APPENDIX G:

VEGETATION TECHNICAL INFORMATION AND ANALYSIS

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VEGETATION TECHNICAL INFORMATION AND ANALYSIS

G.1 ANALYSIS METHODS

The analysis of impacts on plant communities is primarily based on the evaluation of four performance metrics that were developed for the Long-Term Experimental and Management Plan (LTEMP) assessment process. The metrics are calculated using the results of an existing state and transition model for Colorado River riparian vegetation downstream from Glen Canyon Dam. Model details are described in Ralston et al. (2014). The four metrics are as follows:

- Relative change in cover of native vegetation community types (other than arrowweed[1]) on sandbars and channel margins using the total percent increase in native states (change in native cover = $\text{cover}_{final}/\text{cover}_{initial}$).

- Relative change in diversity of native vegetation community types (other than arrowweed) on sandbars and channel margins using the Shannon-Weiner Index for richness/evenness (change in diversity = $\text{diversity}_{final}/\text{diversity}_{initial}$).

- Relative change in the ratio of native (other than arrowweed)/nonnative dominated vegetation community types on sandbars and channel margins (change in native/nonnative ratio = $\text{ratio}_{final}/\text{ratio}_{initial}$).

- Relative change in the arrowweed state on sandbars and channel margins using the total percent decrease in arrowweed states (Change in arrowweed = $\text{arrowweed}_{initial}/\text{arrowweed}_{final}$).

These performance metrics were developed from the resource goal for riparian vegetation downstream from Glen Canyon Dam: *Maintain native vegetation and wildlife habitat, in various stages of maturity that is diverse, healthy, productive, self-sustaining, and ecologically appropriate*.

The state and transition model was developed to compare the effects of various flow regimes on Colorado River riparian vegetation. Seven vegetation states are used in the model to represent plant community types found along the river on sandbars and channel margins in the new high-water zone and fluctuation zone. Species associated with a state respond similarly to Colorado River hydrologic factors such as depth, timing, and duration of inundation. These states and the plant species associated with each are given in Table G-1. The model and data used to calculate performance metrics are based on vegetation studies conducted within Grand Canyon National Park and may have limited application to riparian vegetation communities within Glen

[1] This species was selected to be excluded from the native species metrics and to be a fourth metric. It is managed differently than other native species because of its tendency to rapidly establish on sandbars to the exclusion of other species.

Canyon. The model consists of six submodels based on landforms: lower separation bar, upper separation bar, lower reattachment bar, upper reattachment bar, lower channel margin, and upper channel margin. Upper and lower bars are divided at the 25,000 cfs flow stage.

The model uses the daily maximum flow from the GTMax-Lite 2 hydrograph (GTMax-Lite 2 includes hourly flows for the entire 20-year flow period); it does not include daily fluctuations (the range in flows within a day). A total of 63 hydrology-sentiment trace combinations were included in the analysis of each alternative and long-term strategy. Within each run of each alternative, the model identifies the occurrence of hydrologic events, such as spill flows, spring and fall high-flow experiments (HFEs), extended low flows, extended high flows, and growing or non-growing seasons without extended high or low flows, occurring during the growing season (May–September) or non-growing season (October–March) (see Table G-2). The model then records transitions between vegetation states, based on a set of rules developed for each submodel, driven by these hydrologic events. The model includes a subset of states and transition rules for each bar type and channel margin type. The transition rules for the upper portions of the bars and channel margin are the same because of the similarity of plant community types and responses to flow characteristics. The transition rules are based on the effects of scouring, drowning, desiccation, and sediment deposition on riparian plant species. The interrelationships among vegetation states were developed primarily from published vegetation studies based on data collected in Grand Canyon National Park (see Ralston et al. 2014 and citations therein). A subject matter expert team refined the transitions based on extensive field experience in the Colorado River riparian system. Transition rules for the submodels are given in Table G-3. Although the model is a simplification of the complexities of the riparian ecosystem, it is a valuable tool in estimating the changes in riparian vegetation under a variety of flow regimes.

Model results include the total number of years each state occurs for the 20-year period of the model run, according to each potential starting state in each submodel (i.e., the number of years each feature is in each state, based on the transition rules). Each model run starts with each potential state of each submodel, shown in Table G-1. For example, the lower Reattachment Bar submodel uses five different starting states for each hydrologic trace: bare sand, *Phragmites australis* Temperate Herbaceous Vegetation, *Equisetum hyemale* Herbaceous Vegetation, Tamarisk Temporarily Flooded Shrubland, and *Pluchea sericea* Seasonally Flooded Shrubland. Therefore, five model runs, each with a different starting state, are made with the Reattachment Bar submodel for each trace.

G.1.1 Old High-Water Zone Analysis

Plant communities of the old high-water zone are not included in the riparian state and transition model. Therefore, a qualitative assessment was conducted to evaluate impacts of alternatives. The old high-water zone vegetation is located at high flow stage elevations (above 60,000 cfs, but primarily from about 100,000 to approximately 200,000 cfs), well above the level of current dam operations. Dam operations, other than HFEs, are limited to 31,500 cfs flows (generally will not exceed 25,000 cfs), and HFEs do not exceed 45,000 cfs.

None of the alternatives considered would include flows sufficient to maintain these pre-dam plant communities. HFEs could potentially provide occasional soil moisture to some older deep-rooted plants located in the old high-water zone. Dam releases can affect water availability for plants at elevations up to approximately 15,000 cfs above discharge levels (Melis et al. 2006; Ralston 2005). Alternatives with more frequent spring HFEs—such as Alternative F, with annual spring HFEs, or Alternative G; Alternative C, long-term strategies C1 and C2; and Alternative D, long-term strategies D1–D4, all with considerably more spring HFEs than Alternative A—may result in higher survival rates of plants at lower elevations of the old high-water zone than under Alternative A. Spill flows (between 45,000 and 85,000 cfs) would provide soil moisture to old high-water zone plants; however, these have not occurred since the mid-1980s. Periodic spill flows could occur within the 20-year period of this evaluation, but would likely be infrequent and would occur equally under all alternatives. Because of a lack of sufficiently high flows and nutrient-rich sediment, mortality of pre-dam plants within this zone has been occurring for decades, along with a lack of seedling establishment for some species, such as mesquite and hackberry (Kearsley et al. 2006; Anderson and Ruffner 1987; Webb et al. 2011). Because of generally continued low soil moisture and lack of recruitment opportunities under all alternatives, the upper margins of this zone would be expected to continue moving downslope, with a continued narrowing of this zone. Desert species occurring on the pre-dam flood terraces and aeolian deposits above the Old High-Water Zone would increasingly establish within this zone.

G.1.2 New High-Water Zone

The four metrics, (1) relative change in cover of native vegetation community types, (2) relative change in diversity of native vegetation community types, (3) relative change in the ratio of native/nonnative dominated vegetation community types, and (4) relative change in the arrowweed state, were calculated from the model results for each alternative and long-term strategy. The four native-dominated states are *Phragmites australis* Temperate Herbaceous Vegetation, *Salix exigua-Baccharis emoryi* Shrubland/*Equisetum laevigatum* Herbaceous Vegetation, *Populus fremontii*/*Salix exigua* Forest, and *Prosopis glandulosa* var. *torreyana* Shrubland. Two of these states, both of which represent wetland community types, are further discussed below. Although arrowweed is a native species, because of its invasive characteristics and tendency to form monocultures, the *Pluchea sericea* Seasonally Flooded Shrubland state is excluded from the native states in the performance metrics.

Model results were used to calculate the performance metrics for each alternative/long-term strategy using the sum of years of each of the states for all six models. This value is then compared to the number of years each state would have accumulated if the current condition was maintained (i.e., if no transitions occurred and each of the seven states remained the same for the full 20 years of the model run). This proportion was then multiplied by the acreage of mapped cover types from the NPS Vegetation Map of Grand Canyon National Park (Table G-4) corresponding to the seven model states (Table G-5). This final acreage and the initial mapped acreage were then used to calculate the performance metrics.

The results for the four metrics were then summed to derive a final score for each alternative long-term strategy. Alternatives with higher scores were considered to have come closer to achieving the resource goal.

The 63 hydrology-sediment trace combinations used in the model runs were developed from the historical record (see Section 4.1 of the DEIS for a detailed description). Twenty-one potential Lake Powell inflow scenarios for the 20-year LTEMP period were sampled from the 105-yr historic record (water years 1906–2010), producing 21 hydrology traces for analysis. In addition, three 20-year sequences of sediment input from the Paria River sediment record (water years 1964–2013) were analyzed. In combination, the analysis considered 63 possible hydrology-sediment scenarios. An assumption underlying the model results is that future river flows will be similar to past flows. To examine the effect of potential climate change, each of the traces used in the model runs was then differentially weighted (see Section 4.17.1.2). Weights were developed based on climate change projections of the 2012 Colorado River Basin Water Supply and Demand Study (Reclamation 2012). These assigned weights thus reflect the likelihood of occurrence of each hydrology trace under potential future climate change, emphasizing the drier scenarios. The model result for each trace was then multiplied by the assigned weight.

G.1.2.1 Native Cover Metric

Relative change in cover of native vegetation community types (other than arrowweed) on sandbars and channel margins using the total percent increase in native states (change in native cover = $cover_{final}/cover_{initial}$).

The results for the Native Cover metric based on historical flows are shown in Figure G-1. The two highest-scoring long-term strategies, E6 and E3, are significantly different from the others (differences between means of the 63 traces based on a three-factor ANOVA followed by Tukey's Studentized Range [HSD] Test) but not from each other. Results under projected climate change are similar to those for historical flows (all alternatives score slightly higher) and are shown in Figure G-2; thus the relative performance of each alternative under climate change would be similar to that modeled under historical conditions.

To illustrate the relative change in native cover, the modeled acreage changes for several alternative/long-term strategies are shown in Table G-6.

Native states tend to increase with growing and non-growing seasons without extended high or low flows. Bare Sand, Tamarisk Temporarily Flooded Shrubland, and *Pluchea sericea* Seasonally Flooded Shrubland tend to increase with extended high and extended low flows. The effect of differences between hydrologic traces is greater than the effect of differences between alternatives.

G.1.2.2 Native Diversity Metric

Relative change in diversity of native vegetation community types (other than arrowweed) on sandbars and channel margins using the Shannon-Weiner Index for richness/evenness (change in diversity = $diversity_{final}/diversity_{initial}$).

The Native Diversity metric is calculated using the Shannon-Weiner Index for richness/evenness: $-\Sigma(p_i)(\log_2 p_i)$ where p_i is the proportion of the *i*-th state of the total native cover. The calculations use the initial mapped cover and final (modeled) cover of each of the four native-dominated states. The results for the Native Diversity metric based on historical flows are shown in Figure G-3; the two highest scoring alternatives—Alternative E, long-term strategy E4, and Alternative B, long-term strategy B1—are not significantly different from each other (differences between means based on a three-factor ANOVA followed by Tukey's Studentized Range [HSD] Test); long-term strategy B1 is not significantly different from long-term strategies D3 and D2. Results under projected climate change are similar to those for historical flows, with 11 alternatives showing a slight increase and eight with a slight decrease, and are shown in Figure G-4; thus the performance of each alternative under climate change would be similar to that modeled under historical conditions. The results for all alternatives include all states. Therefore, there is no difference in the number of states between alternatives; diversity is increased by the evenness of states. For example, long-term strategy B2 and Alternative F, which are somewhat lower scoring, have a low representation of the *Phragmites australis* Temperate Herbaceous Vegetation state, while long-term strategies B1 and E4, somewhat higher scoring, have a relatively high representation of that state. The transition to the *Phragmites australis* Temperate Herbaceous Vegetation state from the bare sand state in the lower reattachment bar is slowed by growing season extended high flows, and growing season extended low or high flows contribute to transitions of the *Phragmites australis* Temperate Herbaceous Vegetation state to other states. The effect of differences between alternatives is greater than the effect of differences between hydrologic traces.

G.1.2.3 Native/Nonnative Ratio Metric

Relative change in the ratio of native (other than arrowweed)/nonnative dominated vegetation community types on sandbars and channel margins (change in native/nonnative ratio = $ratio_{final}/ratio_{initial}$).

The Native/Nonnative Ratio metric is calculated using the ratio of the cover of each of the four native-dominated states to the cover of the tamarisk state. The ratio of the final (modeled) cover is then divided by the ratio of the initial mapped cover. The results for the Native/Nonnative Ratio metric based on historical flows are shown in Figure G-5; the three highest-scoring long-term strategies, E6, E3, and E5, are not significantly different from each other (between means based on a three-factor ANOVA followed by Tukey's Studentized Range [HSD] Test); long-term strategy E5 is not significantly different from long-term strategy B1. Results under projected climate change are similar to those for historical flows (all alternatives score slightly higher) and are shown in Figure G-6; thus the performance of each alternative under climate change would be similar to that modeled under historical conditions.

Native states tend to increase with growing and non-growing seasons without extended high or low flows. The tamarisk state tends to increase with extended high flows followed by extended low flows, as well as spring HFEs with an extended low or high flow. Under Alternative C, long-term strategy C1, and Alternative F, high flows shift all states to sand, which then shifts to tamarisk (e.g., lower reattachment bar, growing season extended low).

G.1.2.4 Arrowweed Metric

Relative change in the arrowweed state on sandbars and channel margins using the total percent decrease in arrowweed states (change in arrowweed = $\text{arrowweed}_{initial}/\text{arrowweed}_{final}$). The results for the arrowweed metric based on historical flows are shown in Figure G-7; the two highest-scoring long-term strategies, C1 and C2, are not significantly different from each other (between means based on a three-factor ANOVA followed by Tukey's Studentized Range [HSD] Test); long-term strategy C2 is not significantly different from Alternatives F and G. Results under projected climate change are similar to those for historical flows (all alternatives score slightly lower) and are shown in Figure G-8; thus the performance of each alternative under climate change would be similar to that modeled under historical conditions (Alternative F would be the highest scoring, however).

To illustrate the relative change in arrowweed, acreage changes for several alternatives/long-term strategies are shown in Table G-7.

The arrowweed state tends to increase with extended high and extended low flows, but this increase can be slowed by fall HFEs. The effect of differences between hydrologic traces is greater than the effect of differences between alternatives.

G.1.2.5 Overall Score

The results for the overall score based on historical flows are shown in Figure G-9; The six highest-scoring long-term strategies, D4, E4, E6, E3, E5, and B1, are not significantly different from each other (between means based on a three-factor ANOVA followed by Tukey's Studentized Range [HSD] Test); long-term strategies E5 and B1 are not significantly different from long-term strategy E2. These alternatives included the five highest scores in the Native Cover metric and Native/Nonnative Ratio. The lowest scoring is long-term strategy C3, which is the lowest in the arrowweed metric and consistently low scoring in the other metrics. Results under projected climate change are similar to those for historical flows, with four alternatives showing a slight decrease and all others with a slight increase, and are shown in Figure G-10; thus the performance of each alternative under climate change would be similar to that modeled under historical conditions.

For the overall score, the effects of the differences between alternatives are greater than the effects of differences between hydrologic traces; sediment traces 1 and 2 are significantly different.

In reviewing the components of the overall score:

- Native Cover Index: long-term strategies E6 and E3 are the highest scoring; native states tend to increase with growing and non-growing seasons without extended high or low flows.

- Native Diversity Index: long-term strategies E4 and B1 are the highest scoring. The transition to the *Phragmites australis* Temperate Herbaceous Vegetation state from the bare sand state in the lower reattachment bar is slowed by growing season extended high flows, reducing diversity, and growing season extended low or high flows contribute to transitions of the *Phragmites australis* Temperate Herbaceous Vegetation state to other states.

- Native/Nonnative Ratio: long-term strategies E6, E3, and E5 are the highest scoring; the tamarisk state tends to increase with extended high flows followed by extended low flows, as well as spring HFEs with an extended low or high flow.

- Arrowweed Index: long-term strategies C1and C2 are the highest scoring; the arrowweed state tends to increase with extended high and extended low flows.

G.1.3 Wetlands

Two of the model states discussed above represent wetland community types: *Phragmites australis* Temperate Herbaceous Vegetation, a marsh community; and *Salix exigua-Baccharis emoryi* Shrubland/*Equisetum laevigatum* Herbaceous Vegetation, a shrub wetland community. These occur on the lower reattachment bar and lower channel margin (as well as lower reattachment bar), respectively (Table G-1), and occupy 4.4 and 0.2 ac, respectively (Table G-5). The relative change in cover of these wetland community types was calculated from the model results using the method described for metric 1 above. The results for the 19 alternatives/long-term strategies are presented in Figure G-11 (a score of 1.0 means no change from initial conditions). Only Alternative E long-term strategies E3, E5, and E6 show an increase in wetland community cover (based on mean scores); all others show a decrease. Decreases of greater than 50% occur under Alternative B, long-term strategy B2; Alternative C; Alternative F; and Alternative G. Results under projected climate change are similar to those for historical flows (all alternatives score slightly higher; however, Alternative F shows only a minimal increase), and are shown in Figure G-12; thus the performance of each alternative under climate change would be similar to that modeled under historical conditions.

G.2 ALTERNATIVE-SPECIFIC IMPACTS

This section provides additional information related to the impacts of alternatives, specifically the impacts associated with the long-term strategies that were analyzed for condition-dependent alternatives (Alternatives B, C, D, and E). This analysis supplements the information presented in Section 4.6 of the DEIS.

G.2.1 Alternative A (No Action Alternative)

Alternative A includes sediment-triggered spring and fall HFEs through 2020 (no spring HFEs until 2015). Alternative A has higher monthly volumes in the high electricity demand months of December, January, July, and August. This alternative has fewer spring and fall HFEs than other alternatives, occasional extended low flows, and more frequent extended high flows than most other alternatives, the latter being particularly frequent in the growing season. The model results for each of the metrics as well as the overall score are presented in Table G-8.

G.2.2 Alternative B

Alternative B includes spring and fall HFEs (the number of HFEs not to exceed one every other year). This alternative lacks low summer flows, and has higher monthly volumes December–January and July–August. Alternative B has few spring HFEs, similar to Alternative A, but it also has more fall HFEs than Alternative A. The expected number of HFEs would be lower under this alternative than under any other. This alternative has the same monthly pattern in release volume as the Alternative A; however, Alterative B has no extended low flows; long-term strategy B1 has a slightly greater frequency of extended high flows compared to Alternative A, and long-term strategy B2 has considerably more extended high flows than long-term strategy B1—far more than any other alternative long-term strategy. The results for this alternative are presented for long-term strategy B1 (Table G-9), followed by long-term strategy B2 (Table G-10).

G.2.3 Alternative C

Alternative C includes spring and fall HFEs in long-term strategies C1 and C2, fall HFEs only in long-term strategy C4, and no HFEs in long-term strategy C3; proactive spring HFEs are tested in April, May, or June in high-volume years. This alternative features low summer flows in some years in long-term strategy C2, and has highest monthly release volumes December–January and July, and lower volumes from August through November. Long-term strategies C1–C4 have more extended low flows and fewer growing season extended high flows than Alternative A (although long-term strategies C2–C4 have more growing season extended high flows than long-term strategy C1); long-term strategy C3 has slightly more non-growing season extended high flows than the other Alternative C long-term strategies. Long-term strategies C1 and C2 have considerably more spring and fall HFEs than Alternative A; the number of long-term strategy C4 fall HFEs is similar to those of long-term strategies C1 and C2. The model results for each of the metrics, as well as the overall score for this alternative, are presented for long-term strategy C1 (Table G-11), followed by long-term strategies C2 (Table G-12), C3 (Table G-13), and C4 (Table G-14).

G.2.4 Alternative D (Preferred Alternative)

Alternative D includes spring (March–April) and fall (October–November) HFEs; proactive spring HFEs (24 hours, 45,000 cfs) would be tested (April, May, or June) in high-volume years; no spring HFEs the first 2 years; and extended-duration fall HFEs (up to 250-hour duration, up to 45,000 cfs), up to four in a 20-year period. As a result, Alternative D has a greater frequency of fall and spring HFEs compared to the Alternative A. Monthly water volumes would be similar to Alternative E but August and September would have higher volumes and January through July would be slightly lower than Alternative E. A 2- or 3-year test for invertebrate production would reduce flows to the minimum flow for the month on Saturdays and Sundays in May through August starting the third year of the LTEMP period; if successful, these flows would be implemented for the remainder of the LTEMP period (up to 18 years total), resulting in few, if any, growing season extended high flows during those years. Low summer flows (July, August, September) would be tested in two or three of the second 10 years. This alternative has very few growing season extended low flows, as well as slightly fewer non-growing season extended low or high flows, due to the monthly pattern of flows as well as the amount of daily fluctuations. Alternative D has frequent growing season extended high flows but not as many as under Alternative A. Seasons, especially non-growing seasons, without extended low or high flows are frequent. The model results for each of the metrics as well as the overall score for this alternative are presented for long-term strategy D1 (Table G-15) followed by long-term strategies D2 (Table G-16), D3 (Table G-17), and D4 (Table G-18).

G.2.5 Alternative E

Alternative E includes spring and fall HFEs; no spring HFEs in first 10 years; rapid response is tested every fourth HFE matching Paria flood; spring and fall HFEs in long-term strategies E1 and E2; fall HFEs only in long-term strategy E4; and no HFEs in long-term strategies E3, E5, and E6. This alternative has lower monthly water volumes in August, September, and October. Low summer flows occur in some years (triggered) of the second 10 years in long-term strategies E2 and E5. Long-term strategies E1–E6 have fewer growing season extended high flows than Alternative A, (long-term strategies E2 and E5 have slightly more than the other Alternative E long-term strategies); and more HFEs than Alternative A. Long-term strategies E1 and E2 have similar numbers of HFEs; the number of long-term strategy E4 fall HFEs is similar to long-term strategies E1 and E2. The model results for each of the metrics as well as the overall score for this alternative are presented for long-term strategy E1 (Table G-19), followed by long-term strategies E2 (Table G-20), E3 (Table G-21), E4 (Table G-22), E5 (Table G-23), and E6 (Table G-24).

G.2.6 Alternative F

Alternative F includes spring and fall HFEs; peak flows in May and June; base flows from July through January; and a 168-hour (7-day) 25,000 cfs flow at the end of June. This alternative also features higher volumes than Alternative A April–June, and lower volumes than Alternative A in the other months. This alternative has more extended low flows, slightly fewer extended high flows, and considerably more HFEs than Alternative A (more than any other alternative). The model results for each of the metrics as well as the overall score for this alternative are presented in Table G-25.

G.2.7 Alternative G

Alternative G includes spring and fall HFEs; HFEs can extend for up to 336 hours (2 weeks); proactive spring HFEs are tested in high-volume years; and monthly volumes vary only in response to runoff forecast and other requirements. This alternative has more extended low flows and fewer extended high flows than Alternative A. The model results for each of the metrics, as well as the overall score for this alternative, are presented in Table G-26.

G.3 SUMMARY

Transitions between plant community types, or to bare sand, are driven by specific flow events that vary among the alternatives. Spring HFEs, fall HFEs, spill flows, extended low flows, extended high flows, and seasons without extended high or low flows occurring during the growing or non-growing season result in changes in the distribution and cover of New High Water Zone plant communities.

HFEs result in sediment deposition, but scouring is minor and limited to low-elevation wetland species. HFEs transport seeds of nonnative as well as native species. Repeated extended high flows result in removal of vegetation by drowning and scouring, primarily on lower elevation surfaces. Increased soil moisture at upper elevations from extended high flows can increase vegetation growth and seedling establishment. The germination of seeds transported by HFEs or extended high flows is promoted by extended low flows (e.g., elevated base flows) that reduce disturbance, expose lower elevation surfaces, and maintain soil moisture at lower elevations, all of which are conducive to seedling growth. Extended low flows also can result in the lowering of groundwater levels, thus increasing the depth to groundwater and the reduction of soil moisture, creating conditions that favor the growth of more drought-tolerant species.

Repeated seasons of extended high flows, extended high flows above 50,000 cfs, or spill flows transition native communities to bare sand through the processes of drowning, scouring, and burial. All the alternatives would result in a decrease in native plant community cover. Wetland communities generally transition only from bare sand or other wetlands; they can transition back to bare sand or to arrowweed, tamarisk, or cottonwood-willow communities. Alternatives that include frequent extended low flows, such as annually for Alternative F, or extended high flows followed by extended low flows tend to result in transitions of wetlands to other plant community types. All the alternatives are expected to result in a decrease in wetland cover, with particularly large decreases for Alternative F.

The overall cover of tamarisk-dominated communities would be expected to increase under Alternatives C, F, and G, each of which is expected to produce frequent transitions to tamarisk communities, in large part because they frequently have extended high flows, extended low flows, and spring HFEs. This combination of flows encourages transitions to tamarisk because tamarisk increases when high flows coincide with seed release during spring and early summer, followed by lower flows, all of which results in establishment of seedlings above the elevation of subsequent floods. Also, under these alternatives, various community types frequently shift to bare sand, which then shifts to tamarisk. Each of these alternatives has more extended low flows and more spring HFEs than the other alternatives. The overall cover of the tamarisk is expected to decrease under Alternatives A, B, D, and E. Each of these alternatives has frequent extended high flows, which result in consecutive seasons and consecutive years of extended high flows. Two or more years of extended high flows are required for tamarisk to be removed by drowning, leaving a bare sand lower reattachment bar, or two consecutive seasons on a lower separation bar.

The overall cover of the arrowweed community would be expected to increase under Alternatives A, B, and E; under these alternatives, bare sand would transition to arrowweed rather than tamarisk because there are few spring HFEs and/or few growing-season extended high flows, both of which promote the establishment of tamarisk on bare sand, and, except in Alternative B, arrowweed would transition from marsh because of growing-season extended low flows. Once established, arrowweed would tend to remain for many years under these alternatives. HFEs alone are not effective at reducing arrowweed as burial typically results in resprouting from roots, buried stems, and rhizomes, and subsequent vegetative growth occurs. Arrowweed would decrease under Alternatives C, D, F, and G, usually by transitioning to bare sand with repeated extended high flows, but often by transitioning to tamarisk.

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TABLE G-1 Vegetation States, Plant Associations, and Corresponding Submodels

Vegetation States	Primary Plant Species	Additional Species	Submodel/Landform
Bare Sand	<1% vegetation		All submodels
Phragmites australis Temperate Herbaceous Vegetation[a]	Common reed (*Phragmites australis*), cattail (*Typha domingensis*, *T. latifolia*)	Common tule (*Schoenoplectus acutus*), creeping bent grass (*Agrostis stolonifera*)	Lower Reattachment Bar
Salix exigua–Baccharis emoryi Shrubland/ *Equisetum laevigatum* Herbaceous Vegetation[a]	Horsetail (*Equisetum laevigatum*), coyote willow (*Salix exigua*), *Baccharis emoryi*, *Schoenoplectus pungens*	*Eleocharis palustris, Muhlenbergia asperifolia*	Lower Channel Margin, Lower Reattachment Bar
Tamarix spp. Temporarily Flooded Shrubland[b]	Tamarisk (*Tamarix* spp.)		All submodels
Populus fremontii/Salix exigua Forest[a]	Coyote willow, cottonwood (*Populus fremontii*)	*Salix gooddingii, Baccharis salicifolia, Distichlis spicata, Muhlenbergia asperifolia, Phragmites australis*, *Equisetum* spp., *Juncus spp.*, *Carex* spp., *Elaeagnus angustifolia, Tamarix* spp., *Poa pratensis, Melilotus* spp.	Lower Channel Margin, Lower Separation Bar
Pluchea sericea Seasonally Flooded Shrubland	Arrowweed (*Pluchea sericea*)	*Baccharis* spp., *Mesquite* (*Prosopis glandulosa*), coyote willow	Lower Reattachment Bar, Upper Separation Bar, Upper Reattachment Bar, Upper Channel Margin
Prosopis glandulosa var. *torreyana* Shrubland[a]	Mesquite (*Prosopis glandulosa* var. *torreyana*)	*Baccharis* spp., *Pluchea sericea*,	Lower Channel Margin, Upper Separation Bar, Upper Reattachment Bar, Upper Channel Margin

[a] Native-dominated states used in the metric calculations.

[b] Nonnative-dominated state used in the metric calculations.

Source: Ralston et al. (2014).

TABLE G-2 Hydrologic Events Considered in the Riparian Vegetation Model

Event	Flow Range	Timing
Spill flow[a]	>45,000 cfs one day or more	Any month
Spring HFE	>31,500 cfs to ≤45,000 cfs, less than 30 days[b]	March–June
Fall HFE	>31,500 cfs to ≤45,000 cfs, less than 30 days[b]	October–December
Extended low flow	≤10,000 cfs for at least 30 consecutive days	Growing season; non-growing season
Extended high flow	≥20,000 cfs to ≤45,000 cfs for at least 30 consecutive days	Growing season; non-growing season
Growing or non-growing seasons without extended high or low flows	Flows that can fluctuate up to 25,000 cfs (i.e., the absence of spill flows or extended high or extended low flows)	Growing season; non-growing season

[a] Spill flows (i.e., flows that include releases through the spillway, and total >45,000 cfs) are not a function of the alternatives, but rather a function of annual hydrology. These do not differ among the alternatives.

[b] A peak or spike in flow between 31,500 cfs and 45,000 cfs that begins or ends below 31,500 cfs is considered an HFE.

TABLE G-3 Riparian Vegetation Model Transition Rules

Transition	From	To	Trigger	Notes
Upper Separation Bar				
T1	Bare Sand	*Pluchea sericea* Seasonally Flooded Shrubland	*Pluchea* cover[a] = 30%	*Pluchea* growth variable (before T1 transition): cover starts at 1% in bare sand frame; non-growing season extended low flow or season without extended high or low flow + growing season extended low flow or season without extended high or low flow same year = 5%; non-growing season extended low flow or season without extended high or low flow + growing season extended high flow same year = 7.5%; non-growing season extended high flow + growing season extended low flow or season without extended high or low flow same year = 7.5%; non-growing season extended high flow + growing season extended high flow same year = 10%; fall HFE same year = increase × 0.5
T2	Bare Sand	Tamarisk Temporarily Flooded Shrubland	Spring HFE + growing season extended high flow same year	*Pluchea* cover must be ≤10%
T3	Tamarisk Temporarily Flooded Shrubland	*Prosopis glandulosa* var. torreyana Shrubland	*Prosopis* cover = 25%	*Prosopis* growth variable (before T3 transition): cover starts at 0% in tamarisk frame; spring HFE + growing season without extended high or low flow same year = +2%; spring HFE + growing season extended high flow same year = +2%; growing season extended low flow = -0.5%
T4	Tamarisk Temporarily Flooded Shrubland, *Pluchea sericea* Seasonally Flooded Shrubland, or *Prosopis glandulosa* var. *torreyana* Shrubland	Bare Sand	Spill flow; <u>OR</u> any season extended high flow > 50K cfs	Extended high flow must be >50K cfs

TABLE G-3 (Cont.)

Transition	From	To	Trigger	Notes
Lower Separation Bar				
T1	Bare Sand	*Populus fremontii/Salix exigua* forest	*Populus/Salix* cover = 20%	*Populus/Salix* growth variable (before T1 transition): cover starts at 1% in S1 frame; non-growing season without extended high or low flow + growing season without extended high or low flow same year = +3%; non-growing season extended high flow + growing season without extended high or low flow same year = cover × 0.5
T2	Bare Sand	Tamarisk Temporarily Flooded Shrubland	Non-growing season extended high flow + growing season extended low flow same year; <u>OR</u> spring HFE + growing season extended low flow same year	
T3	Tamarisk Temporarily Flooded Shrubland or *Populus fremontii*/*Salix exigua* Forest	Bare Sand	Non-growing season or growing season spill flow; <u>OR</u> non-growing season extended high flow + growing season extended high flow same year; <u>OR</u> growing season extended high flow + non-growing season extended high flow next year	
Lower Reattachment Bar				
T1	Bare Sand	*Phragmites australis* Temperate Herbaceous Vegetation	*Phragmites* cover = 20%	*Phragmites* growth variable (before T1 transition): growing season without extended high or low flow = +10%; growing season extended high flow set to 0

TABLE G-3 (Cont.)

Transition	From	To	Trigger	Notes
Lower Reattachment Bar (Cont.)				
T2	*Phragmites australis* Temperate Herbaceous Vegetation	*Salix exigua-Baccharis emoryi* shrubland/*Equisetum laevigatum* Herbaceous Vegetation	Growth variable = 4 (see "Notes" column of this table for growth variable calculation)	*Salix-Baccharis/Equisetum* growth variable (before T2 transition): non-growing season without extended high or low flow + growing season without extended high or low flow same year = +1; fall HFE or spring HFE = -1; any season extended high flow sets to 0. Values are not additive within a year; e.g., fall HFE + spring HFE in same year is still -1. Non-growing season extended low flow = season without extended high or low flow.
T3	*Salix exigua-Baccharis emoryi* Shrubland/*Equisetum laevigatum* Herbaceous Vegetation	Tamarisk Temporarily Flooded Shrubland	Non-growing season extended high flow + growing season extended low flow same year; OR growing season extended high flow + next year growing season extended low flow	
T4	*Phragmites australis* Temperate Herbaceous Vegetation, or *Salix exigua-Baccharis emoryi* Shrubland/*Equisetum laevigatum* Herbaceous Vegetation, or *Pluchea sericea* Seasonally Flooded Shrubland	Bare Sand	Non-growing season extended high flow + growing season extended high flow same year; OR growing season extended high flow + non-growing season extended high flow next year; OR growing season extended high flow + growing season extended high flow next year; OR any spill flow	
T5	*Phragmites australis* Temperate Herbaceous Vegetation	Tamarisk Temporarily Flooded Shrubland	Non-growing season extended high flow + growing season extended low flow same year OR growing season extended high flow + growing season extended low flow next year	

TABLE G-3 (Cont.)

Transition	From	To	Trigger	Notes
Lower Reattachment Bar (Cont.)				
T6	Tamarisk Temporarily Flooded Shrubland	Bare Sand	Growing season extended high flow + non-growing season extended high flow in sequence of 4; OR growing season extended high flow in sequence of 4; OR any season spill flow	Does not have to be same year
T7	Bare Sand	Tamarisk Temporarily Flooded Shrubland	Growing season extended low flow	
T8	*Pluchea sericea* Seasonally Flooded Shrubland	Tamarisk Temporarily Flooded Shrubland	Growing season extended high flow + growing season extended low flow the next year OR non-growing season extended high flow + growing season extended low flow same year	
T9	*Phragmites australis* Temperate Herbaceous Vegetation	*Pluchea sericea* Seasonally Flooded Shrubland	Growing season extended low flow	NOT if non-growing season extended high flow same year (then *Phragmites* transitions to tamarisk).
Lower Channel Margin				
T1	Bare Sand	*Salix exigua-Baccharis emoryi* Shrubland/*Equisetum laevigatum* Herbaceous Vegetation	Growth variable = 4 (see *Notes* for growth variable calculation)	*Salix-Baccharis/Equisetum* growth variable (before T1 transition): non-growing season without extended high or low flow + growing season without extended high or low flow same year = +1; growing season extended low flow = -1; fall HFE or spring HFE = -1; any season extended high flow sets to 0. Values are not additive within a year; e.g., fall HFE + growing season extended low flow in same year is still -1.

TABLE G-3 (Cont.)

Transition	From	To	Trigger	Notes
Lower Channel Margin (Cont.)				
T2	*Salix exigua-Baccharis emoryi* Shrubland/*Equisetum laevigatum* Herbaceous Vegetation	*Populus fremontii/Salix exigua* Forest	Non-growing season extended high flow + growing season extended low flow same year; OR growing season extended high flow + next year growing season extended low flow	
T3	Bare Sand	Tamarisk Temporarily Flooded Shrubland	Non-growing season extended high flow + growing season extended low flow	*Salix-Baccharis/Equisetum* must be ≤2.
T4	Tamarisk Temporarily Flooded Shrubland	*Prosopis glandulosa* var. *torreyana Shrubland*	*Prosopis* cover = 25%	*Prosopis* growth variable (before T4 transition): cover starts at 0% in woody riparian tamarisk frame; spring HFE + growing season without extended high or low flow same year = 2%; spring HFE + growing season extended high flow = 2%; growing season extended low flow = -0.5%
T5	Tamarisk Temporarily Flooded Shrubland, *Populus fremontii/Salix exigua* Forest, *Prosopis glandulosa* var. *torreyana* Shrubland	Bare Sand	Any season spill flow; OR any season extended high flow >50K cfs	Extended high flow must be >50K cfs
T6	*Salix exigua-Baccharis emoryi* Shrubland/*Equisetum laevigatum* Herbaceous Vegetation	Bare Sand	Any season extended high flow >25K cfs	Extended high flow must be >25K cfs

[a] Percent cover refers to the overall percentage of a hypothetical geomorphic feature (e.g., lower reattachment bar) beneath a vertical projection of the vegetation canopy.

TABLE G-4 New High-Water Zone and Old High-Water Zone Vegetation Classes Mapped from Lees Ferry to Diamond Creek[a]

Vegetation Class	Dominant Species	Area (ac)
New High-Water Zone		
Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation	Cattail, common reed	4.4
Tamarix spp. Temporarily Flooded Semi-natural Shrubland	Tamarisk	273.7
Baccharis spp.–*Salix exigua*–*Pluchea sericea* Shrubland Alliance	*Baccharis* spp., coyote willow, arrowweed	354.7
Prosopis glandulosa var. *torreyana* Shrubland	Western honey mesquite	137.1
Abronia elliptica Herbaceous Dune Vegetation	Fragrant white sand verbena	4.0
Acacia greggii Shrubland	Catclaw acacia	30.4
Arctostaphylos–*Quercus turbinella* Shrubland Alliance	Bearberry, live oak	2.2
Artemisia bigelovii Shrubland Alliance	Bigelow sagebrush	1.1
Artemisia tridentata Shrubland Alliance	Big sagebrush	2.4
Brickellia longifolia–*Fallugia paradoxa*–*Isocoma acradenia* Shrubland	Longleaf brickellbush, Apache plume, goldenbush	65.5
Encelia (*farinosa, resinifera*) Shrubland Alliance	Brittlebush, sticky brittlebush	401.0
Ephedra (*torreyana, viridis*) Mixed Semi-desert Grasses Shrubland	Mormon tea, green ephedra	29.0
Ephedra fasciculate Mojave Desert Shrubland Alliance	Arizona joint-fir	103.6
Ephedra torreyana–*Opuntia basilaris* Shrubland	Mormon tea, beavertail cactus	64.0
Gutierrezia (*sarothrae, microcephala*)–*Ephedra* (*torreyana, viridis*) Mojave Desert Shrubland Alliance	Snakeweed, broom snakeweed, Mormon tea, green ephedra	14.5
Larrea tridentata–*Encelia* spp. Shrubland Alliance	Creosote, brittlebush	15.3
Sparsely Vegetated Slickrock	–[b]	5.4
Other[c]	–	5.0

TABLE G-4 (Cont.)

Vegetation Class	Dominant Species	Area (ac)
Old High-Water Zone		
Abronia elliptica Herbaceous Dune Vegetation	Fragrant white sand verbena	5.7
Acacia greggii Shrubland	Catclaw acacia	56.1
Artemisia tridentata Shrubland Alliance	Big sagebrush	1.1
Baccharis spp.–*Salix exigua–Pluchea sericea* Shrubland Alliance	*Baccharis* spp., coyote willow, arrowweed	200.2
Brickellia longifolia–Fallugia paradoxa–Isocoma acradenia Shrubland	Longleaf brickellbush, Apache plume, goldenbush	78.5
Encelia (*farinosa, resinifera*) Shrubland Alliance	Brittlebush, sticky brittlebush	438.1
Ephedra (*torreyana, viridis*) Mixed Semi-desert Grasses Shrubland	Mormon tea, green ephedra	41.4
Ephedra fasciculata Mojave Desert Shrubland Alliance	Arizona joint-fir	120.1
Ephedra torreyana–(*Atriplex canescens, Atriplex confertifolia*) Sparse Vegetation	Mormon tea, four-wing saltbush, shadscale	2.1
Ephedra torreyana–Opuntia basilaris Shrubland	Mormon tea, beavertail cactus	109.7
Great Basin and Intermountain Ruderal Dry Shrubland and Grassland Group	–	1.1
Gutierrezia (*sarothrae, microcephala*)–*Ephedra* (*torreyana, viridis*) Mojave Desert Shrubland Alliance	Snakeweed, broom snakeweed, Mormon tea, green ephedra	24.0
Larrea tridentata–Encelia spp. Shrubland Alliance	Creosote, brittlebush	41.4
Pleuraphis rigida Herbaceous Vegetation	Big galleta	1.3
Prosopis glandulosa var. *torreyana* Shrubland	Western honey mesquite	315.9
Sparsely Vegetated Slickrock	–	1.4
Tamarix spp. Temporarily Flooded Semi-natural Shrubland	Tamarisk	224.6
Unvegetated Surfaces and Built-up Areas	–	32.1
Other[c]	–	6.4

Footnotes on next page.

TABLE G-4 (Cont.)

[a] The New High-Water Zone and Old High-Water Zone were separated at the 45,000 cfs stage elevation.

[b] – = No dominant species identified.

[c] Includes all vegetation classes with less than 1 ac mapped within the zone.

Source: Kearsley et al. (2015).

TABLE G-5 Vegetation States and Corresponding Mapped Vegetation Types

Vegetation States	Mapped Vegetation Classes[a]	Area (acres)
Bare Sand	Unvegetated Surfaces and Built Up Areas	112
Phragmites australis Temperate Herbaceous Vegetation	*Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation	4.4
Salix exigua Baccharis emoryi shrubland/*Equisetum laevigatum* Herbaceous Vegetation	Arid West Emergent Marsh	0.2
Tamarisk Temporarily Flooded Shrubland	*Tamarix* spp. Temporarily Flooded Semi-natural Shrubland	273.7
Populus fremontii/Salix exigua Forest	*Baccharis* spp.–*Salix exigua–Pluchea sericea* Shrubland Alliance	177.3[b]
Pluchea sericea Seasonally Flooded Shrubland	*Baccharis* spp.–*Salix exigua–Pluchea sericea* Shrubland Alliance	177.3[b]
Prosopis glandulosa var. *torreyana* Shrubland	*Prosopis glandulosa* var. *torreyana Shrubland*	137.1

[a] Kearsley et al. (2015), which mapped river miles 0–278; vegetation classes and area are based on 2007 and 2010 aerial photography and do not necessarily reflect current conditions.

[b] The *Baccharis* spp.–*Salix exigua–Pluchea sericea* Shrubland Alliance (354.7 ac) was divided equally between the *Populus fremontii/Salix exigua* forest state and *Pluchea sericea* Seasonally Flooded Shrubland state.

TABLE G-6 Example Results for the Native Cover Metric[a]

Alternative/ Long-Term Strategy	Final Acres	Change
E6	307	−12
D4	280	−39
A	264	−55
B2	169	−150

[a] Initial acres: 319 (based on Kearsley et al. 2015).

TABLE G-7 Example Results for the Arrowweed Metric[a]

Alternative/ Long-Term Strategy	Final Acres	Change
C1, C2	152	−25
D4	160	−17
A	222	45
C3	235	58

[a] Initial acres: 177 (based on Kearsley et al. 2015).

TABLE G-8 Results for Alternative A

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.827	0.983	1.051	0.799	3.661
Change	17.3% reduction in cover of native states	1.7% reduction in diversity of native states[a]	5.1% increase in the native/ nonnative ratio	25.1% increase in the arrowweed state cover	Overall movement away from the resource goal
Modeled values	263.8 ac, all four native states (initial cover 319.0 ac)	Modeled diversity 1.065, all four native states (initial diversity 1.083)	Modeled ratio 1.226 (initial ratio 1.166)	221.8 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 55.2 ac	NA	Tamarisk state decrease of 58.4 ac[b]	Arrowweed state increase of 44.5 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-9 Results for Alternative B, Long-Term Strategy B1

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.849	1.027	1.148	0.842	3.865
Change	15.1% reduction in cover of native states	2.7% increase in diversity of native states[a]	14.8% increase in the native/ nonnative ratio	18.8% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	270.7 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.113, all four native states (initial diversity 1.083)	Modeled ratio 1.338 (initial ratio 1.166)	210.6 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 48.3 ac	NA	Tamarisk state decrease of 71.4 ac[b]	Arrowweed state increase of 33.3 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-10 Results for Alternative B, Long-Term Strategy B2

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0. 529	0.913	0. 869	0. 809	3.120
Change	47.1% reduction in cover of native states	8.7% decrease in diversity of native states[a]	13.1% decrease in the native/ nonnative ratio	23.6% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	168.9 ac, all four native states (initial cover 319 ac)	Modeled diversity 0.988, all four native states (initial diversity 1.083)	Modeled ratio 1.013 (initial ratio 1.166)	219.2 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 150.1 ac	NA	Tamarisk state decrease of 107.0 ac[b]	Arrowweed state increase of 41.9 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-11 Results for Alternative C, Long-Term Strategy C1

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.631	0.924	0.457	1.165	3.177
Change	36.9% reduction in cover of native states	7.6% decrease in diversity of native states[a]	54.3% decrease in the native/ nonnative ratio	14.2% decrease in the arrowweed state cover	Movement away from the resource goal
Modeled values	201.3 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.001, all four native states (initial diversity 1.083)	Modeled ratio 0.533 (initial ratio 1.166)	152.2 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 117.7 ac	NA	Tamarisk state increase of 104.0 ac[b]	Arrowweed state decrease of 25.1 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-12 Results for Alternative C, Long-Term Strategy C2

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.632	0.925	0.463	1.163	3.183
Change	36.8% reduction in cover of native states	7.5% decrease in diversity of native states[a]	53.7% decrease in the native/ nonnative ratio	14.0% decrease in the arrowweed state cover	Movement away from the resource goal
Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Modeled values	201.5 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.001, all four native states (initial diversity 1.083)	Modeled ratio 0.540 (initial ratio 1.166)	152.4 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 117.5 ac	NA	Tamarisk state increase of 99.3 ac[b]	Arrowweed state decrease of 24.9 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-13 Results for Alternative C, Long-Term Strategy C3

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.626	0.923	0.529	0.755	2.834
Change	37.4% reduction in cover of native states	7.7% decrease in diversity of native states[a]	47.1% decrease in the native/ nonnative ratio	32.5% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	199.8 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.000, all four native states (initial diversity 1.083)	Modeled ratio 0.617 (initial ratio 1.166)	234.9 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 119.2 ac	NA	Tamarisk state increase of 50.1 ac[b]	Arrowweed state increase of 57.6 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-14 Results for Alternative C, Long-Term Strategy C4

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.632	0.925	0.533	0.892	2.981
Change	36.8% reduction in cover of native states	7.5% decrease in diversity of native states[a]	46.7% decrease in the native/ nonnative ratio	12.1% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	201.5 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.001, all four native states (initial diversity 1.083)	Modeled ratio 0.621 (initial ratio 1.166)	198.8 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 117.5 ac	NA	Tamarisk state increase of 50.9 ac[b]	Arrowweed state increase of 21.5 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-15 Results for Alternative D, Long-Term Strategy D1

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.840	1.017	0.910	0.905	3.671
Change	16.0% reduction in cover of native states	1.7% increase in diversity of native states[a]	9.0% decrease in the native/ nonnative ratio	10.5% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	267.8 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.101, all four native states (initial diversity 1.083)	Modeled ratio 1.061 (initial ratio 1.166)	196.0 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 51.2 ac	NA	Tamarisk state decrease of 21.2 ac[b]	Arrowweed state increase of 18.7 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-16 Results for Alternative D, Long-Term Strategy D2

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.845	1.019	0.919	0.903	3.686
Change	15.5% reduction in cover of native states	1.9% increase in diversity of native states[a]	8.1% decrease in the native/ nonnative ratio	10.7% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	269.5 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.103, all four native states (initial diversity 1.083)	Modeled ratio 1.072 (initial ratio 1.166)	196.2 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 49.5 ac	NA	Tamarisk state decrease of 22.2 ac[b]	Arrowweed state increase of 18.9 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-17 Results for Alternative D, Long-Term Strategy D3

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.859	1.019	0.930	0.889	3.697
Change	14.1% reduction in cover of native states	1.9% increase in diversity of native states[a]	7.0% decrease in the native/ nonnative ratio	12.5% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	274.0 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.104, all four native states (initial diversity 1.083)	Modeled ratio 1.084 (initial ratio 1.166)	199.5 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 45.0 ac	NA	Tamarisk state decrease of 21.0 ac[b]	Arrowweed state increase of 22.2 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-18 Results for Alternative D, Long-Term Strategy D4

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.876	1.017	0.954	1.107	3.954
Change	12.4% reduction in cover of native states	1.7% increase in diversity of native states[a]	4.6% decrease in the native/ nonnative ratio	9.6% decrease in the arrowweed state cover	Movement away from the resource goal
Modeled values	279.5 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.101, all four native states (initial diversity 1.083)	Modeled ratio 1.112 (initial ratio 1.166)	160.2 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 39.5 ac	NA	Tamarisk state decrease of 22.4 ac[b]	Arrowweed state decrease of 17.1 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-19 Results for Alternative E, Long-Term Strategy E1

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.801	0.979	0.961	0.801	3.541
Change	19.9% reduction in cover of native states	2.1% decrease in diversity of native states[a]	3.9% decrease in the native/ nonnative ratio	24.8% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	255.5 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.060, all four native states (initial diversity 1.083)	Modeled ratio 1.120 (initial ratio 1.166)	221.3 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 63.5 ac	NA	Tamarisk state decrease of 45.7 ac[b]	Arrowweed state increase of 44.0 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-20 Results for Alternative E, Long-Term Strategy E2

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.875	1.019	1.067	0.881	3.842
Change	12.5% reduction in cover of native states	1.9% increase in diversity of native states[a]	6.7% increase in the native/ nonnative ratio	13.5% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	279.3 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.103, all four native states (initial diversity 1.083)	Modeled ratio 1.244 (initial ratio 1.166)	201.2 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 39.7 ac	NA	Tamarisk state decrease of 49.2 ac[b]	Arrowweed state increase of 23.9 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-21 Results for Alternative E, Long-Term Strategy E3

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.961	0.977	1.227	0.768	3.932
Change	3.9% reduction in cover of native states	2.3% decrease in diversity of native states[a]	22.7% increase in the native/ nonnative ratio	30.3% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	306.5 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.058, all four native states (initial diversity 1.083)	Modeled ratio 1.430 (initial ratio 1.166)	231.0 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 12.5 ac	NA	Tamarisk state decrease of 59.4 ac[b]	Arrowweed state increase of 53.7 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-22 Results for Alternative E, Long-Term Strategy E4

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.899	1.027	1.124	0.884	3.934
Change	10.1% reduction in cover of native states	2.7% increase in diversity of native states[a]	12.4% increase in the native/ nonnative ratio	13.2% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	286.8 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.113, all four native states (initial diversity 1.083)	Modeled ratio 1.311 (initial ratio 1.166)	200.6 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 32.2 ac	NA	Tamarisk state decrease of 54.9 ac[b]	Arrowweed state increase of 23.3 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-23 Results for Alternative E, Long-Term Strategy E5

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.941	0.977	1.187	0.769	3.875
Change	5.9% reduction in cover of native states	2.3% decrease in diversity of native states[a]	18.7% increase in the native/ nonnative ratio	30.0% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	300.2 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.058, all four native states (initial diversity 1.083)	Modeled ratio 1.384 (initial ratio 1.166)	230.5 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 18.8 ac	NA	Tamarisk state decrease of 56.9 ac[b]	Arrowweed state increase of 53.2 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-24 Results for Alternative E, Long-Term Strategy E6

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.961	0.977	1.227	0.768	3.933
Change	3.9% reduction in cover of native states	2.3% decrease in diversity of native states[a]	22.7% increase in the native/ nonnative ratio	30.3% increase in the arrowweed state cover	Movement away from the resource goal
Modeled values	306.7 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.058, all four native states (initial diversity 1.083)	Modeled ratio 1.431 (initial ratio 1.166)	231.0 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 12.3 ac	NA	Tamarisk state decrease of 59.4 ac[b]	Arrowweed state increase of 53.7 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-25 Results for Alternative F

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.702	0.909	0.381	1.143	3.136
Change	29.8% reduction in cover of native states	9.1% decrease in diversity of native states[a]	61.9% decrease in the native/ nonnative ratio	12.5% decrease in the arrowweed state cover	Movement away from the resource goal
Modeled values	224.0 ac, all four native states (initial cover 319 ac)	Modeled diversity 0.985, all four native states (initial diversity 1.083)	modeled ratio 0.444 (initial ratio 1.166)	155.1 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 95.0 ac	NA	Tamarisk state increase of 230.7 ac[b]	Arrowweed state decrease of 22.2 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

TABLE G-26 Results for Alternative G

Parameter	Metric 1: Change in Native Cover, Final Cover/ Initial Cover	Metric 2: Change in Diversity, Final Diversity/ Initial Diversity	Metric 3: Change in Native/ Nonnative Ratio, Final Ratio/ Initial Ratio	Metric 4: Change in Arrowweed, Initial Arrowweed/ Final Arrowweed	Overall Score
Mean score (weighted mean for all sediment traces)	0.706	0.967	0.604	1.128	3.405
Change	29.4% reduction in cover of native states	3.3% decrease in diversity of native states[a]	39.6% decrease in the native/ nonnative ratio	11.3% decrease in the arrowweed state cover	Movement away from the resource goal
Modeled values	225.3 ac, all four native states (initial cover 319 ac)	Modeled diversity 1.047, all four native states (initial diversity 1.083)	Modeled ratio 0.704 (initial ratio 1.166)	157.2 ac arrowweed state (initial cover 177.3 ac)	NA
Change in cover (acres)	Native states decrease of 93.7 ac	NA	Tamarisk state increase of 46.4 ac[b]	Arrowweed state decrease of 20.1 ac	NA

[a] Because the results for each modeled run include the same number of states (each state is a different starting condition for model runs), a reduction in diversity indicates a reduction in evenness among the vegetation states.

[b] A relative increase in native cover or decrease in nonnative cover can increase the ratio.

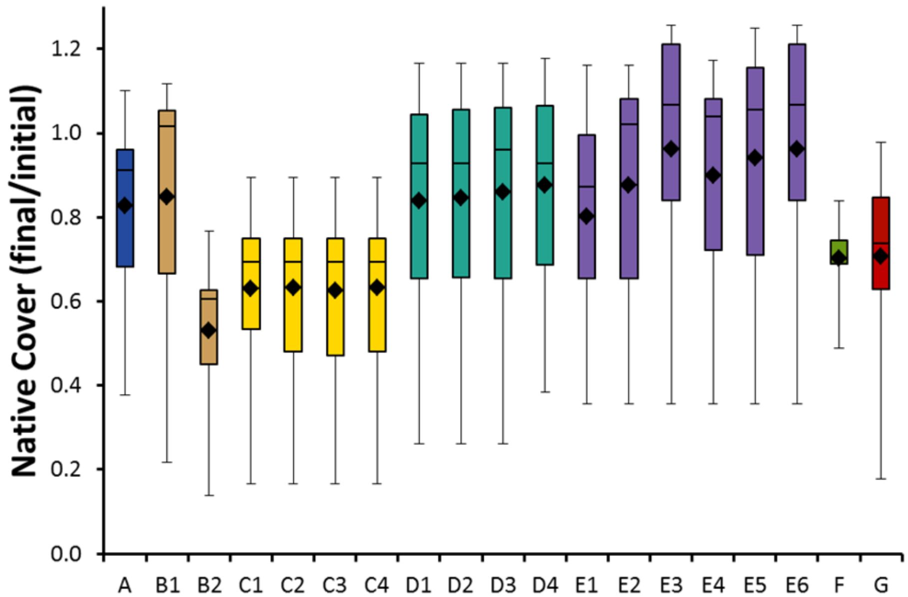

FIGURE G-1 Native Cover Metric for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

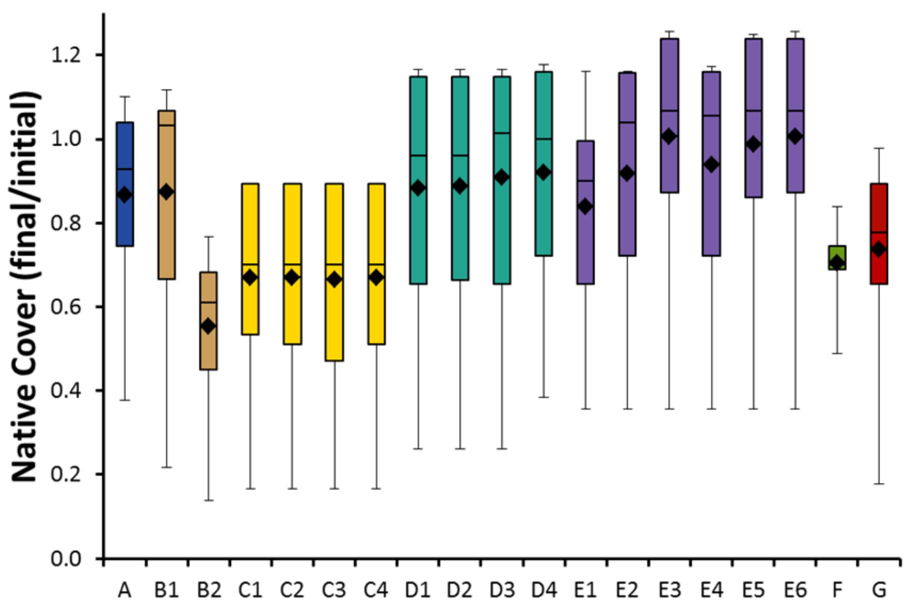

FIGURE G-2 Native Cover Metric under Climate Change for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

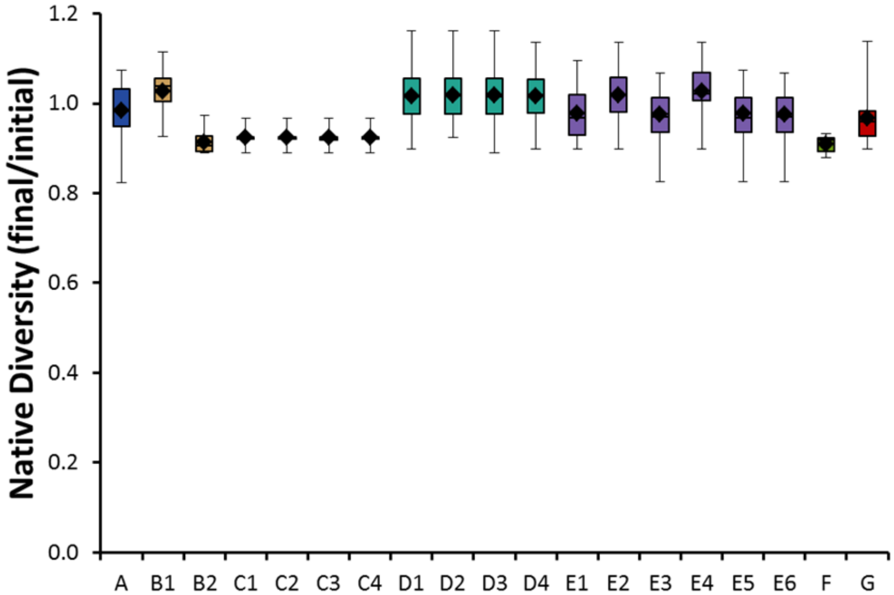

FIGURE G-3 Native Diversity Metric for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

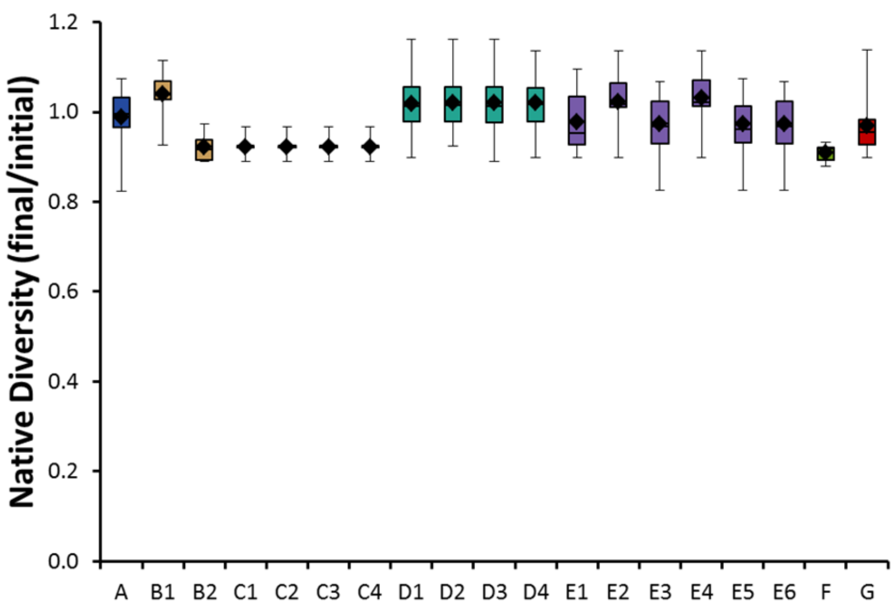

FIGURE G-4 Native Diversity Metric under Climate Change for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

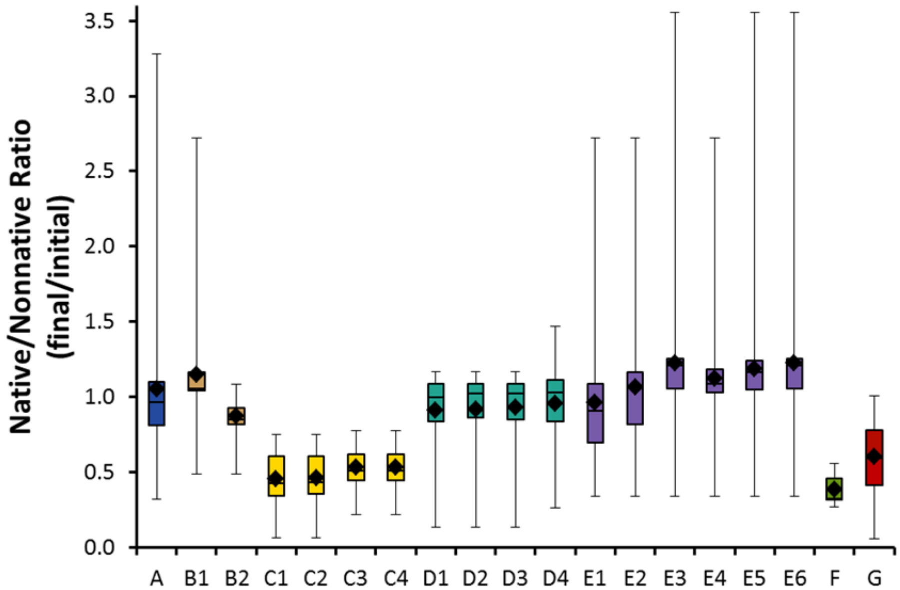

FIGURE G-5 Native/Nonnative Ratio Metric for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

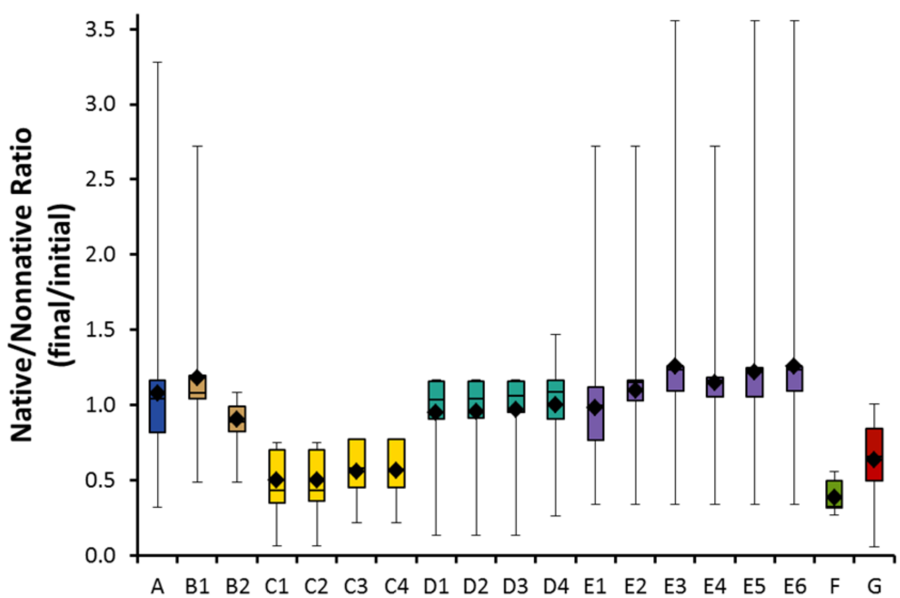

FIGURE G-6 Native/Nonnative Ratio Metric under Climate Change for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

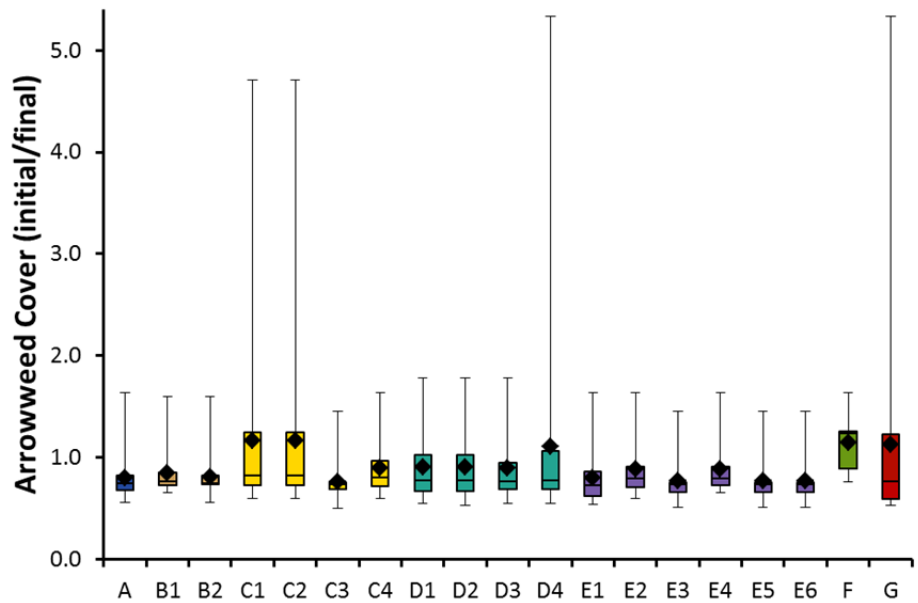

FIGURE G-7 Arrowweed Metric for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

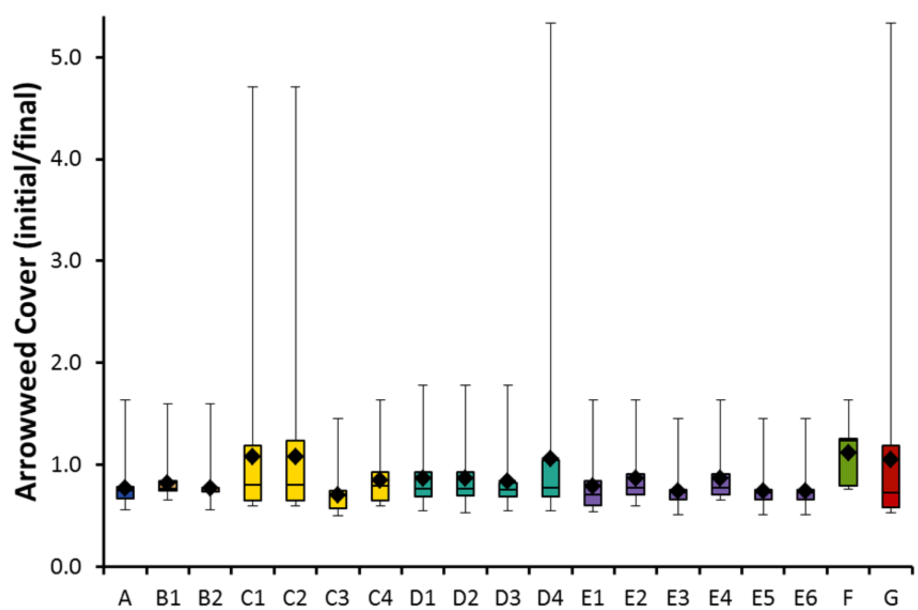

FIGURE G-8 Arrowweed Metric under Climate Change for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

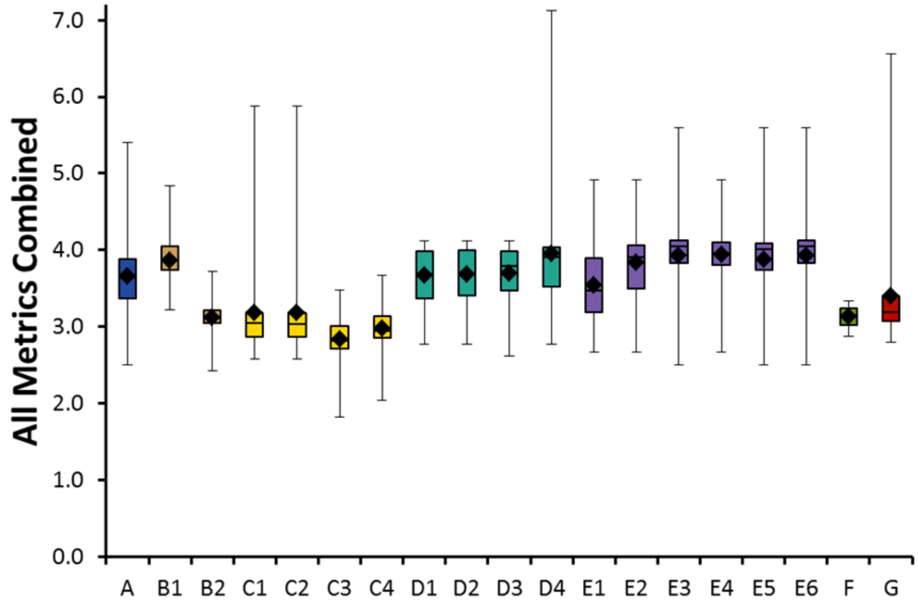

FIGURE G-9 Overall Combined Score for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

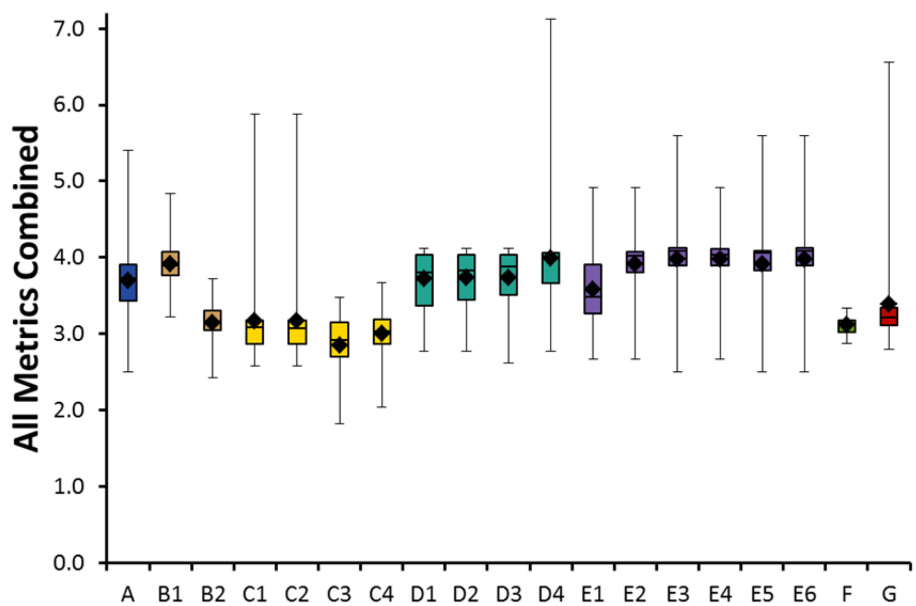

FIGURE G-10 Overall Combined Score under Climate Change for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

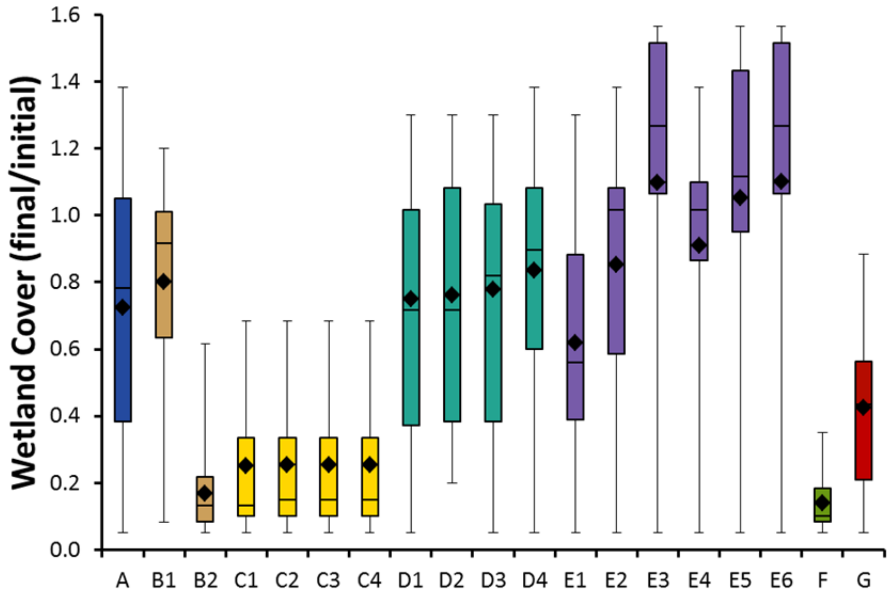

FIGURE G-11 Relative Change in Wetland Cover for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)

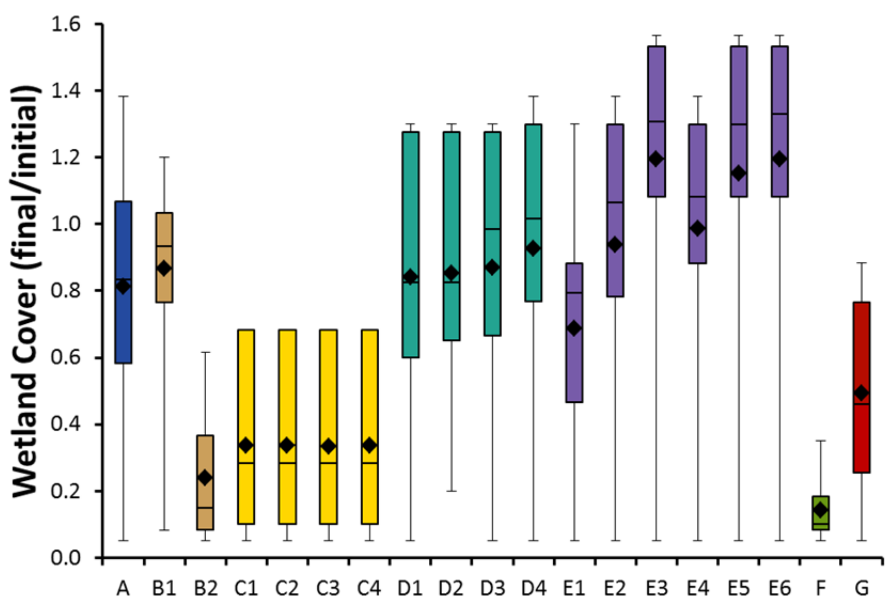

FIGURE G-12 Relative Change in Wetland Cover under Climate Change for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers) (Note that diamond = mean; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum of the values for the 63 traces analyzed.)