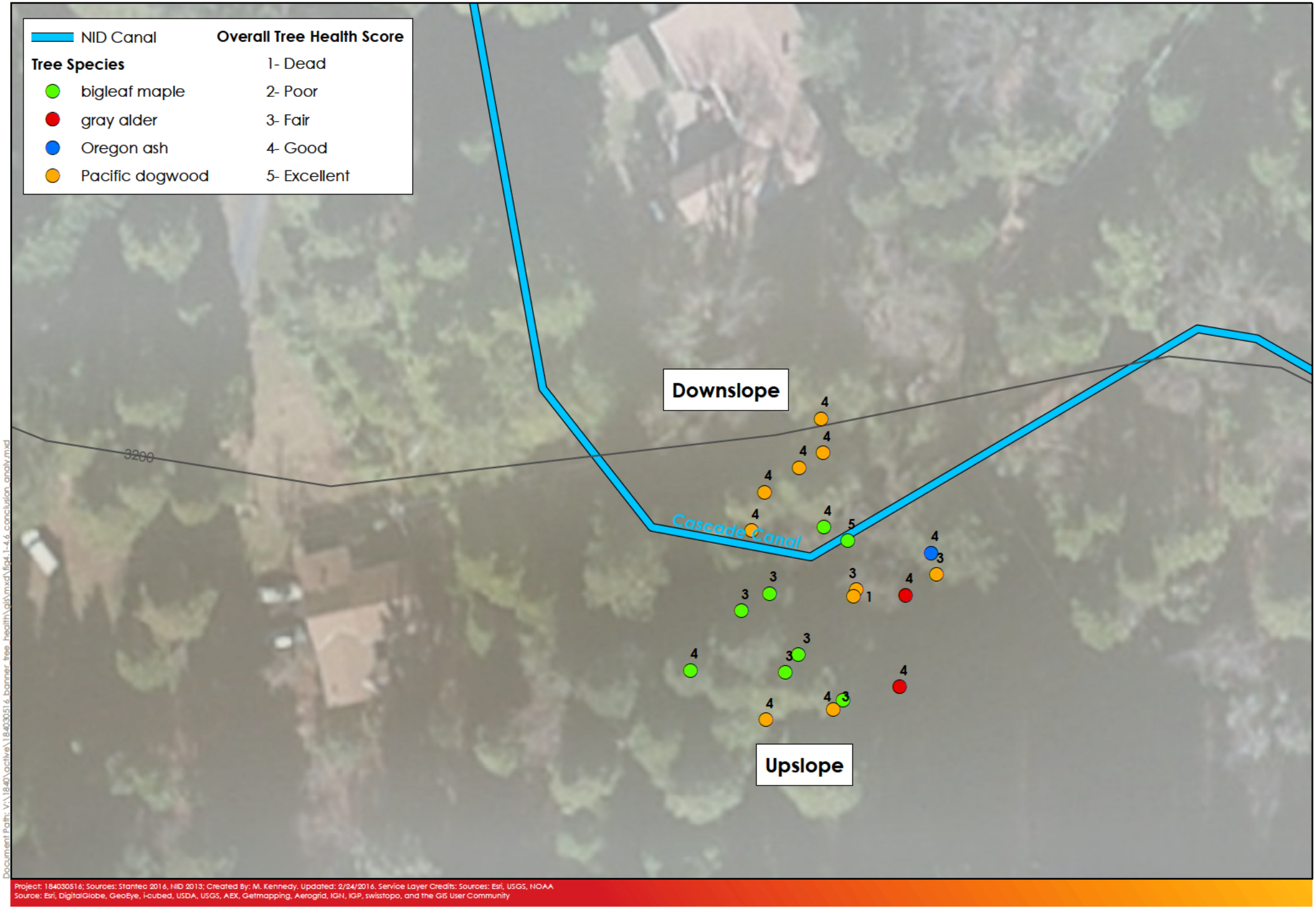


Figure 4.1
Conclusions Analysis- LCC Site 1
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project



Project: 184030516; Sources: Stantec 2016, NID 2013; Created By: M. Kennedy. Updated: 2/24/2016. Service Layer Credits: Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Stantec

0 50 Feet

20 Foot Contour Interval

Nevada

Figure 4.2
Conclusions Analysis- LCC Site 2
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project

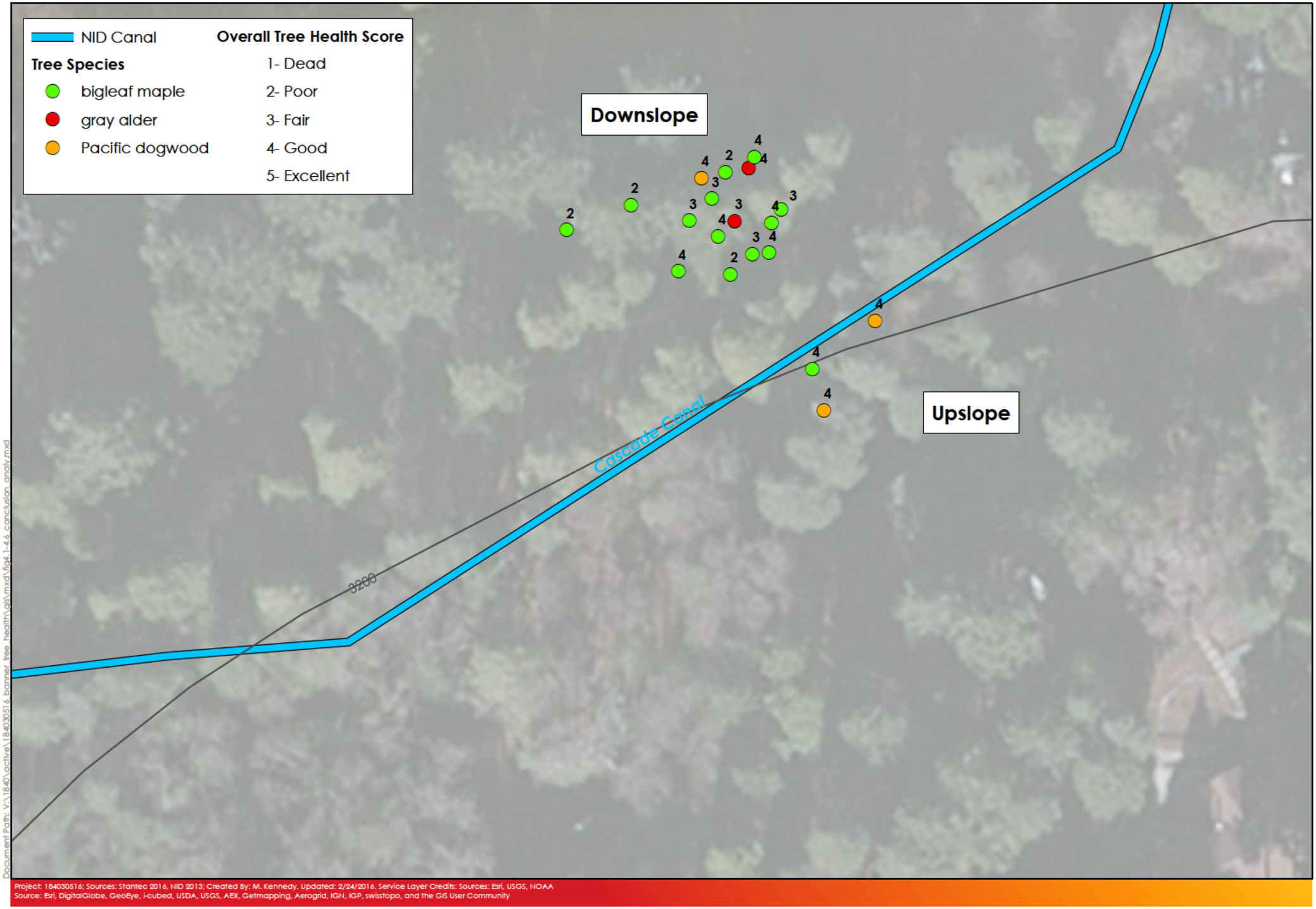


Figure 4.3
Conclusions Analysis- LCC Site 3
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project

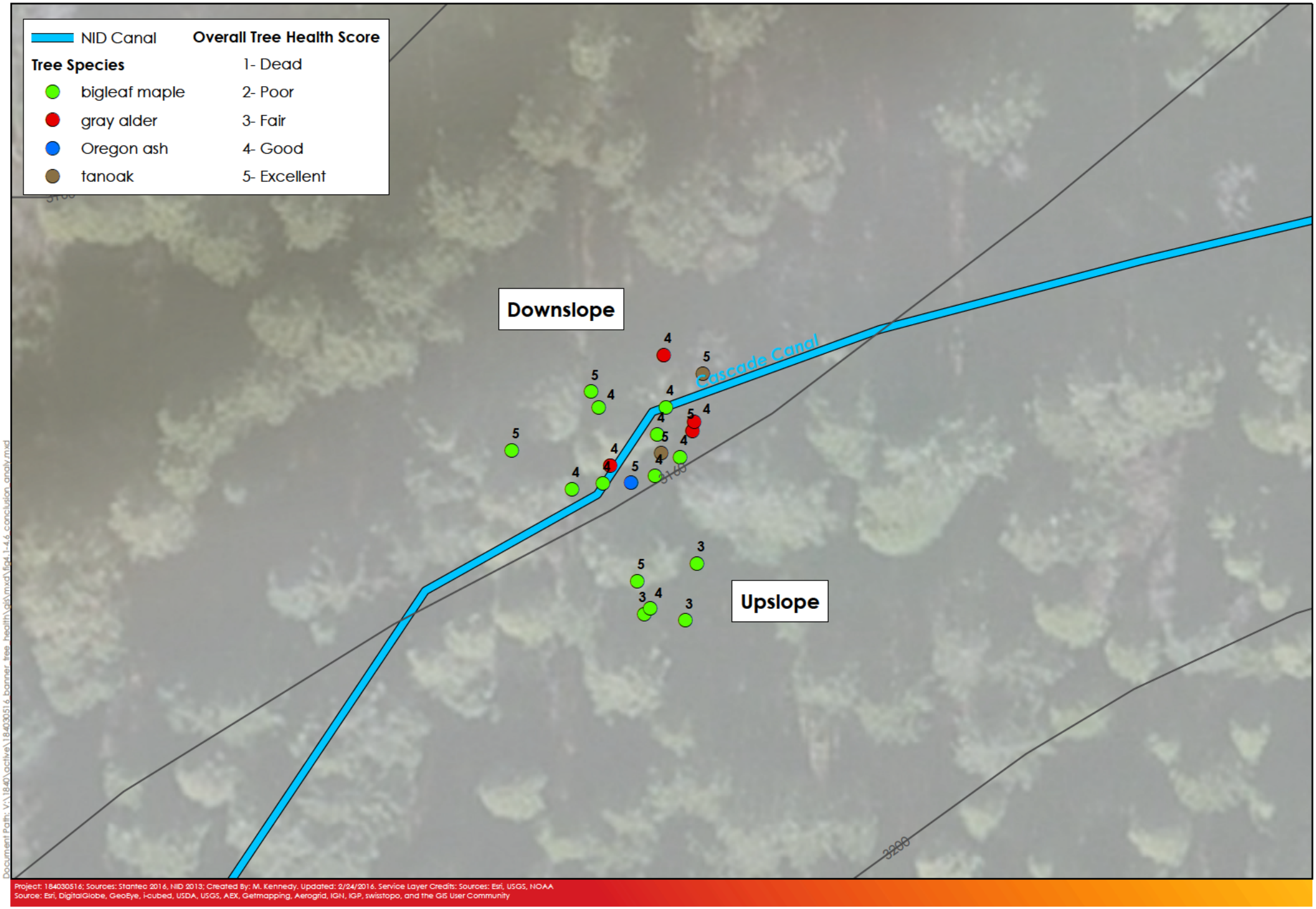


Figure 4.4
Conclusions Analysis- LCC Site 4
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project

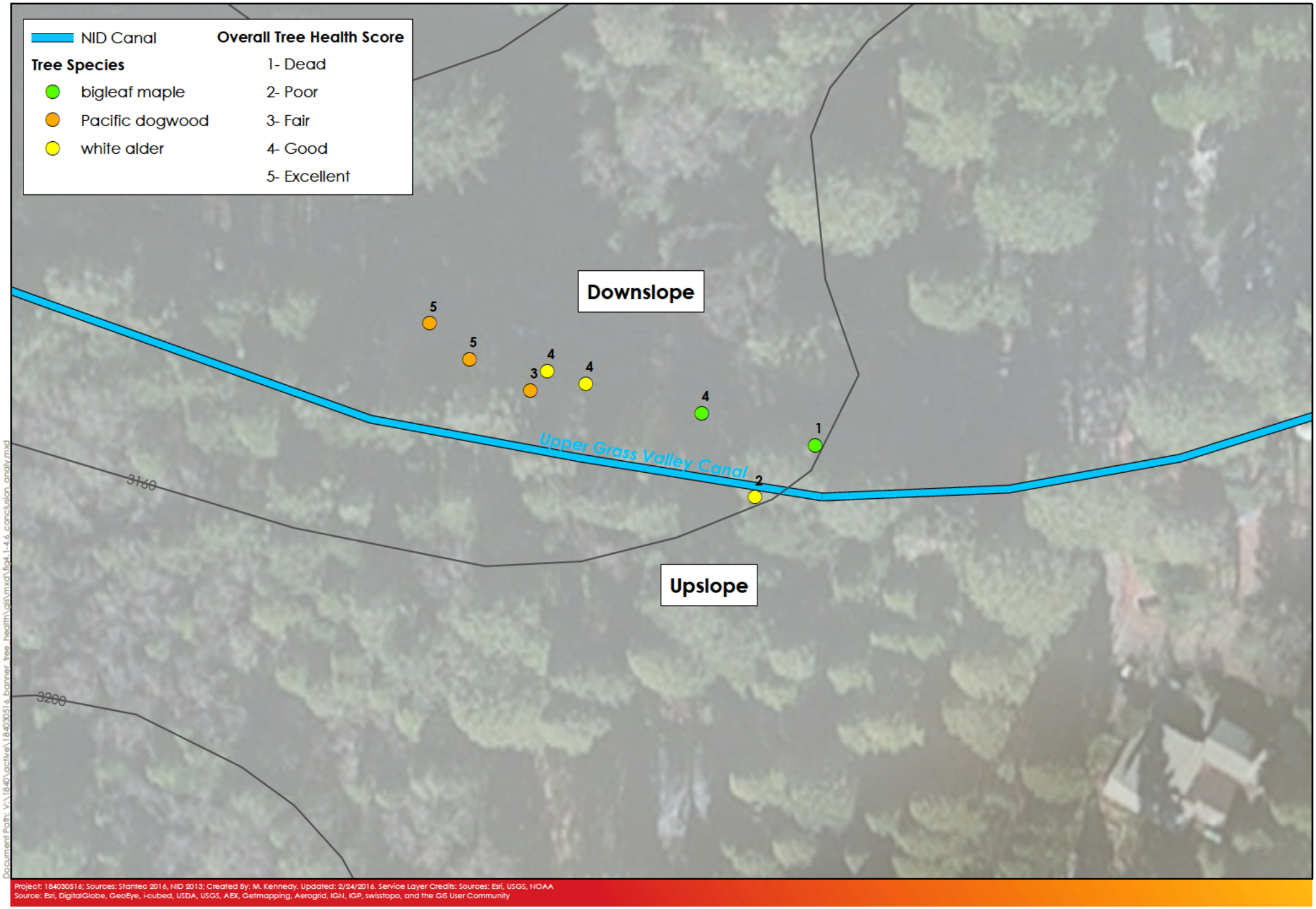
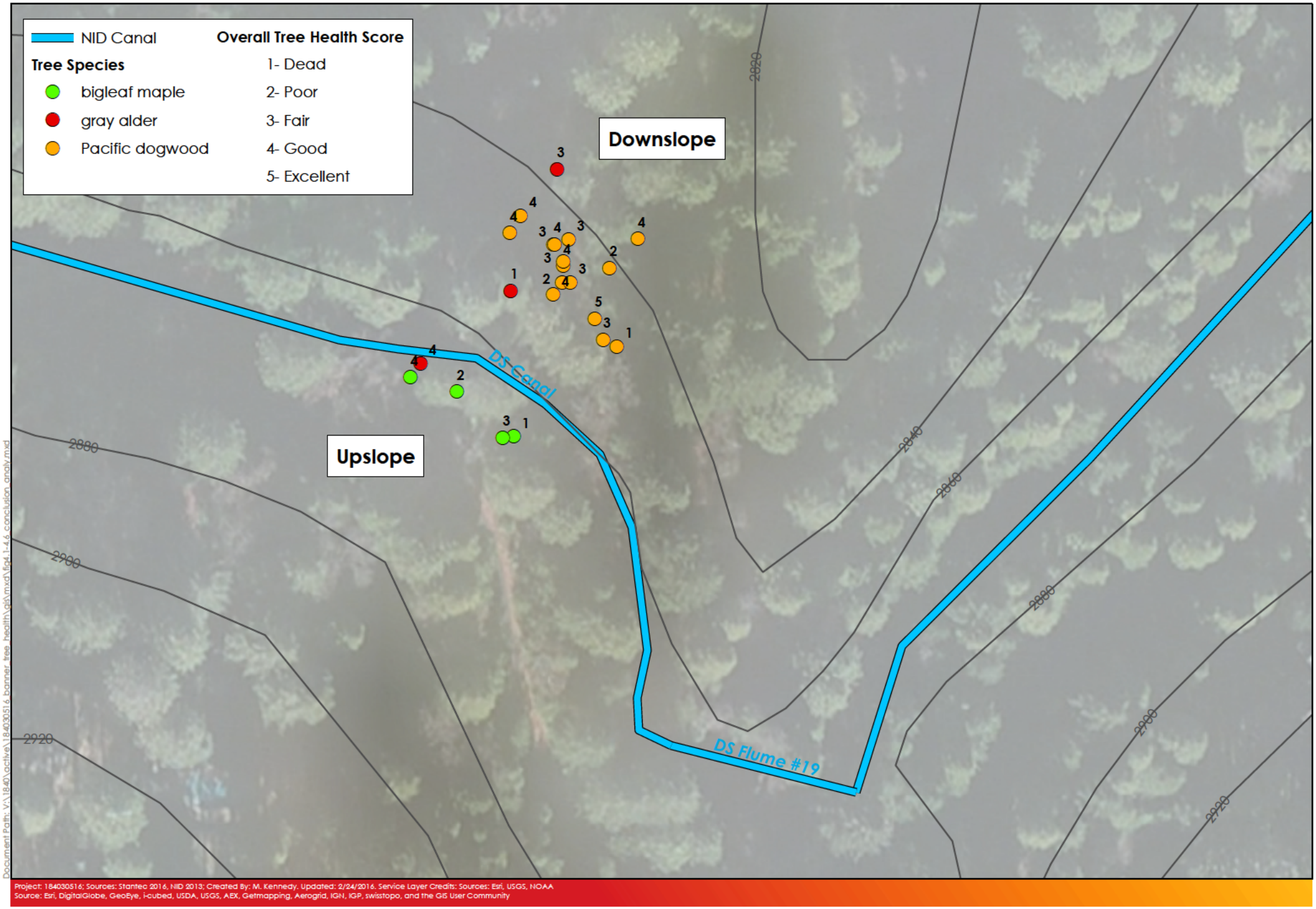


Figure 4.5
Conclusions Analysis- UGVC Site 5
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project



Project: 184030516; Sources: Stantec 2016, NID 2013; Created By: M. Kennedy. Updated: 2/24/2016. Service Layer Credits: Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Stantec

0 60 Feet

20 Foot Contour Interval

Nevada

Figure 4.6
Conclusions Analysis- DS Canal (Control) Site 6
Long Term Canopy Cover Study, Tree Health Assessment, Year 2

Nevada Irrigation District, Banner Cascade Project

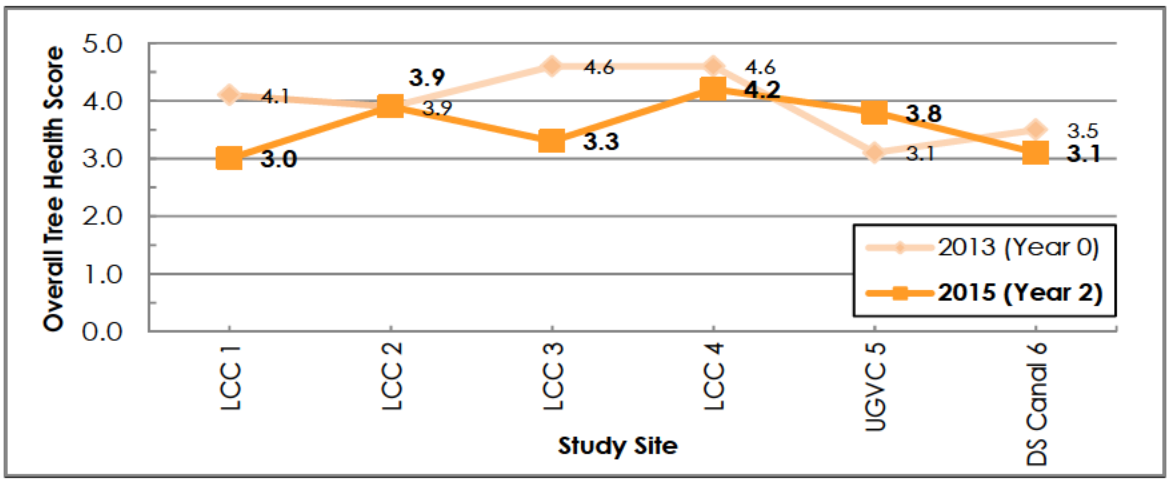
4.7 CONCLUSIONS SUMMARY

Flows in the LCC were reduced from 45 to three to five CFS as part of the Project. The Assessment results and comparative analysis between Monitoring Year 0 and Year 2 conclude that overall health of riparian trees at study Sites 1 to 4 on LCC decreased on average of one point in the scoring protocol (i.e., Sites 1, 3, and 4), or remained with no overall shift (i.e., Site 2). Increased disease, parasite presence (e.g., mistletoe), and insect infestation observations were drivers in leading to lower overall health scores at the study sites along the LCC. Other environmental factors leading to a decrease in overall tree health is further discussed in Section 5.0 below. Canopy cover significantly improved between Monitoring Year 0 and Year 2. Therefore, it can be concluded that associated riparian shade canopy remains intact. There was also a minimal loss of riparian tree species along the LCC study sites (i.e., Sites 1 and 3), with those trees observed as dead in Year 2 being observed as compromised with a low overall health scoring in Year 0. Although the loss of riparian trees was not significant along the LCC, all sites were generally lacking in new growth observations (i.e., riparian forest regeneration). Assessment average scores for overall tree health for study Sites 1 to 4 on the LCC can be referenced in Figure 4.7 below.

Flows in the UGVC were reduced from 12 to one to two CFS as part of the Project. The Assessment results and comparative analysis between Monitoring Year 0 and Year 2 conclude that overall health of riparian trees at study Site 5 on the UGVC increased on average by a quarter of a point in the scoring protocol. Decreased disease, no parasite presence, and normal leaf health observations contributed to the higher overall health scoring at study Site 5 on the UGVC. Canopy cover marginally improved between Monitoring Year 0 and Year 2. Therefore, it can be concluded that associated riparian shade canopy remains intact. There was no recorded loss of riparian tree species along the UGVC at study Site 5; however the study site was measurably lacking in new growth observations. Assessment average scores for overall tree health for Site 5 on the UGVC can be referenced in Figure 4.7 below.

Flows in the DS Canal were not reduced, thus making study Site 6 (Control Site) on the DS Canal not influenced by the Project. Therefore, the riparian community along this canal was selected as a Control Site to comparably measure the findings from the study sites along the LCC and UGVC. The Assessment results and comparative analysis between Monitoring Year 0 and Year 2 conclude that overall health of riparian trees at study Control Site 6 on the DS Canal marginally decreased on an average of half a point in the scoring protocol. Increased disease and surface growths on the trees (e.g., non-native vegetation species) are the primary drivers leading to lower overall health scoring at study Control Site 6 along the DS Canal. Other environmental factors leading to a decrease in overall tree health is further discussed in Section 5.0 below. There was no recorded loss of riparian tree species along the DS Canal at study Control Site 6; however the study site was measurably lacking in new growth observations. Assessment, average scores for overall tree health for Site 6 (Control Site) on the DS Canal, can be referenced in Figure 4.7 below.

Figure 4.7 Tree Health Assessment Scores for Average Overall Tree Health by Study Site



Tree Health: 1- Dead; 2- Poor; 3- Fair; 4- Good; 5- Excellent

General environmental conditions and overall riparian forest health relative to the Sierra Nevada foothill region and the associated Project is further discussed in Section 5.0. Other prevailing site-specific conclusions include the notable sweeping decrease in new growth presence (i.e., average 50 percent decrease) at all of the study sites between Monitoring Year 0 and Year 2. Regeneration of riparian forest is greatly dependent on hydrology, both groundwater/seepage and overall precipitation, thus supporting forest composition and maintenance. Between Monitoring Year 0 and Year 2, the region experienced drought conditions (i.e., the overall decrease in annual precipitation), as well as a spike in overall seasonal temperature. Decreased water availability and the offset of normal seasonal variation subsequently can drive increases in non-native and upland species encroachment and growth within riparian forest communities. These conditions can also inflate broad scale tree disease as well as insect infestation. It can be concluded that the aforementioned factors compounded with a decrease in overall canal flows lends to the overall observed lower tree health conclusions for the Project study sites.

5.0 DISCUSSION

This Report provides Year 2 monitoring results for the NID LCC and UGVC Long Term Canopy Cover Study, Tree Health Assessment. This Report also includes the Ten Year Canopy cover Study Monitoring Plan (Appendix B) component to comply with the two canal flow-reduction mitigation measures included in the Final EIR for the Project (NID 2006)[6]. The purpose of the Discussion Section is to provide further conclusions, considerations, and recommendations relevant to the results analysis between Monitoring Year 0 (2013) and Monitoring Year 2 (2015).

Riparian forests are a complex ecological system that are located at the land-water margin. These vegetation communities support dynamic levels of biodiversity and further exhibit high rates of nutrient cycling and ecological function. As a result, riparian species (e.g., Oregon ash) are generally more vulnerable to overarching water-induced stress (e.g., drought, reduction in groundwater seepage) during the growing season. Therefore, shifts in the timing of inundation increases the mortality rates of such species. Decreased water availability often results in a reduction of riparian vegetation, as less flood-tolerant upland species extend further into the riparian forest community. Many riparian plant species depend upon specific conditions at specific times for successful seedling establishment. Changes in flow patterns also shift the timing of these conditions. By changing the timing of the decline in water levels, seed dispersal may occur too early or too late for the successful seedling establishment and other species may establish instead, such as non-native invasive plant species like English ivy as seen at the Project study sites (Naimen et al. 2001).

Early defoliation, or leaf browning, due to drought stress was observed at the Project study sites due to low regional rainfall between Monitoring Year 0 and Year 2. Riparian tree drought stress is observable when leaves of mature trees turn brown and prematurely begin to drop well in advance of the normal time for leaf fall (Swiecki et al. 2006). At the study sites, drought-induced defoliation was differentiated from branch die-back by the fact that buds and twigs of drought-defoliated branches remained alive. It should be noted that for droughts lasting multiple years, symptoms of drought-induced defoliation can be widespread, particularly in riparian communities. It is recommended that drought-stress assessments continue to be considered in subsequent Project monitoring years. Decreased hydrology (i.e., canal flows) at the study sites can be concluded as not a primary indicator in the decreases in overall tree health averages in light of recent drought in the region. Total precipitation for Monitoring Year 0 and Year 2 are outlined by month for Nevada City, California in Table 5.0 below.

[6] Canopy Cover Assessments and Pond Studies were not required in Monitoring Year 2 (2015). Protocols and Year 0 (2013, baseline monitoring year) for these studies can be referenced in the Lower Cascade Canal and Upper Grass Valley Canal Long Term Canopy Cover Study Report, Baseline Year 0.

Table 5.0 Total Precipitation by Month for Nevada City, California

Year / Month	Total Precipitation (inches)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2013-Year 0	1.76	0.89	3.82	1.80	1.25	2.12	0.00	0.22	3.32	0.67	1.79	0.95	18.6
2015-Year 2	0.05	7.67	1.07	3.19	0.27	0.29	0.28	0.01	0.11	0.99	5.1	13.8	32.84

NRCS 2016

Moving forward, additional data will be collected every two years in the next seven years (2017-2023; Years 4, 6, 8, 10) in the late summer (August-September); thus comprising four more studies to complete the monitoring requirements developed to comply with Mitigation Measure 3.8-1 defined in the Final EIR for the Lower Cascade Canal – Banner/Cascade Pipeline Project (NID 2006). Baseline data will be compiled and compared with subsequent data from future study years. It is recommended if a tree species scores below 'good' and has the presence of insects, parasites, new growth, etc., then attribute data should be collected (e.g., type of insects, sap, if tree species is deciduous and losing foliage, surface growth type, etc.). These factors can be indicative of types of tree stressors. If new growth (i.e., forest regeneration) continues to increase, it is recommended that a composite cover assessment of non-native invasive species present at each study site is included in future Assessments and evaluated against the back-drop of other overarching environmental conditions in the future results analysis. General assessments of upland species present at the study sites (for future discussion) are also recommended, as many upland species within these vegetation communities have become accustomed to a wetted environment. Lastly, comparative considerations for future years are recommended to be assessed as needed. These may include, but are not limited to, natural variation assessments, cumulative and sequential impacts evaluation, relevant considerations of threshold and latent effects, and abiotic and biotic conditions (e.g., climatic variability, drought, plant and pest invasive species increases, site aspect, etc.).

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March 3, 2016

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APPENDICES

Appendix A PHOTO RECORD

The following Photo Record is documentation of the riparian habitat and site conditions during Monitoring Year 2 for the Banner Cascade Riparian Canopy Cover- Tree Health Assessments conducted in fall 2015 (September to November), Nevada County, California.

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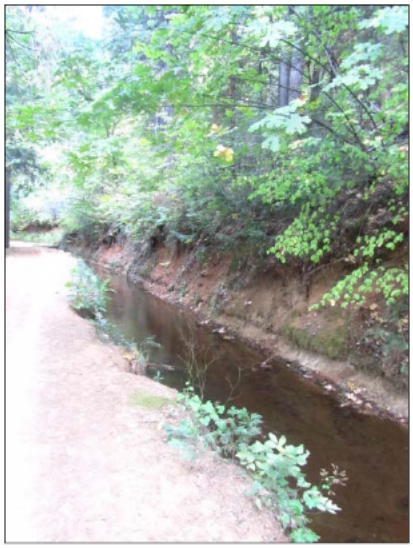
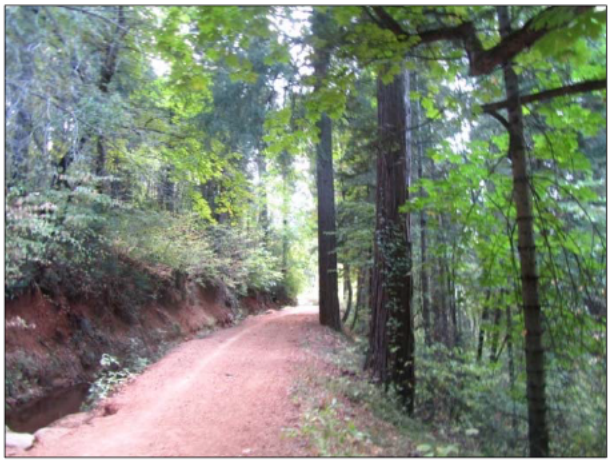
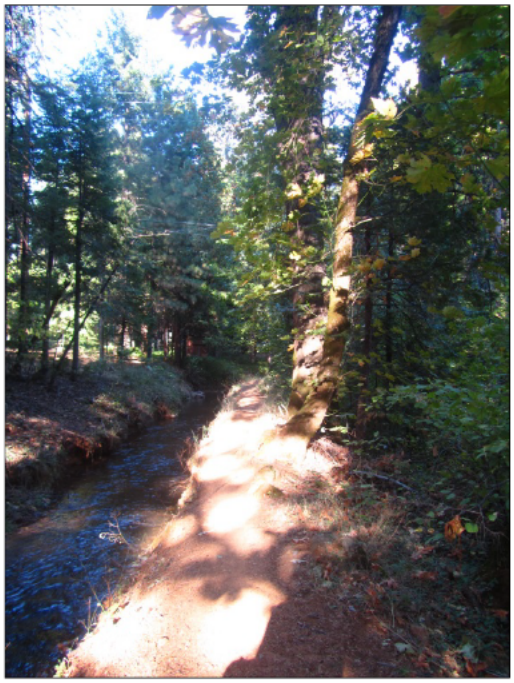
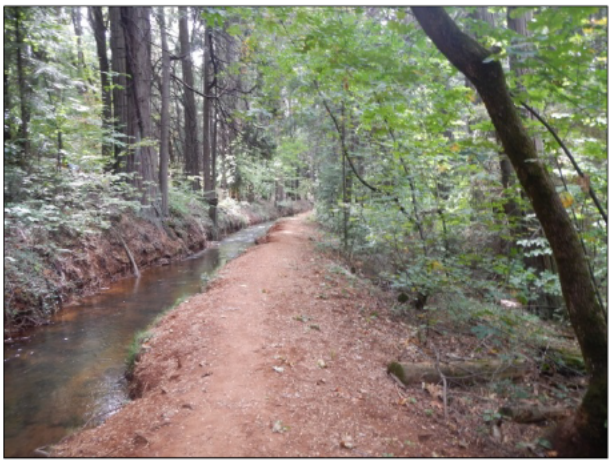
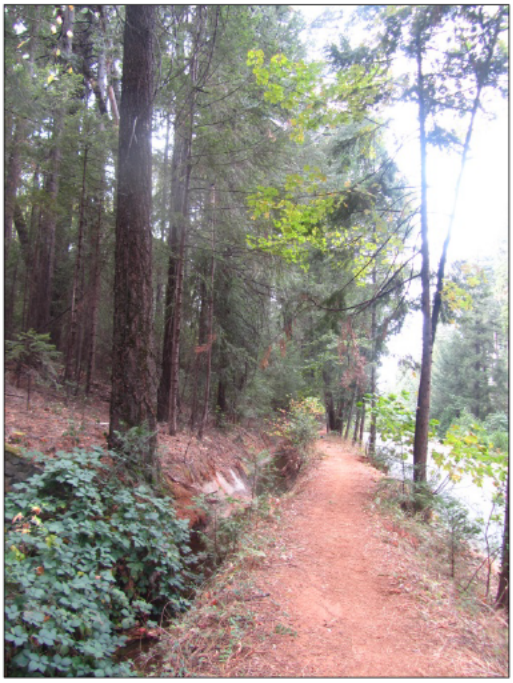
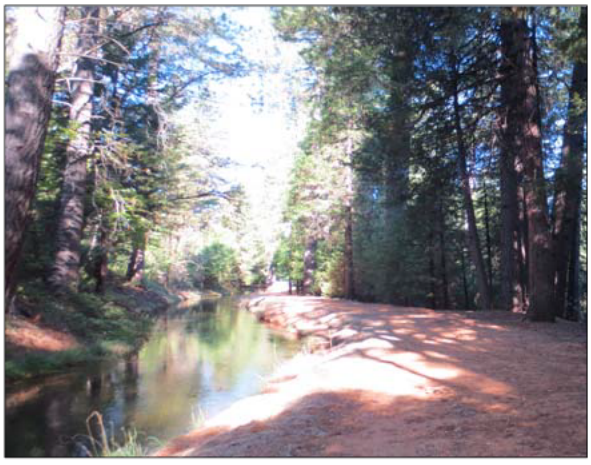
  </td><td>2
  </td></tr>
<tr><td>LCC Site 1, on the east (downslope) side of the canal, facing upstream. Northeast aspect.</td><td>LCC Site 1, on the east (downslope) side of the canal, facing downstream. Southwest aspect.</td></tr>
<tr><td>3
  </td><td>4
  </td></tr>
<tr><td>An example of a multi-stem Pacific dogwood tree at LCC Site 1 (tag number 206, 17 stems total).</td><td>An example of tree root disease/wood decay leading to down woody debris at LCC Site 1.</td></tr>
</table>

Photos 5-10: Site 2 Lower Cascade Canal	
5 	**6** 
LCC Site 2, on the west (downslope) side of the canal, facing upstream. Northwest aspect.	LCC Site 2, on the west (downslope) side of the canal, facing downstream. Southeast aspect.
7 	**8** 
Foot path/trail going through the middle of LCC Site 2 on the west (downslope) side of the canal. West aspect.	East (upslope) side of LCC Site 2. West aspect.

9 	**10** 
An example of a drought-stressed Pacific dogwood tree canopy on the east (upslope) side of LCC Site 2.	An example of biological (composite algae) growth on Pacific dogwood tree bark at LCC Site 2.
Photos 11-14: Site 3 Lower Cascade Canal	
11 	**12** 
LCC Site 3, on the west (downslope) side of the canal, facing upstream. Northeast aspect.	LCC Site 3, on the west (downslope) side of the canal, facing downstream. Southwest aspect.

13 	**14** 
Down woody debris on the downslope side of LCC Site 3. West aspect.	View of the upslope side of LCC Site 3 from the downslope (west) side of the canal. East aspect.
Photos 15-20: Site 4 Lower Cascade Canal	
15 	**16** 
LCC Site 4, on the west (downslope) side of the canal, facing upstream. Northeast aspect.	LCC Site 4, on the west (downslope) side of the canal, facing downstream. Southwest aspect.

17 	**18** 
Downslope (west) side of the canal at LCC Site 4. Note the property owner installed a fence on the left side of the photo. Northwest aspect.	The upslope (east) side of the canal at LCC Site 4. Southeast aspect.
19 	**20** 
An example of biological (English ivy) growth/encroachment by non-native/invasive species on tree bark at LCC Site 4.	An example of fungal growth (tar spotting; black circular spot patterns) on bigleaf maple foliage. This foliage also exhibits another fungal disease, powdery mildew.

Photos 21-22: Site 5 Upper Grass Valley Canal	
21 	**22** 
UGVC Site 5, on the south (downslope) side of the canal, facing upstream. East aspect.	UGVC Site 5, on the south (downslope) side of the canal, facing downstream. West aspect.
Photos 23-26: Site 6 DS Canal (Control Site)	
23 	**24** 
DS Canal (Control Site) Site 6, on the south (downslope) side of the canal, facing downstream. West aspect.	DS Canal (Control Site) Site 6, on the south (downslope) side of the canal. South aspect.

25 	**26** 
DS Canal (Control Site) Site 6, on the south (downslope) side of the canal. South aspect.	DS Canal (Control) Site 6, on the north (upslope) side of the canal. South aspect. An example of wood decay/ root rot.

Appendix B TEN YEAR CANOPY COVER STUDY MONITORING PLAN

The purpose of the Ten Year Canopy Cover Study Monitoring Plan (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 (LCC), and Upper Grass Valley Canal (UGVC), and DS canal (Control Site). The Monitoring Plan is specific to a study timeline and data collection methods which are detailed below.

B.1 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 (2013-2023; Years 0, 2, 4, 6, 8, 10) in the late summer (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) in the late summer (August to September) and concurrent with the Tree Health Assessments.

Table B.1 Status Summary of Tree Health and Canopy Cover Study Assessments and Monitoring Year as of March 2016.

Canopy Cover Study	Monitoring Year					
	2013- Year 0 [1]	2015- Year 2	2017- Year 4	2019- Year 6	2021- Year 8	2023- Year 10
Tree Health Assessment	complete	complete	x	x	x	x
Canopy Cover Assessment	complete	n/a	x	n/a	x	x

[1] Year 0 baseline studies were completed in 2013.

X- Indicates a study year for monitoring to be completed

B.2 STUDY LOCATIONS

The following locations are the Canopy Cover study sites comprising the Tree Health Assessments and the Canopy Cover Assessments for this Ten Year Canopy Cover Study Monitoring.

B.2.1 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 (Control Site)
  - Site 6: Latitude 39.243292, Longitude -121.008359

B.2.2 Canopy Cover Assessment

Table B.2 Canopy Cover Assessment Study Reaches, Location, and Size.

Canal	LCC	UGVC	DS Canal
Canal Sample Size (miles)	7	0.5	1
Total Observations Points	351	24	48

B.3 STUDY DATA COLLECTION

B.3.1 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 below. Each tree should be assigned a score for each category or criteria using the datasheets included in this Monitoring Plan.

Table B.3 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

B.3.2 Canopy Cover Assessment

The Canopy Cover Study- 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. 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).

B.4 STUDY REPORTING

Reporting at the end of each study year will be in the form of an Interim Technical Memorandum (Memo), and will be drafted to summarize the Canopy Cover Studies (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 California's water year data and NID LCC and the UGVC flow data. Each Memo 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 final report will be compiled summarizing data collection methods, results, analysis as well as make findings and recommendations.

Tree Health Assessment Datasheet

Project ______________________ Site ______________________

Client ______________________ Date ______________________

Weather ______________________ Observer(s) ______________________

Site Conditions ______________________

Notes ______________________

Tag	DBH	Species	Overall TreeHealth	Canopy Cover	New Growth	Leaf Color	Bark Health	Surface Growth	Disease	Parasites	Insects	Notes

Project _____ **Site** _____ **Date** _____ Tree Health Assessment Datasheet page__of__

ASSESSMENT KEY

Overall Tree Health	1- Dead; 2- Poor; 3- Fair; 4- Good; 5- Excellent
Canopy Cover	1- Sparse to full die-back (0-25%); 2- Partial (25-50%); 3- Medium (50-75%); 4- Full (75-100%)
New Growth	1- Present; 0- Not present
Leaf Color	1- Normal; 0- Abnormal
Bark Health	1- Poor to No bark (75-100%); 2- Fair (50-75%); 3-Good (25-50%); 4- Excellent (0-25%)
Surface Growth	1- Present; 0- Not present
Disease	1- Present; 0- Not present
Parasites	1- Present; 0- Not present
Insects	1- Present; 0- Not present

RIPARIAN TREE SPECIES QUICK REFERENCE KEY

ACGL- mountain maple (*Acer glabrum*)	**QUCH-** canyon live oak (*Quercus chrysolepis*)
ACMA- big leaf maple *(Acer macrophylum*	**QULO-** valley oak (*Quercus lobata*)
ACNE- boxelder (*Acer negundo*)	**QUKE-** black oak (*Quercus kelloggii*)
ALIC- gray alder (*Alnus incana*)	Other sp.:
ALRH- white aloder (*Alnus rhombifolia*)	Other sp.:
CONU- Pacific dogwood (*Cornus nuttallii*)	Other sp.:
FRLA- Oregon ash (*Fraxinus latifolia*)	Other sp.:
PIPO- Ponderosa pine (*Pinus ponderosa*)	Other sp.:
POFR- cottonwood (*Populus fremontii*)	Other sp.:

CANOPY COVER DATASHEET

Page ____ of ____

PROJECT	DATE	OBSERVER(S)	DATA ENTRY
WEATHER	PROJECT LOCATION		
	SITE NAME AND LOCATION		
NOTES			

DATA POINT #	UPSTREAM	DOWNSTREAM	FACING LEFT BANK	FACING RIGHT BANK