2011 Monitoring Report

Riparian Vegetation Recruitment Monitoring
FERC Project 184

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INTRODUCTION

The El Dorado Irrigation District (District) owns and operates the El Dorado Hydroelectric Project (Project No. 184), which is licensed by the Federal Energy Regulatory Commission (FERC). The Project No. 184 Monitoring Program[1] requires monitoring of riparian vegetation recruitment along Caples Creek and Kirkwood Creek. The specific monitoring requirements for riparian vegetation recruitment are defined in the Project 184 Riparian Vegetation Recruitment Monitoring Plan (Plan; EID, 2010), which was approved by FERC on February 7, 2011.

Riparian vegetation recruitment monitoring was conducted on Caples Creek and Kirkwood Creek in 2000 (Harris and Lindquist 2000) and 2002 (EIP Associates 2002) as part of the relicensing of Project No. 184. Permanent photo points were established by Harris and Lindquist during the initial year of monitoring in 2000. AECOM revisited these sites in August and September, 2011, to make observations on riparian vegetation recruitment, observe changes in stream geomorphology, and to take photographs corresponding to those taken previously. This report presents the results and photographs from the 2011 monitoring effort; photographs taken in 2000 and 2002 are also presented in separate appendices for comparison.

METHODS

This recruitment study focuses on two riparian corridor study areas: Caples Creek (which has project-regulated streamflows) and Kirkwood Creek (which does not). Twenty-three photomonitoring sites were initially chosen during the initial 2000 study: sites 1-14 are located on Caples Creek downstream of its confluence with the Caples Lake Spillway channel, and sites 15/16 through 23/24 are located on Kirkwood Creek downstream of Highway 88 (Exhibit 1). Kirkwood Creek was chosen as a control by Harris and Lindquist in 2000 because it is tributary to Caples Creek and does not have any dams influencing stream hydrology, as does Caples Creek. Both study areas are located in meadows with similar riparian vegetation compositions, primarily *Salix lemmonii* along Kirkwood Creek and *S. lemmonii* and *S. lucida* along Caples Creek. The areas are also grazed to a limited extent by horses from nearby stables.

Specific photomonitoring locations where chosen in 2000 to be on or near fluvial deposits where riparian vegetation recruitment would be expected (Harris and Lindquist 2000). Each site was photographed as in previous reports, generally from three positions: across, downstream, and upstream. In addition to the photographs taken at each site, observations were recorded on the following: 1) presence or absence of any form of plant regeneration on fluvial deposits; 2) flowering and fruiting of willows; 3) herbivory; and 4) notable land-use impacts.

In 2011, we were able to relocate all of the established monitoring locations based on previous monitoring photographs. We determined that photographs at each photomonitoring "point" were taken from multiple locations along the bank, and sometimes with differing focal lengths, apparently in an effort to get the best view of downstream and upstream recruitment sites. We noted the GPS locations of a central point at each site to aid with future monitoring efforts, but we took photographs that matched up with those taken previously, which required taking photographs from multiple areas along the bank and occasionally even from within the channel

[1] Section 7 of the El Dorado Relicensing Settlement Agreement, U.S. Forest Service 4(e) Condition No. 37, and California State Water Resources Control Board Section 401 Clean Water Act Water Quality Certification Condition No. 13

itself where gravel bars or bank edges had migrated. Photomonitoring site locations (latitude and longitude of central points) are presented in Table 1 and shown on Exhibit 1.

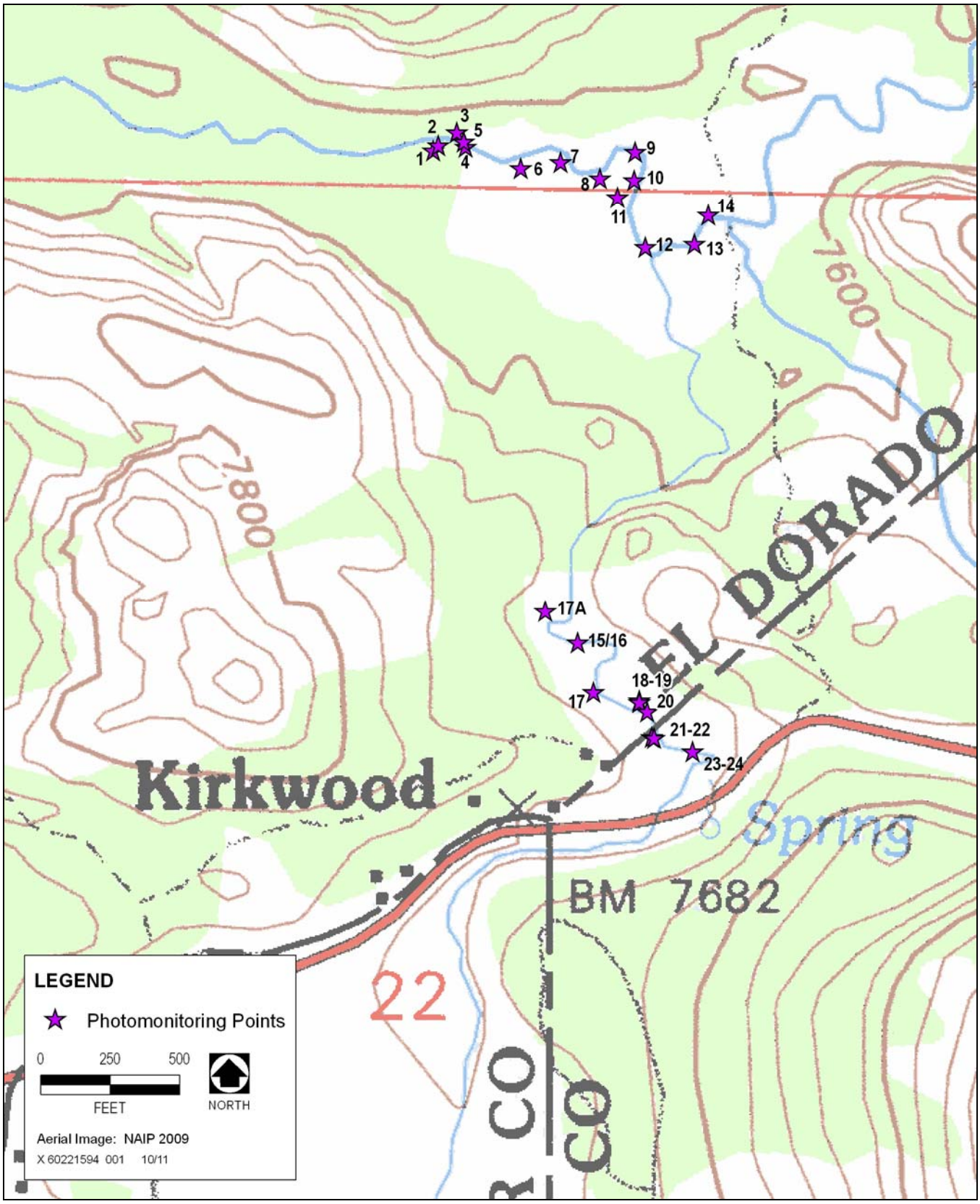
RESULTS AND DISCUSSION

A site-by-site summary of qualitative recruitment observations made in 2011 is presented in Table 2. The photomonitoring sites were visited and photographed twice in 2011, once during mid-summer (August 8-10) and once late in the summer (September 19-21).

Table 1
Riparian Recruitment Photomonitoring Site Locations

Study Area	Photopoint	Latitude (d.dd° N)	Longitude (d.dd° W)
Caples Creek	1	38.7093	120.07385
	2	38.70935	120.07378
	3	38.70948	120.07355
	4	38.70934	120.07344
	5	38.70939	120.07346
	6	38.70913	120.07274
	7	38.70919	120.07224
	8	38.70903	120.07174
	9	38.70929	120.07130
	10	38.70901	120.07131
	11	38.70884	120.07152
	12	38.70835	120.07117
	13	38.70838	120.07055
	14	38.70867	120.07037
Kirkwood Creek	15/16	38.70444	120.07202
	17	38.70395	120.07182
	17A	38.70475	120.07243
	18	38.70387	120.07124
	19	38.70385	120.07124
	20	38.70376	120.07114
	21	38.70351	120.07108
	22	38.7035	120.07105
	23/24	38.70336	120.07057

Note:
Latitude and longitude are given in decimal degrees for a central location for each monitoring site; datum WGS84.



Source: AECOM 2011

Exhibit 1 **Photomonitoring Points**

Table 2
Conditions Observed at Monitoring Sites, Caples Creek and Kirkwood Creek - 2011

Sample Site	Description	Willow Seedlings or Sprouts Present? Willows in Flower/Fruit?	Herbaceous Vegetation Present? Percent Cover?	Comments
Caples 1	Floodplain (previously gravel bar)	No willow seedlings/sprouts observed. *S. lucida* was flowering here in August.	Yes, floodplain bank has >80% cover herbaceous vegetation (~90% in September) with alders and willows behind.	Stream geomorphology in this downstream reach is highly dynamic: 2000 gravel bar was gone in 2002, and 2002 upstream gravel bar has since migrated to mid-channel. Vegetation recruitment protected behind log. Horsetail recruitment on bank.
Caples 2	Debris bar, sand/silt	One willow sprout observed on the mid-channel bar, most likely a rooted cutting. Some layering (~6 plants) on cutbank above where sandbar was in 2002. Willows on banks in this area appear to have grown since 2002 photos taken.	Yes, ~90% herbaceous cover in September by grasses, sedges, and forbs on cutbank around photopoint. Mid-channel bar mostly unvegetated, <5% vegetation cover.	Thalweg of creek has migrated to where gravel bar was in 2002; bank at photopoint is now strongly cut and gravel bar has migrated to mid-channel.
Caples 3	Floodplain/cutbank (previously gravel sand bar)	No. Young willows have increased in size since 2002 photos, however.	Floodplain/cutbank has ~70% cover by grasses and forbs. Some lodgepole pine saplings also present.	Gravel/sand bar shown in 2000/2002 photos is mostly gone, photos taken from within creek to match up to previous years. There is now a mid-channel gravel bar just downstream, and a small gravel bar across the creek which is vegetated with herbaceous vegetation.
Caples 4	Point bar, gravel/sand	Some young willow sprouts (~6) on point bar.	Yes, ~ 70% herbaceous cover by sedges and grasses on the area that was previously a mid-channel bar. More recent fluvial deposits connecting area to floodplain and upstream point bar have little vegetation.	In 2000, this was a mid-channel bar, but it is now connected with the point bar at site 5.
Caples 5	Point bar, gravel/sand	Yes, particularly on back edge of bar. Sprouts of both willow species present (~12), probably mostly by layering. Lodgepole pine and mountain alder saplings also growing on back edge of bar.	Vegetation is patchy on bar; herbaceous cover >10% (~15%) overall; back of bar has closer to 60% herbaceous cover by grasses, sedges, forbs.	Photopoint is on cutbank that has migrated south since 2002.

Table 2
Conditions Observed at Monitoring Sites, Caples Creek and Kirkwood Creek - 2011

Sample Site	Description	Willow Seedlings or Sprouts Present? Willows in Flower/Fruit?	Herbaceous Vegetation Present? Percent Cover?	Comments
Caples 6	Gravel/sand bar	One young *S. lemmonii* sprout observed, probably from seed; not a lot of willows growing here. Two young alder sprouts also observed. *S. lemmonii* flowering nearby.	Yes, ~75% herbaceous cover by sedges, grasses, horsetail, and forbs on upper bar. Lodgepole pine saplings also growing here. Lower bar exposed during low late-summer flows has no vegetation.	Most of bar in 2002 photographs is now vegetated with herbaceous vegetation, except parts exposed during lowest flows. Recent log-fall upstream but no beaver activity apparent here.
Caples 7	Floodplain, sand/silt/gravel	Mature willows on back edge of terrace; some layering of *S. lemmonii* on terrace. Mature *S. lemmonii* also in flower/fruit here.	Yes, floodplain above cutbank has been vegetated with herbaceous species, ~90% cover by sedges and forbs.	Only small pockets of unvegetated gravel/sand remian in floodplain area. Stream channel may have migrated slightly since 2002; gravel bars have changed in this area also.
Caples 8	Point bar, gravel	No, but mature willows behind bar. Many *S. lemmonii* observed flowering and fruiting around this site.	Very little vegetation on most of bar (~5%), but back of bar has ~90% herbaceous cover by sedges, forbs, grasses, with mature willows behind.	No beaver activity observed (incomplete beaver dam observed in 2002).
Caples 9	Point bar, gravel	Yes, 2 young *S. lemmonii* sprouts observed on back of bar, probably from layering. Mature willows behind bar.	Very little vegetation on most of bar (~5%) in patches (mostly sedges and grasses). Back of bar has ~75% herbaceous cover by forbs, sedges, grasses.	Bar has changed since 2002: smaller area and steeper slope, these differences less evident later in the season.
Caples 10	Point bar, gravel	*S. lemmonii* sprouts and young plants observed on back of bar (~11) and on lower bar (~7). *S. lucida* observed in fruit. Willows appear to have filled in on opposite bank since 2002.	~90% herbaceous cover on back of bar, including sedges, forbs, grasses. Lower bar has ~10% herbaceous cover.	Bar is larger in extent than in 2002.
Caples 11	Point bar, gravel/sand	Sprouts/young willows growing on inside of bar (~12) of both species. Many sprouts (especially in debris bar downstream) appear to be rooted cuttings. *S. lucida* observed in flower.	~20% cover by sedges, grasses, forbs.	One heavily browsed alder sprout also observed on gravel bar.
Caples 12	Gravel/sand bar	Three young willows growing on upper bank. Several willow branches were recently deposited on sandbar which appear to have been cut by beavers, and may root on site.	Yes, 85% cover by grasses, forbs, and sedges on limited sand bar remaining.	Sand bar at junction of Caples Creek and Kirkwood Creek, mostly gone since 2002. Mature willows on upper bank, which had been recently cut by beavers during September visit.

Table 2
Conditions Observed at Monitoring Sites, Caples Creek and Kirkwood Creek - 2011

Sample Site	Description	Willow Seedlings or Sprouts Present? Willows in Flower/Fruit?	Herbaceous Vegetation Present? Percent Cover?	Comments
Caples 13	Debris bar, silt/sand	Some willow layering (~3 sprouts) and increased growth of existing willows observed. Several alder sprouts observed also.	Yes, behind where bar was previously, ~70% herbaceous cover by sedges, grasses, forbs.	Bar is reduced since 2002, and thalweg has migrated closer to inside edge of stream, cutting into inside bank. No upstream beaver dam (as observed in 2002).
Caples 14	Sand-silt bar	Mature willow and alder on back of bar. Young plants of both willow species and alder present that may have come in since 2002. *S. lucida* observed in flower/fruit.	~65% herbaceous cover on back of bar by grasses, sedges, forbs; lower bar mostly unvegetated.	No upstream beaver dam (as observed in 2002). Mid-channel bar entirely vegetated.
Kirkwood 15/16	Gravel bar/floodplain	Dense mature willow (*S. lemmonnii*) on back of bar, and some evidence of willow layering observed. *S. lemmonnii* observed in fruit here.	Most of bar vegetated since 2002, ~95% herbaceous cover by sedges and grasses on most of bar except for an upstream portion which had closer to ~15% cover by sedges and horsetail.	Downstream gravel bar seen in 2002 photographs is gone.
Kirkwood 17	Gravel/sand bars	Yes, some layering into upstream gravel bar. Mature willows on banks around site.	~90% herbaceous cover by grasses and sedges on backs of bars, but <5% cover on lower bars closer to water's edge.	Both upstream and downstream gravel bars appear narrower than in 2002 photos. Herbaceous cover appears to have increased on upper bars since 2002.
Kirkwood 17A	Gravel bar, floodplain	Yes, some young willows have established by layering on back of bar/floodplain at photopoint. *S. lemmonii* observed in flower here.	~25% cover by herbaceous vegetation on downstream gravel bar. Herbaceous vegetation around photopoint appears to have filled in since 2002 and is dominated by horsetail, grasses, sedges.	Upstream and downstream point bars were greatly reduced in extent since 2002, but less evidently so later in season.
Kirkwood 18	Floodplain	No, but dense mature willow on all banks.	Yes, ~95% herbaceous cover by sedges, grasses and forbs.	Gravel bars in 202 photographs are vegetated and/or dispersed; water is deep at all banks here now.
Kirkwood 19	Gravel bar/floodplain	No, but dense mature willow on all banks. *S. lemmonnii* observed in flower here.	Yes, ~90% herbaceous cover by horsetail, sedges, grasses; except for lower portion of bar only exposed late in season.	Gravel bar in 2002 photographs is smaller and mostly dispersed.
Kirkwood 20	Floodplain	2 young willow sprouts observed on floodplain. *S. lemmonnii* observed in fruit here.	~95% herbaceous cover on floodplain by sedges, grasses, forbs.	Downstream gravel bar still mostly barren of vegetation.

Table 2
Conditions Observed at Monitoring Sites, Caples Creek and Kirkwood Creek - 2011

Sample Site	Description	Willow Seedlings or Sprouts Present? Willows in Flower/Fruit?	Herbaceous Vegetation Present? Percent Cover?	Comments
Kirkwood 21	Gravel bar/floodplain	Willows have grown on back of bar/floodplain since 2002.	Upper bar/floodplain has ~95% cover by sedges, grasses, and willows; lower bar is unvegetated.	Adjacent to Site 22
Kirkwood 22	Gravel bar/floodplain	Willows have grown on back of bar/floodplain since 2002. Young willow sprouts also observed above cutbank (*S. lemmonnii*).	Upper bar/floodplain has ~95% cover by sedges, grasses, and willows; lower bar is unvegetated.	Adjacent to Site 21
Kirkwood 23/24	Point bar, gravel/sand	No, but mature willows on all banks.	Sedges, grasses and lupine comprise ~90% cover on terrace above bar; lower gravel bar has ~15% herbaceous cover.	Lower gravel bar appears recently flooded.

Photographs taken at each site during each monitoring period are presented in four appendices to this report. Appendix A presents photographs taken by Harris and Lindquist in 2000; Appendix B presents photos taken by EIP Associates in 2002; and Appendices C and D present photographs taken by AECOM in August and September of 2011, respectively. To aid comparison between time periods, the pagination of each of the appendices is identical; i.e., page 5 in Appendix D shows the same viewpoint for the same photomonitoring site as page 5 of the other appendices.

More flowering and fruiting of willows (both *S. lemmonii* and *S. lucida*) was observed this year than in previous monitoring years, although the peak period of willow flowering/fruiting had passed at the time of the first monitoring visit during August 8-10, 2011 (the female flowers observed were already in fruit). Willow flowering/fruiting was limited and not widespread at either site during this monitoring visit.

No willow seedlings (i.e., willows having germinated from seed this year) were observed at any site. Willow recruitment from seed can be extremely variable from year to year (Roelle and Gladwin 1999) and first year mortality of willow seedlings has been found to be high (Sacchi and Price 1992). However, willows are generally fairly persistent once established, so willow cover may be maintained or increased over time even with rare recruitment events. Observations made during these monitoring studies indicate that willow recruitment at these sites may be more frequently via root layering from terraces or by rooting of cuttings that wash downstream. Several young willow sprouts observed on fluvial deposits this year were from rooted plant fragments that had likely washed downstream and deposited during high flows. These recently rooted cuttings were only apparent as such when they were pulled from the ground and their root structure exposed (Exhibit 2). Some of these fragments were cleanly cut, suggesting they resulted from beaver activity, but others appeared to be branches broken by flooding or other disturbance. Other young willow sprouts were observed at many sites that could have established either by layering, rooted fragments, or from seed.

Additional recruitment of woody vegetation observed within the study area consisted of limited occurrences of lodgepole pine (*Pinus contorta* ssp. *murrayana*) and mountain alder (*Alnus incana* ssp. *tenuifolia*) along Caples Creek.

Examples of willow cuttings/branches that washed downstream and rooted on a point bar at Caples Creek site 11. Several rooted cuttings were observed in this study area; clonal propagation may be an important aspect of willow recruitment in this system.

Willow cutting (cut recently by beavers) recently deposited along a fluvial surface at Caples Creek site 12

Exhibit 2 **Willow Recruitment by Cuttings/Fragments at Caples Creek**

Vegetation recruitment on recent fluvial surfaces (e.g. gravel or sand bars) was almost exclusively herbaceous. The most commonly observed herbaceous species on fluvial surfaces along both creeks included sedges (primarily *Carex nebrascensis* and *C. utriculata*), grasses (primarily *Deschampsia caespitosa, Hordeum brachyantherum*, and *Calamagrostis canadensis*), horsetail (*Equisetum arvense*), and perennial forbs (including *Lupinus polyphyllus, Artemisia douglasiana, Achillea millefolium, Castilleja miniata, Solidago canadensis*, and *Senecio triangularis*). As noted in the 2000 and 2002 reports, herbaceous vegetation recruitment is most vigorous in sites protected by woody debris, near the littoral edges of bars, and near the bar/bank interface.

On both streams it is evident that these gravel/sand bars were deposited at much higher flows, and many would only be inundated during bankfull or higher discharges (particularly along Caples Creek). A great deal of bar evolution and migration has occurred since 2002 along Caples Creek, with many gravel bars that were present in 2002 since disappearing or migrating downstream or across the channel (Table 2, and compare September 2002 photographs [Appendix B] with September, 2011 photographs [Appendix C]).

Caples Creek has been subjected to extensive alterations by the nonnative beaver (*Castor canadensis*) for many years; during the 2000 and 2002 monitoring periods beaver were very active both upstream of and within the Caples Creek study area. Browsing by beavers reduces both the cover and height of willows adjacent to the stream, but it is unknown if browsing reduces the ability of plants to produce flowers and seed. However, this year beaver activity was greatly reduced and hardly evident, aside from observations of a few recently gnawed willow branches at Caples Creek Site 12 (Exhibit 2) and occasionally observed rooted willow cuttings as mentioned above.

Both the Caples Creek and Kirkwood Creek study areas are subjected to limited domestic horse traffic and grazing, but this impact appears to have lessened since 2002 as creek banks and bars were generally undisturbed by horses. It did not appear that horses are currently impacting willow or herbaceous recruitment at either site.

In both 2002 and 2011, an infestation of yellow/orange fungus (rust) was observed on the foliage of the vast majority of willows in both the Caples Creek and Kirkwood Creek study areas. Willow rust (*Melamspora* sp.) is commonly encountered on many species of willow. This phenomenon was widely observed on both species of willow during the late summer (September 19-21) monitoring visits in 2011, but no rust was observed during the August, 2011 visits.

CONCLUSIONS

Willow recruitment and growth has occurred at both the Kirkwood Creek and Caples Creek study areas since 2000/2002. At Kirkwood Creek, most willow sprouts appeared to be from root layering by mature willows into terraces and upper point bars. Kirkwood Creek is surrounded by dense stands of *S. lemmonnii (S. lucida* is absent from this site) with less extensive unvegetated fluvial surfaces for new willow establishment than found on Caples Creek. Willow recruitment at Caples Creek included layering of both species of willow from nearby terraces, as well as multiple instances of apparent willow sprouts that were revealed to be rooted cuttings that had washed downstream. Clonal propagation via cuttings along Caples Creek may be a result of high peak flows along with upstream beaver activity. Riparian ecosystems are often hydrologically and ecologically dynamic, and Caples Creek appears to be a particularly dynamic waterway in that locations and extents of fluvial deposits (i.e., point and mid-channel bars) had changed greatly within that study area since 2000/2002 photographs were taken. We

also observed less active beaver activity at Caples Creek than during previous years and no beaver activity at Kirkwood Creek.

As previously, we found that exposed lower fluvial surfaces (i.e., many gravel bars) generally had little vegetation recruitment near the water level, but protected areas behind woody debris and along backs of bars had greater herbaceous recruitment. We attribute this difference in recruitment to flooding/scouring frequency.

During the August, 2011 surveys, we observed many willows of both species in flower and fruit (S. *lemmonii* along Kirkwood Creek and both *S. lemmonnii* and *S. lucida* at Caples Creek). Even so, we did not observe any recently germinated willow seedlings at either site during either monitoring period, nor were current year seedlings observed during the 2000 and 2002 surveys (young "sprouts" observed were either >1 year old or established clonally). We conclude that establishment of willows from seed in this ecosystem is probably relatively rare.

The Caples Creek and Kirkwood Creek study areas differ in many ways beyond streamflow regulation, and this study is limited in scope in that it only compares these two sites over time. Nevertheless, the results of this monitoring study so far show no reason for concern that streamflow regulation is negatively affecting willow recruitment or cover by riparian vegetation in the Caples Creek study area.

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APPENDIX A

Monitoring Photographs—June 28, 2000 (from Harris and Lindquist 2000)

APPENDIX B

Monitoring Photographs—September 23, 2002 (from EIP Associates, 2002)

APPENDIX C

Monitoring Photographs—August 8-10, 2011

APPENDIX D

Monitoring Photographs – September 19-21, 2011