# Riparian Vegetation in the San Miguel River Corridor

A Product of the San Miguel Pilot Project

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lōtic

**Prepared For:**

TROUT UNLIMITED

SAN MIGUEL WATERSHED COALITION

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# 1 Introduction

Stakeholders participating in the San Miguel Pilot Project requested an evaluation of riparian areas in the San Miguel watershed. Riparian zones are disturbance-mediated ecosystems that exist adjacent to streams and rivers. Riparian areas provide important habitat for terrestrial and aquatic wildlife and buffer impacts from physical and chemical inputs originating in upland areas. Riparian area extent, species composition, and ecosystem function is largely a product of landscape position, local hydrology and moisture gradients, alluvial and colluvial disturbance magnitude and frequency, and development activities in the floodplain. Despite their relatively small total land coverage in the San Miguel watershed, riparian zones produce outsized contributions to biological diversity and abundance, as well as strong controls on water quality, aquatic habitat, and physical channel dynamics. Participants in the San Miguel Pilot Project are particularly interested in understanding the role that the hydrological regime plays in maintaining healthy riparian areas.

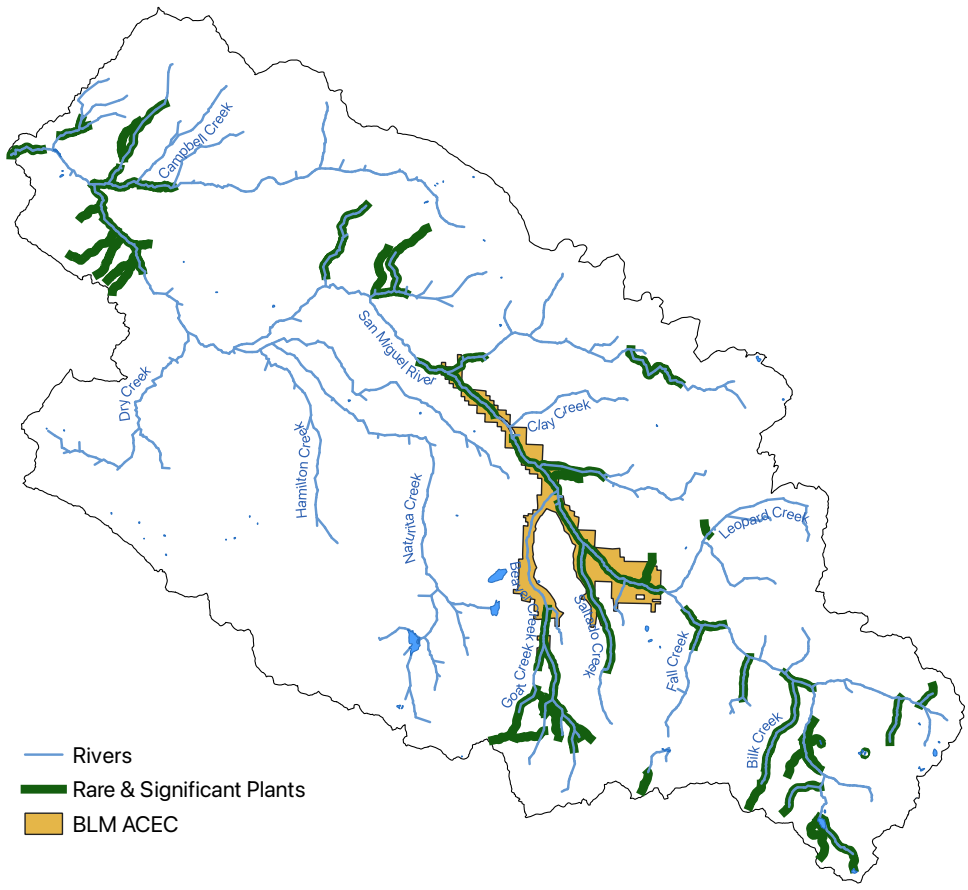


*Figure 1. Locations of rare and significant plant communities inhabiting riparian zones. River segments managed as Areas of Critical Environmental Concern within the San Miguel watershed.*

The Bureau of Land Management (BLM) designates several segments of the San Miguel River and its tributaries as Areas of Critical Environmental Concern (ACEC) due to high biodiversity significance (Figure 1). BLM applies special management actions towards preserving the extensive and exemplary riparian community present in these areas. Existing and proposed ACEC lands within the watershed extend from Deep Creek to the Dolores River and include sections of Saltado Creek, Beaver Creek and a portion of Leopard Creek [1]. Stakeholders indicated that all special management areas and reaches containing rare and significant plant communities should be included in evaluations of water management impacts on riparian health.

# 2 Literature Review and Data Analysis

An assessment of riparian communities in the San Miguel watershed was conducted as a component of the San Miguel Pilot Project. The assessment included a characterization of riparian community structure and distribution along the San Miguel River, an evaluation of observed vs. expected community composition, and an investigation into the hydrological controls on the health of woody vegetation.

## 2.1 Species Distributions

The San Miguel is home to many rare plants and significant plant communities [2]. Many of these plant communities exist along the mainstem San Miguel River between Calamity Draw and Tabeguache Creek and above the Dolores River confluence. Some rare or significant communities also occur along parts of Lake Fork, South Fork of the San Miguel River, Bilk Creek, Big Bear Creek, Horsefly Creek, Little Red Canyon, Cottonwood Creek, Big Bucktail Creek, Tabeguache Creek, Spring Creek, and Naturita Creek. Riparian areas present in other areas of the watershed are valuable for their role in providing habitat, forage area, channel stability, and general ecological health and functioning, but do not contain specific rare or significant plants and plant communities.

Flood-dependent and woody species occurring on the floodplain beyond zones of frequent inundation dominate riparian areas along the lower San Miguel River. Below the confluence with Horsefly Creek, Fremont cottonwood dominate the overstory. Rio Grande cottonwood and hybrid cottonwood species dominate the overstory in the San Miguel mainstem above Uravan Canyon. The understory in the lower watershed is mostly comprised of native shrubs: skunkbush, New Mexico Privet, and buffaloberry, with sandbar willow present immediately adjacent the channel. Above the confluence with Horsefly Creek, riparian community composition is less strongly governed by floods. The riparian overstory in Norwood Canyon is conifer-dominated: mostly blue spruce, Douglas fir, and ponderosa pine. The understory consists of alder and redosier dogwood in areas adjacent the stream. Native shrubs, including skunkbush and buffaloberry, occur in less-frequently inundated areas on the floodplain. The reaches of the San

Miguel River between Norwood and Telluride exhibit an overstory of mixed conifer and narrowleaf cottonwood, which occur primarily on high terraces. Alder, sandbar willow and planeleaf willow dominate the understory immediately adjacent to the channel. Above Telluride the overstory cosists mostly of barrenground and planeleaf willows. Sedges and tufted hairgrass dominate the understory in this area [3].

The disturbance regime and moisture gradients controlling riparian zone extent significantly differ between the upper and lower watershed. Alluvial processes control disturbance and riparian recruitment in the lower basin, while riparian extent is more strongly controlled by colluvial processes (e.g. landslides) and beaver activity in the upper basin and in headwaters tributaries. Shallow water tables exist only in close proximity to streams, rivers, and irrigation canals in the lower basin, constraining areas with soil moisture sufficient to support most riparian species. In the upper basin, hillslope groundwater inputs and a wetter precipitation regime create patches of favorable soil moisture and water table elevations much further from the stream.

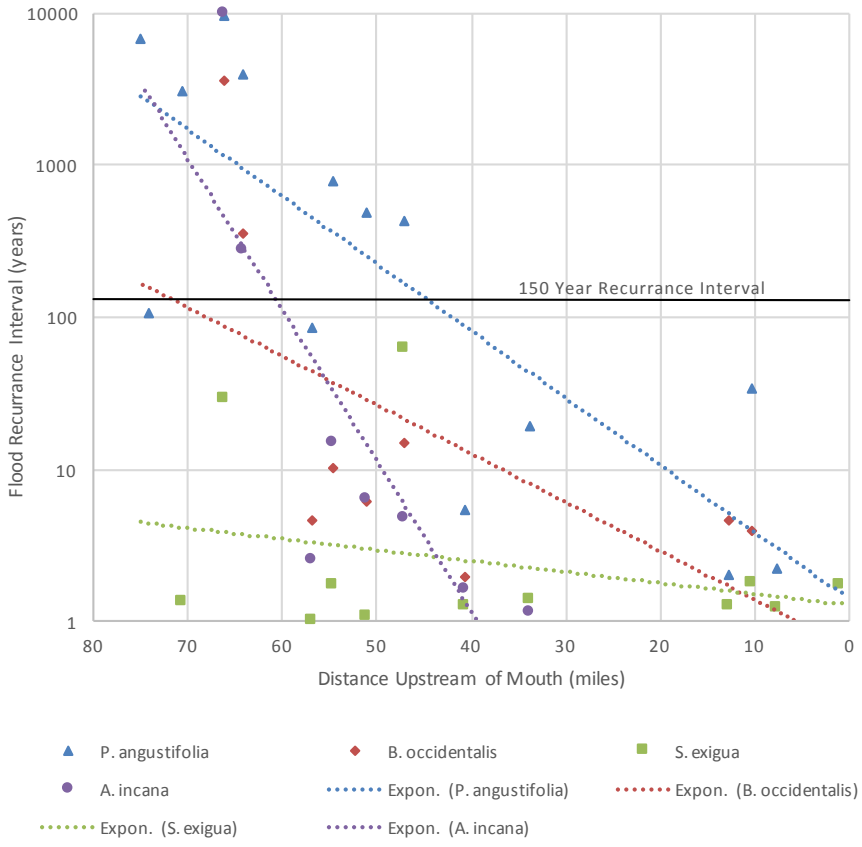


*Figure 2. Differences in disturbance regimes and moisture gradients allow a greater fraction of riparian vegetation to occur outside the historic stream channel in the upper watershed than in the lower watershed. S. exigua (narrowleaf willow) and B. occidentalis (river birch) occur close to the stream throughout the corridor, while P. angustifolia (narrowleaf cottonwood) and A. incana (alder) occur outside the historic floodplain at higher elevations in the watershed [4].*

The effect of disturbance and moisture patterns plays out in the decreasing fraction of riparian vegetation occupying the historic river channel as one moves from upstream to downstream along the San Miguel River. Near Uravan, 100% of the riparian zone occurs within the historically inundated floodplain, while only 50% of riparian vegetation occurs within that zone along the South Fork of the San Miguel River (Figure 2) [4]. As a result, riparian areas in the lower watershed are expected to exhibit more sensitivity to water management activities than riparian areas in the upper watershed. Conversely, riparian areas in the upper watershed will respond to changes in land use activities on hillslopes much more strongly than those positioned lower in the system (Figure 3, Figure 4).

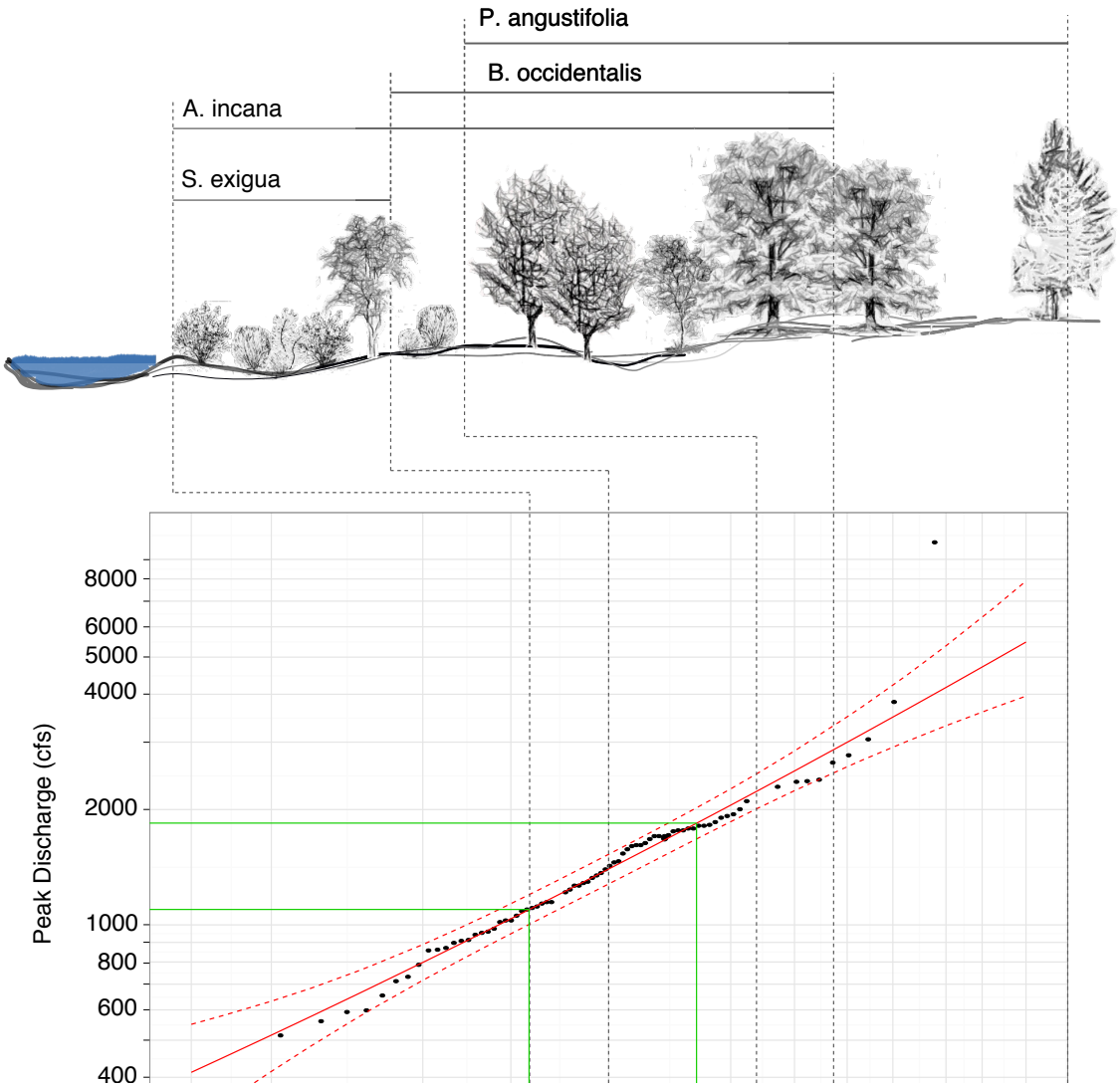


*Figure 3. Along the South Fork San Miguel River, riparian species persist in areas well beyond historical floodplain due to high water availability and frequent colluvial disturbances from debris flows, beaver activity, etc. In these locations, communities of S. exigua (narrowleaf willow) will be most sensitive to water management activities. P. angustifolia (narrowleaf cottonwood) will be relatively insensitive to water management activities that impact fluvial processes.*

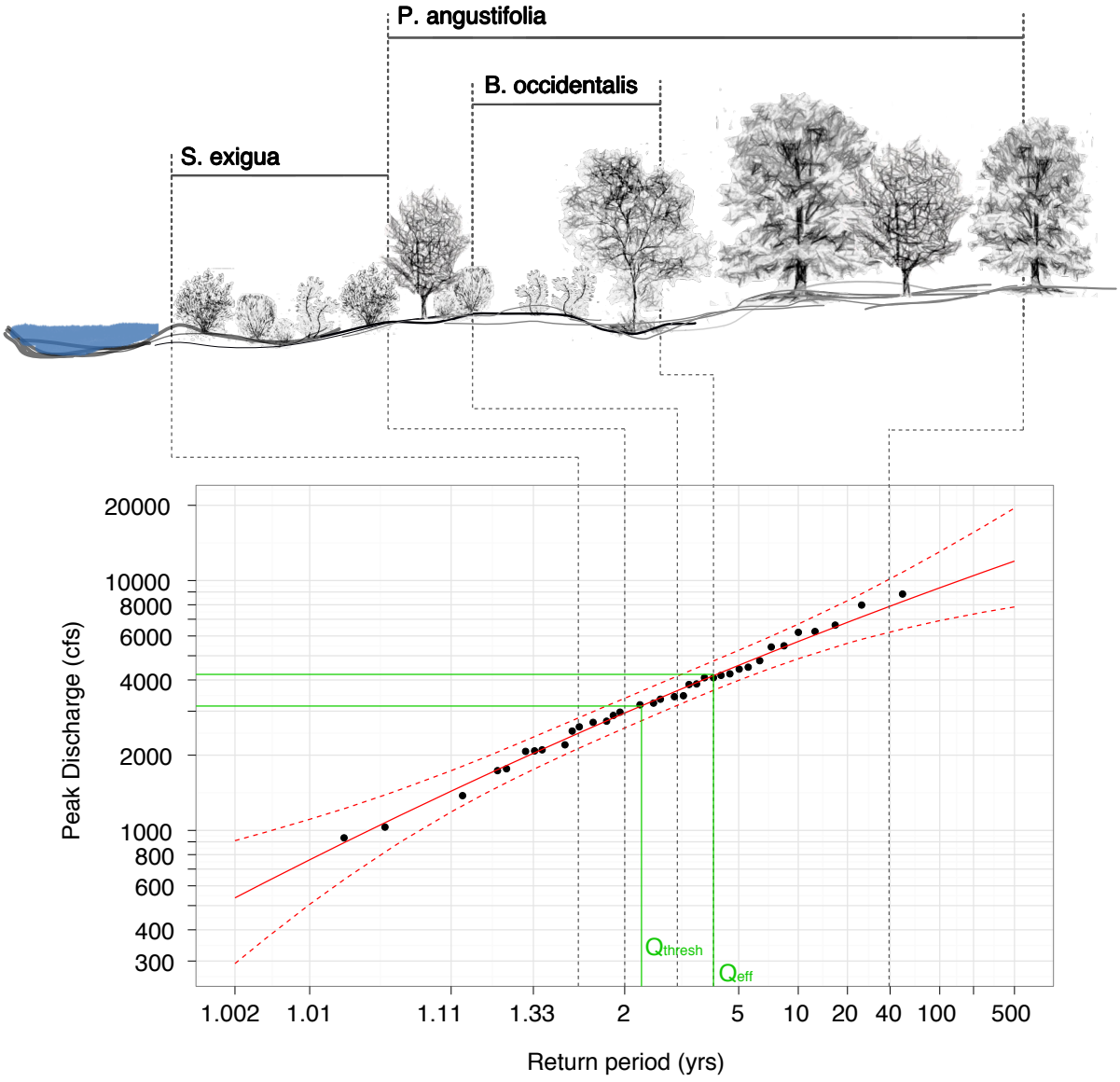


*Figure 4. Along the San Miguel River near Uravan, all riparian vegetation is located within the historical floodplain, indicating strong hydrological/hydraulic controls on community composition and extent. In these areas, a large areal fraction of the riparian forest will be sensitive water management activities that alter fluvial processes.*

## 2.2 Invasive Species

Though the San Miguel is home to a healthy and intact riparian area, non-native invasive plant species constitute a significant threat to the functioning of the riverine ecosystem. Invasive species out-compete native species in disturbance zones, alter wildlife habitat, and consume water that would otherwise benefit native plant species, aquatic biota, and human water uses. Three invasive plants—Russian olive, Siberian elm, and tamarisk—occur in the lower part of the San Miguel watershed. Due to extensive mitigation and removal work across the lower basin in recent years, tamarisk are present only in sparse, low density pockets along the mainstem San Miguel River, Naturita Creek and Hamilton Creek [5] (Figure 5). Russian olive and Siberian elm are the primary remaining invasive woody species of concern. Russian knapweed, an invasive herbaceous plant, is prolific in the western watershed. Further discussion of invasive plants is provided in Attachment 1.

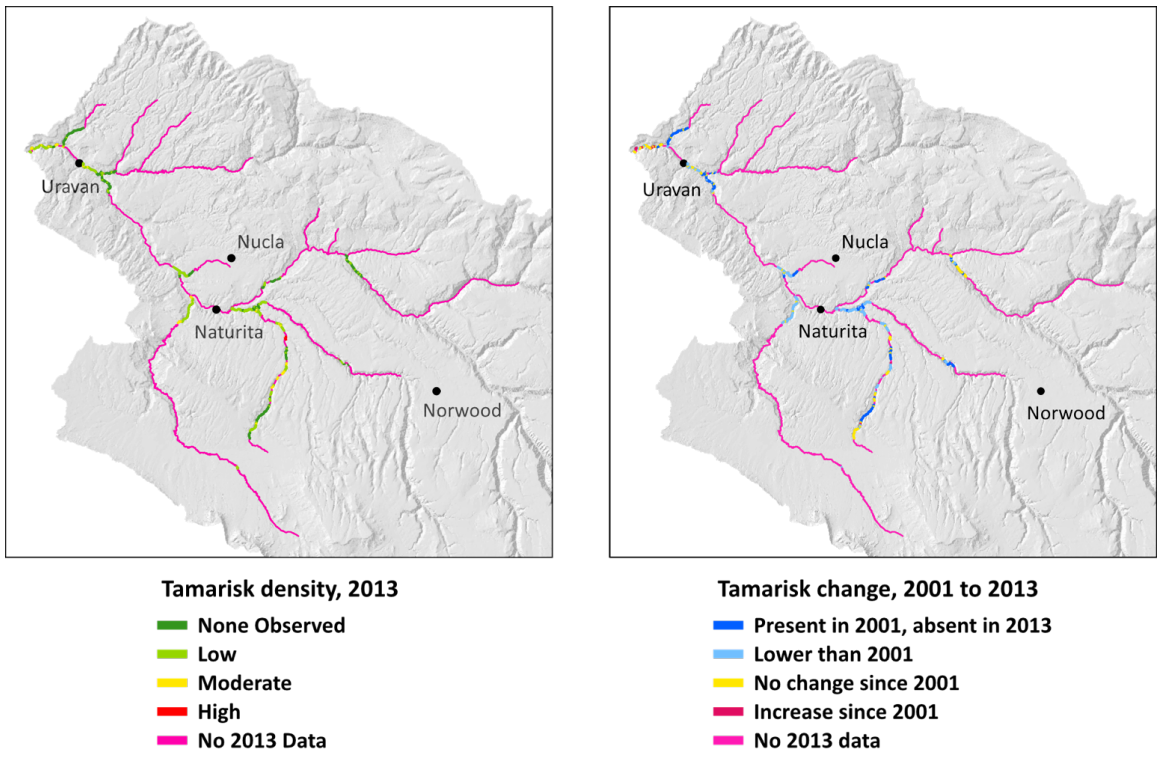


*Figure 5. Tamarisk densities observed in 2013 and observed changes in density between 2001 and 2013 following active treatment and removal efforts (Data source: The Nature Conservancy).*

Russian olive is a woody tree-shrub, originally planted as ornamental vegetation and windbreaks. Russian olives live below 8,000 ft. of elevation and prefer riparian areas, floodplains, and valley bottoms where the water table is relatively close to the surface. Rapid growth, high germination rates, and tolerance of and adaptability to a range of environmental conditions (flooding, drought and extreme temperatures)

allow it to outcompete native cottonwood and willow species after colonizing an area. Russian olive colonization of streambanks may alter the relationship between the flood regime and channel geometry by making streambanks less deformable and increasing rates of channel incision. The species may also reduce nutrient and moisture availability to native species [6]. Populations are spread from upstream by birds using the fruit as a surrogate food source.

The densest populations of Russian olive in San Miguel watershed occur near agricultural runoff zones and adjacent drainages. The species is firmly established around on the mainstem around Nucla and Naturita, and in Calamity Draw and Tuttle Draw. Sparser populations are present along the rest of the river corridor between the CC Highline Ditch and the Dolores confluence. A Superfund site in Uravan Canyon exhibits significantly altered vegetative communities and a high density of Russian olive.

Siberian elm is the second woody invasive species of concern in the San Miguel watershed. These elms prefer areas of recent disturbance (e.g. riparian areas, rangeland and road corridors). Like the Russian olive, aggressive growth and germination rates, and tolerance and adaptability to a wide range of environmental conditions (prolonged drought, low soil moisture, poor soil and high wind) allow the Siberian elm to dominate newly colonized locations in a span of just a few years. The tree can quickly outcompete native species in recently disturbed and sparsely vegetated zones and will inhibit shade intolerant species once they are established [7]. The threat of downstream population spread is high due to its capacity for prolific seed production. Siberian elm dominates many riparian areas on the mainstem San Miguel River around Naturita, Uravan, and Pinon Bridge. The species also occurs in many areas between Naturita and the Dolores River confluence.

## 2.3 Alteration of Riparian Extent

Functional surveys and inventories of riparian health provide resource managers with important information to support and guide management actions. Application of the Riparian Vegetation Departure (RVD) Index method [8] to the San Miguel watershed provides an indication of locations where the current extent of riparian zones deviate from expected conditions. An RVD index for the San Miguel watershed was created by comparing state-and-transition modelling products available in the LANDFIRE dataset (the expected condition based on biophysical properties of a given location) to Colorado Natural Heritage Program riparian mapping data layers (the existing condition). Areas where deviation between the expected and the observed condition is most pronounced may be worthy of more focused investigations, ground-truthing or focused management considerations.

The differences between expected and existing riparian extent occur where development exists in or near floodplains. These locations include the valley floor near Telluride, short reaches in the Sawpit-Placerville corridor and the floodplain in the vicinity of Naturita and Uravan (Figure 6). Larger departures around Lake Fork and Trout Lake area may be attributed to stream corridor disturbances associated with the legacy

mining and current patterns of urban development. In many instances, invasive species, the close proximity of the highway corridor and the presence of numerous bridges and other stream crossings also alter or degrades riparian vegetation coverage. Limited data for headwater tributaries constrained analysis by the RVD method for these areas. Stream segments excluded from this analysis include the upper segments of Beaver Creek, Naturita Creek, and Tabeguache Creek.

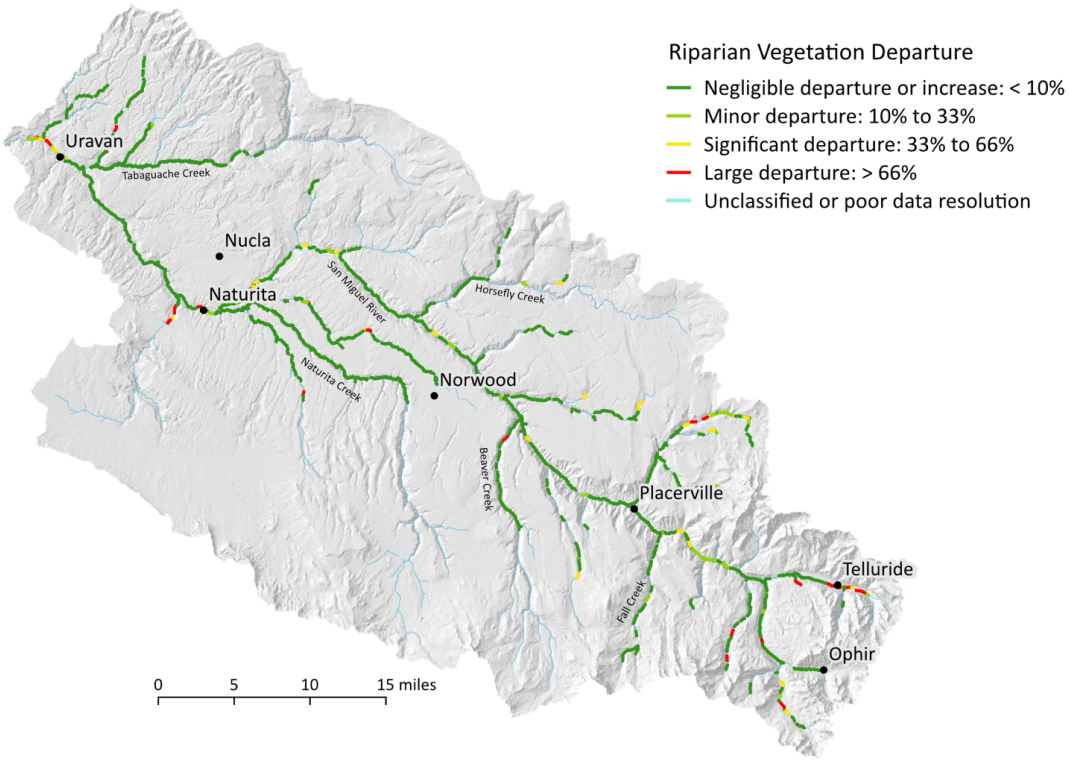


*Figure 6. Riparian Vegetation Departure in the San Miguel watershed. RVD is calculated as the ratio of current floodplain area occupied by riparian plant communities to the predicted areal extent of riparian vegetation.*

## 2.4 Hydrological Controls on Riparian Health

While land management activities may significantly alter riparian community health or extent, water resource management actions may similarly impact riparian vegetation. Riparian vegetation communities exist in a dynamic state governed by the local geometry of the channel/floodplain system and the inter-annual pattern of flood flows and baseflows (Figure 7). Occasional scouring of overbank areas provides the necessary habitat for germination of many riparian plant species (Table 1). Following germination, seedlings require a relatively slow reduction in water table height over the progression of the growing season. Rapid water table elevation reductions or late season water table heights that drop below the rooting depth of cottonwoods and other riparian plants stress vegetation and can lead to seedling

mortality. Changers in channel and floodplain structure or adjustments in the magnitude, timing or frequency of peak flows and baseflows may, therefore, limit riparian recruitment and produce decadent stands of vegetation exhibiting little or no regeneration.

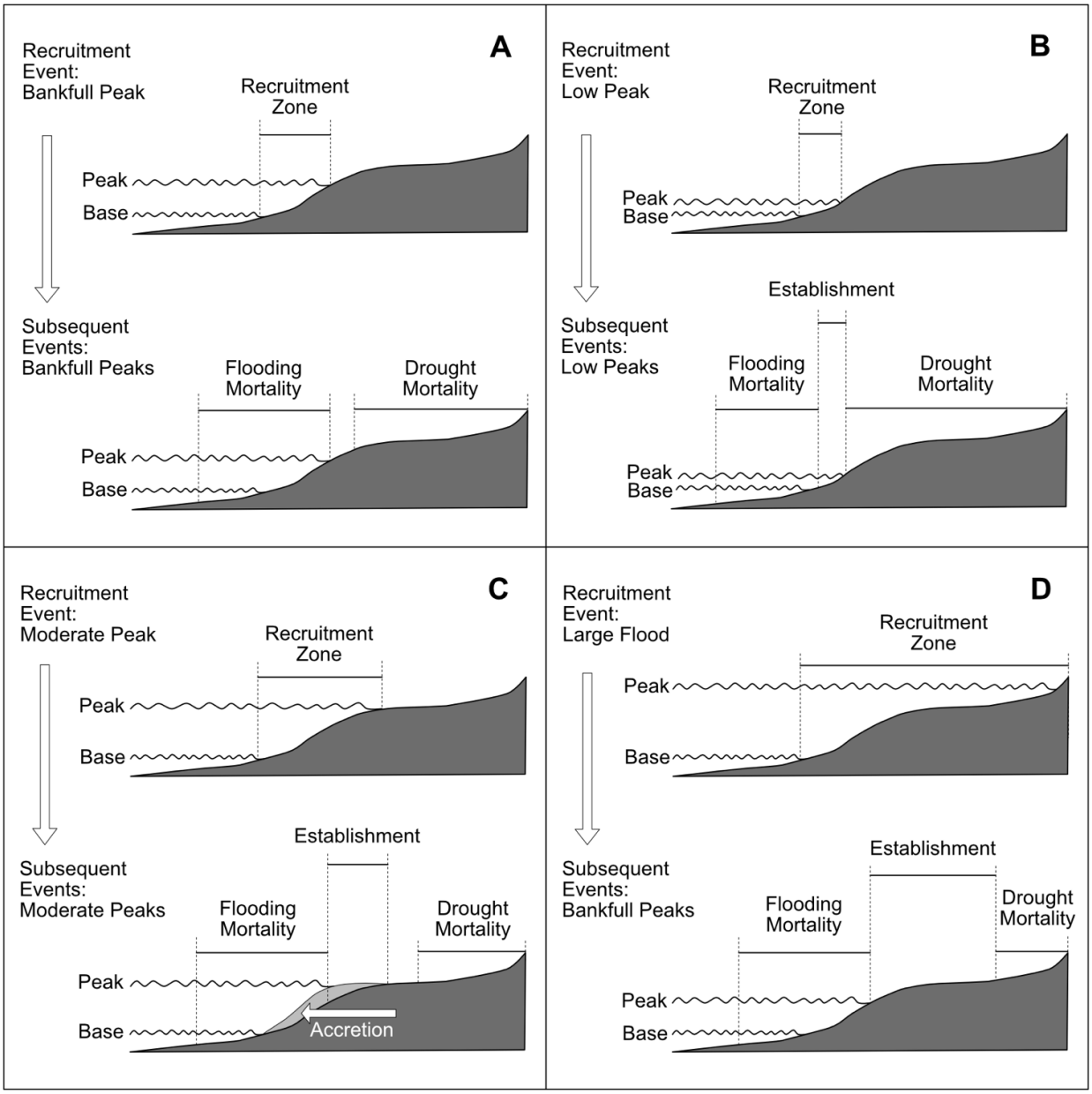


*Figure 7. Riparian recruitment dynamics on alluvial reaches are largely governed by flood disturbances. A) Where inter-annual variability in flow is low, little or no pioneer recruitment occurs. B) Long term drought or management-induced reductions in peak flows leads to narrowing of the riparian zone as new recruits establish on former channel beds. C) Meandering channels support pioneer recruitment of on accreting point bars. D) Infrequent large floods enable recruitment on higher floodplain surfaces [9].*

*Table 1. Hydrological controls on cottonwood establishment along the lower San Miguel River as discussed by Fleener [10].*

| Flood Regime | Flow (cfs) | Geomorphic Response | Cottonwood Response |
|---|---|---|---|
| **Snowmelt Driven:** Annually reliable. Synchronous with seed fall. Long duration. Rarely exceeds 2.5 times mean annual flood size. Occurs April through June. | 1,442 cfs | Initiation of sediment motion, bars and channels may exchange particles | Seedlings may germinate but will not survive due to flood disturbance |
| | 3,776 cfs | Bankfull or channel forming flow, sometimes results in significant floodplain reorganization | Many establishment sites within bankfull channel, but survival depends on channel movement away from establishment site |
| | >3,776 cfs | If moderately persistent, will result in significant bottomland reorganization, channel widening, braiding, followed by narrowing and channel abandonment | Widespread establishment and survival likely on all abandoned surfaces due to lateral separation from subsequent floods |
| | 8,583 cfs | Widespread bottomland disturbance, channel widening and braiding | Widespread establishment and survival likely on all abandoned surfaces |
| **Monsoon Driven:** Annually unreliable. Not synchronized with seed fall. Short flow duration. May exceed 3-5 times mean annual flood magnitude. Occurs July through November. May activate tributary sediment inputs. | 1,442 cfs | Not likely to have significant geomorphic consequences | May provide moisture for newly established vegetation |
| | 3,776 cfs | May result in short pulse of sediment transport, after which deposition may cause channel avulsions, or deposition on low lying floodplain surfaces | May destroy new seedlings, provide sites for salt cedar establishment, or prepare beds for next year's vegetation |
| | 8,583 cfs | May result in significant overbank deposition | Flood deposits may provide future establishment sites with good vertical separation from future disturbance |
| | >>8,583 cfs | Catastrophic changes to bottomland environment, removal of many existing trees | Catastrophic stripping of existing vegetation, widespread recruitment following |

Fleener [10] collected core samples and aged cottonwoods along the San Miguel River. Results indicated that establishment of most cottonwood stands between Naturita and Uravan occurred after three large snowmelt-driven flood events. These floods significantly reworked large portions of the floodplain, created new channels and abandoned others. Scouring of floodplain surfaces and creation of new surfaces

created ample opportunity for recruitment of new woody vegetation. These conclusions align well with the findings of others [4] (Figure 2) and support the notion that peak flow hydrology is a dominant control on the distribution of riparian vegetation in the lower watershed.

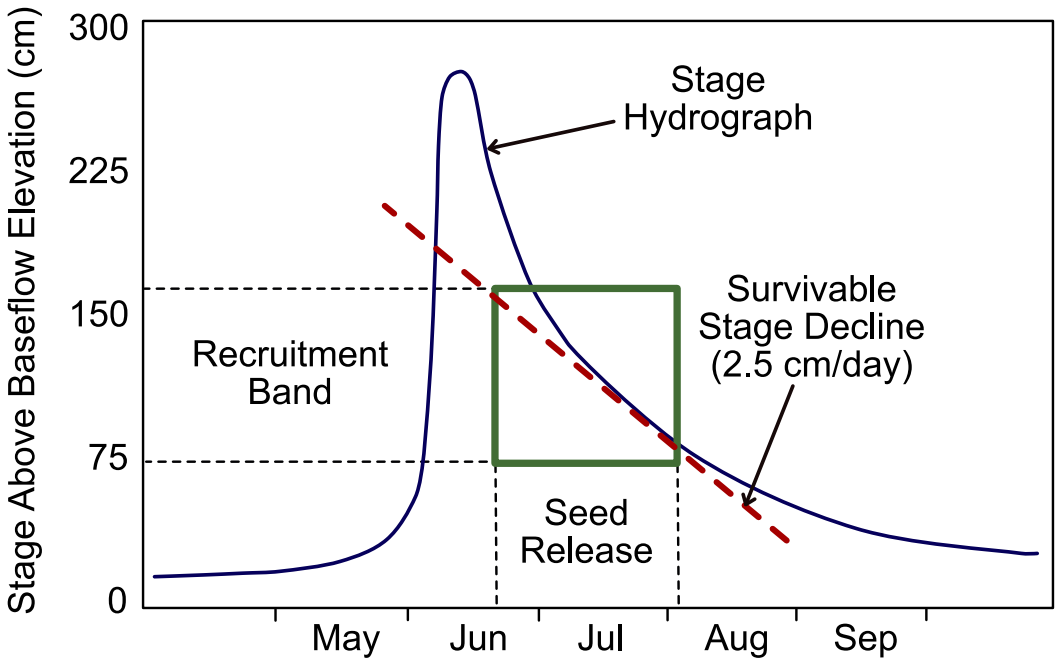


*Figure 8. The Riparian Recruitment Box describes recruitment potential of riparian vegetation as a function of overbank flow timing and magnitude, seed release timing, and the rate of stage decline—a proxy for changes in floodplain water table elevations. Survivable rates of stage decline correspond to the maximum root growth rate of a given riparian species.*

The "Recruitment Box" model [11] was used to evaluate the relationships between the peak flow hydrology, local channel structure, and riparian recruitment potential. This approach assumes that strong channel controls on floodplain groundwater elevations exist and that overbank flows and groundwater elevations represent critical mediators of the recruitment success for riparian vegetation (Figure 8). The Recruitment Box methodology helps identify constraining characteristics of local channel hydraulics on riparian health and is one of the few methods available for linking streamflow characteristics to riparian conditions. The model was implemented for stream segments across the watershed using simulated hydrological data sets and local hydraulic and cross-sectional information. One-dimensional hydraulic models were created at numerous points along the San Miguel River mainstem in order to develop site-specific stage-discharge curves. Scientific literature regarding the hydrograph peak and recession characteristics necessary to support recruitment of cottonwood and other species in riparian zones [11]

informed selection of appropriate water table recession characteristics in the San Miguel watershed (Table 2). Results were assessed to identify when and where patterns of overbank flow and stage recession on alluvial river reaches of the San Miguel River limit recruitment potential. Conclusions from previous studies conducted by BLM on several sections of the San Miguel River mainstem provided indication of low flow limits necessary for maintaining riparian health [12].

*Table 2. Maximum rates of stage decline required for successful recruitment of various species of woody riparian vegetation.*

| Acceptable Stage Decline per Day (mm) | Riparian Species | Common Name |
|---|---|---|
| 6.0 - 13.0 | Populus fremontii | Freemont cottonwood |
| 4.0 | Populus deltoides | Rio Grande cottonwood |
| 3.0 | Populus angustifolia | Narrowleaf cottonwood |

Recruitment Box modeling results for the alluvial sections of the San Miguel River produced little evidence for significant water management-induced seedling mortality events. Undesirable rates of stage decline were not observed at most assessed locations. This reflects the largely natural peak flow hydrology present in the San Miguel watershed. While stage decline generally follows favorable patterns for new riparian recruits, altered baseflows in some areas may limit riparian area extent and stress established vegetation.

The existing flood hydrology regime in the lower the watershed is critical to maintaining riparian zone width and providing suitable conditions for recruitment of new plants. While existing hydrological regime characteristics do not appear to limit riparian recruitment potential, biophysical conditions on the San Miguel River and its tributaries in the lower watershed tend to support invasive species and allow them to outcompete native vegetation in many areas (Figure 9). As a result, ongoing mechanical and/or biological invasive species control programs are likely necessary. Future changes in climate that increase the frequency of large monsoonal rainfall events may further advantage invasive species in the lower watershed.

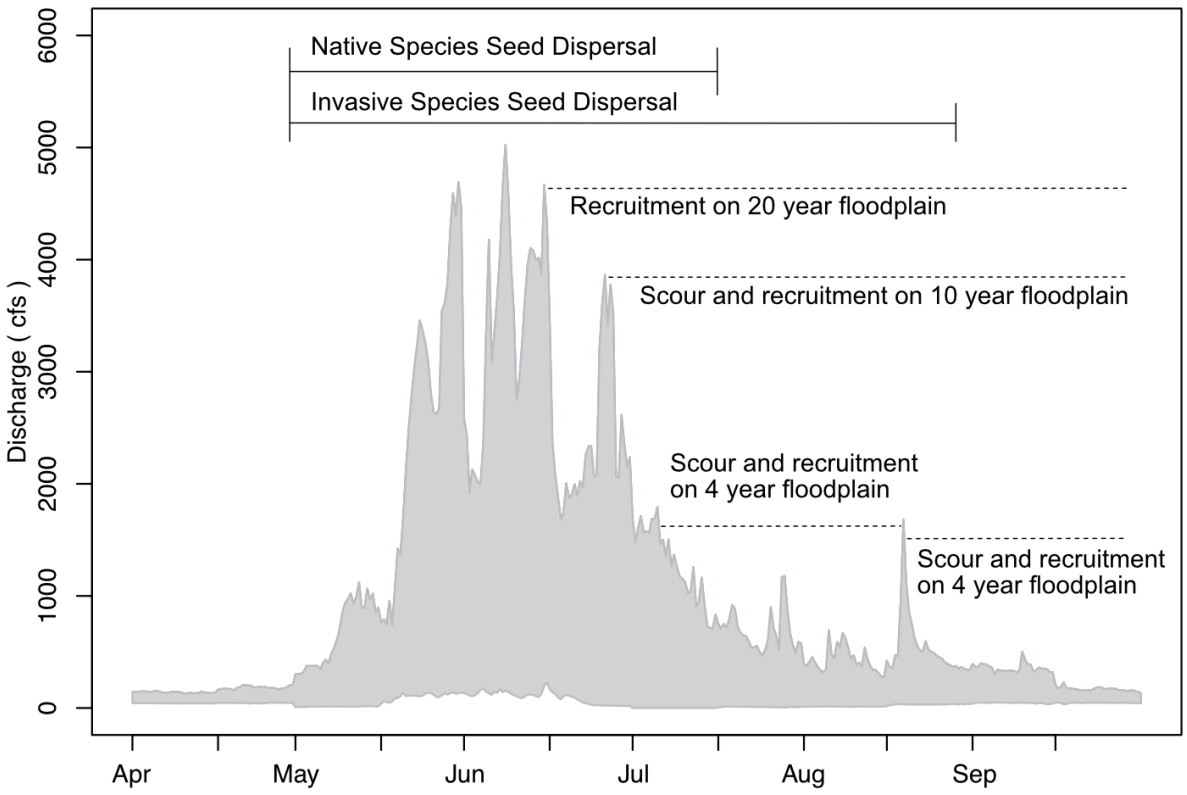


*Figure 9. Recruitment Box assessment results indicate the long-term patterns of floodplain inundation and stage recession that promote or prohibit seedling establishment. In the lower reaches of the San Miguel River, late season peak flow events scour floodplain surfaces, providing recruitment opportunity for invasive species with longer seed dispersal windows than native riparian vegetation.*

## 2.5 Scenario Modeling

Investigations into riparian community structure conducted by USGS [13], [4] provide a simplistic representation of how those communities may change under altered patterns of flood hydrology. A model relating community composition to flood magnitude and recurrence interval suggests that reductions to peak flow magnitudes due to climate change or future water management actions (e.g. large reservoir or transmountain diversion projects) will reduce diversity of riparian communities (Figure 10). The existing nine plant associations found along the San Miguel are reduced to four as peak flows shrink to 10% of the historically observed flows—acreages of three State Rare and two State Vulnerable plant associations are reduced. Predicted changes show incremental shifts toward later successional riparian and upland plant associations. No predictions are available for changes to the overall size of riparian habitat in the San Miguel basin, but those total acreages are expected to shrink with reduced peak flows as vegetation further from the river dies out and is replaced by upland plant associations.

Evaluation of the distribution of riparian plant communities across floodplains in the lower San Miguel watershed, combined with characterization of flood regimes and mapping of flood inundation frequency bounds within those riparian communities (**Error! Reference source not found.**) provides a means for u nderstanding how future changes in flood regimes may impact riparian forests. Riparian communities along the lower San Miguel River are, generally, expected to become less diverse as peak flow magnitudes diminish (Figure 10). Cottonwood-alder forests, sandbar willow communities, and birch communities decrease in areal extent as floods with a given return frequency decrease. Cottonwood forests mixed with spruce and other upland shrubs, woody and herbaceous species are expected to become more dominant. A reduction in the diversity of riparian plant communities present along the river corridor is expected to diminish habitat quality for terrestrial and avian species.

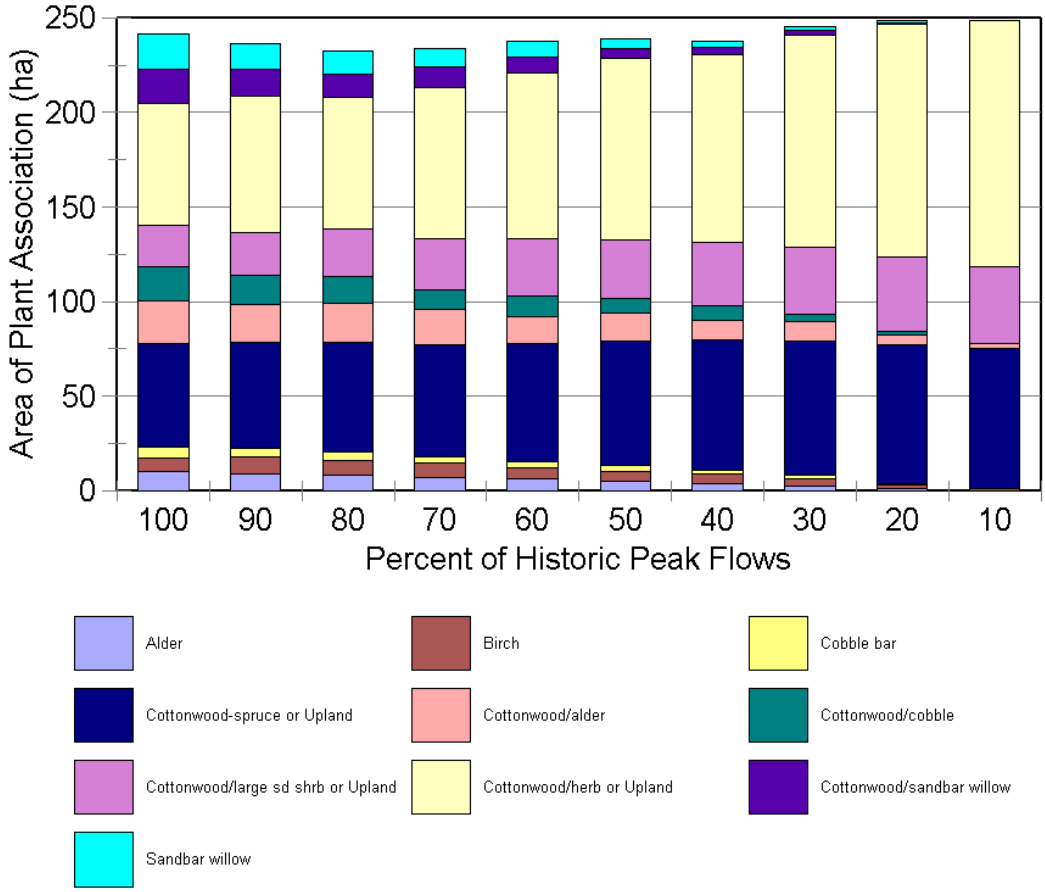


*Figure 10. Changes in riparian community composition under reduced peak streamflows predicted by a model of observed relationships between flood magnitude and recurrence interval and the relative position of various plant communities [13].*

Scenario modeling indicates varying degrees of change in annual peak flow change in the upper, middle and lower San Miguel River corridor. The climate change scenarios (i.e. C, D, and E) indicate a ~10% to 25% decline in the 50$^{th}$-75$^{th}$ percentile peak flow magnitude between Telluride and Naturita (Table 3). Declines predicted at Uravan are less severe and range between ~0% and 15%. Scenario modeling, thus, indicates that the potential impacts of climate change in the San Miguel basin include simplification of riparian forest community structure.

*Table 3. Annual flood magnitudes predicted at several locations along the San Miguel River corridor under various scenarios. The 50$^{th}$ percentile annual flood magnitude is equivalent to the 1-in-2-year flood. The 75$^{th}$ percentile magnitude is approximately equivalent to the 1-in-4-year flood.*

| Location | Percentile | Baseline Value | Scenario A % Change | Scenario B % Change | Scenario C % Change | Scenario D % Change | Scenario E % Change |
|---|---|---|---|---|---|---|---|
| San Miguel River at Telluride | 50th | 412 | 0 | 0 | -7 | -24 | -24 |
| | 75th | 537.5 | 0 | 0 | -9 | -18 | -18 |
| San Miguel River at Placerville | 50th | 1113 | 0 | 0 | -19 | -20 | -21 |
| | 75th | 1461 | 0 | 0 | -8 | -20 | -21 |
| San Miguel River at Naturita | 50th | 1472 | 5 | 6 | 9 | -27 | -25 |
| | 75th | 2184 | 2 | 2 | -2 | -9 | -7 |
| San Miguel River at Uravan | 50th | 1922 | -2 | -2 | -1 | -10 | -11 |
| | 75th | 2454.5 | 1 | 1 | 4 | -8 | -16 |

Recent investigations conducted by the BLM [12] on segments of the mainstem San Miguel River to assessed the importance of interactions between the river channel and alluvial aquifer for maintaining healthy riparian zones. BLM's work found that riparian vegetation near Placerville is stressed during late summer months and that flows of approximately 88 cfs are necessary to recharge groundwater and maintain alluvial aquifer water table elevations sufficient for cottonwood health. They also found that riparian vegetation near Uravan demonstrates significant stress during the late summer months, and a prolonged period of drought or further reduction of baseflows in this area may lead to uncontrolled die-back of woody riparian plants. The mean annual minimum 90-day average flow near Uravan is approximately 84 cfs. This flow condition likely also represents a critical threshold flow for vegetation in this part of the river network. Consideration of the flow statistics generated for both Placerville and Uravan suggests that a minimum streamflow of 85 cfs during the growing season (April-October) may be sufficient to maintain long-term riparian health along the lower San Miguel River. Additional research may be required to assess the validity of this assumption on river segments near Naturita and Uravan.

*Table 4. Changes in streamflow behavior predicted by scenario modeling for the San Miguel at Placerville.*

| Metric | Units | Percentile | Baseline Value | Scenario A % Change | Scenario B % Change | Scenario C % Change | Scenario D % Change | Scenario E % Change |
|---|---|---|---|---|---|---|---|---|
| Annual Max | cfs | 25th | 863 | 0 | 0 | -18 | -24 | -26 |
| | | 50th | 1113 | 0 | 0 | -19 | -20 | -21 |
| | | 75th | 1461 | 0 | 0 | -8 | -20 | -21 |
| Time to 75% of Total Annual Yield | doy | 25th | 198 | 0 | 0 | -11 | -11 | -11 |
| | | 50th | 203 | 0 | 0 | -9 | -9 | -9 |
| | | 75th | 211 | 0 | 0 | -6 | -7 | -6 |
| April Max | cfs | 25th | 346 | 0 | 0 | 11 | 5 | -2 |
| | | 50th | 481 | 0 | 0 | 22 | 13 | 8 |
| | | 75th | 619.5 | 0 | 0 | 29 | 23 | 11 |
| May Max | cfs | 25th | 655.5 | 0 | 0 | -3 | -10 | -11 |
| | | 50th | 834 | 0 | 0 | 4 | 2 | 0 |
| | | 75th | 1038 | 0 | 0 | 7 | 1 | 5 |
| June Max | cfs | 25th | 812 | 0 | 0 | -37 | -49 | -50 |
| | | 50th | 1092 | 0 | 0 | -37 | -41 | -42 |
| | | 75th | 1447.5 | 0 | 0 | -21 | -33 | -34 |
| July Max | cfs | 25th | 364 | -8 | -8 | -53 | -63 | -63 |
| | | 50th | 606 | 0 | 0 | -56 | -62 | -62 |
| | | 75th | 955 | 0 | 0 | -58 | -65 | -66 |
| July Min | cfs | 25th | 131 | 5 | 5 | -43 | -48 | -48 |
| | | 50th | 201 | 0 | 0 | -51 | -57 | -56 |
| | | 75th | 327 | 0 | 0 | -63 | -66 | -65 |
| August Min | cfs | 25th | 93.5 | 2 | 2 | -34 | -44 | -43 |
| | | 50th | 114 | 1 | 1 | -37 | -39 | -40 |
| | | 75th | 140 | 0 | 0 | -37 | -44 | -44 |
| September Min | cfs | 25th | 69.25 | 0 | 0 | -28 | -36 | -38 |
| | | 50th | 84 | 1 | 1 | -26 | -32 | -33 |
| | | 75th | 95.5 | 8 | 8 | -19 | -29 | -28 |
| October Min | cfs | 25th | 60 | -4 | -4 | -36 | -54 | -53 |
| | | 50th | 77 | 0 | 0 | -33 | -48 | -49 |
| 3-day Min | cfs | 75th | 57.83 | 0 | 0 | -24 | -35 | -34 |
| | | 25th | 39.33 | 0 | 0 | -22 | -58 | -58 |
| | | 50th | 46.67 | 0 | 0 | -21 | -40 | -37 |
| 7-day Min | cfs | 25th | 41.71 | 0 | 0 | -22 | -56 | -55 |
| | | 50th | 48.43 | -1 | -1 | -18 | -35 | -35 |
| | | 75th | 60.21 | 0 | 0 | -23 | -35 | -34 |
| 30-day Min | cfs | 25th | 45.63 | 0 | 0 | -20 | -39 | -39 |
| | | 50th | 52.77 | 0 | 0 | -17 | -32 | -31 |
| | | 75th | 64.53 | 0 | 0 | -22 | -35 | -34 |

Scenario modeling results indicate climate change may reduce low flow conditions during the late summer growing season (Table 4). Minimum monthly flows during dry years may decrease at Placerville by ~25-40%. This change could increase the frequency of water stress for riparian forests in the middle sections of the watershed.

# 3 Discussion and Conclusions

Riparian health is not a concept that lends itself well to the development of flow prescriptions on a given reach of river. However, understanding the landscape processes that control existing riparian community characteristics provides an important baseline for predicting change resulting from some future change land use or hydrological in the system. Riparian areas are disturbance-mediated communities that depend on flow *variability*, both in magnitude and frequency, to maintain the patch dynamics that define resilient ecosystems. Depending on landscape position within the San Miguel watershed, the disturbance regime may be dominated by colluvial processes, fluvial processes, or some combination of the two. Colluvial processes significantly impact riparian disturbance regimes in small tributary streams and on the mainstem San Miguel River above Placerville. In these locations, forest and land-use management decisions may be as important or more important than water management in maintaining functional, healthy riparian systems. Riparian communities along the San Miguel River below Placerville exhibit characteristics indicative of strong fluvial controls. These riparian systems will be much more sensitive to water management activities than along other stream segments within the watershed No water supply gaps affecting the recruitment of woody riparian vegetation were identified in this study. Periodic water supply gaps affecting late season vegetation stress near Placerville exist in low water years. Potential for water supply gaps relating to vegetation stress exist on lower reaches of the San Miguel River as well, but water supply needs on those reaches have not been well-quantified.

Flow recommendations for support of existing riparian communities reflect the expectation that existing riparian extents will be maintained through peak streamflow behavior reflecting historical conditions (Table 5). The peak flows noted here correspond those with relatively low recurrence intervals, as those are expected to be flows most vulnerable to water management in the future—the 20-year or 100-year floods on the San Miguel mainstem are probably too large to be significantly impacted by human activities. Small water gaps (~8 cfs for < 10 days) for support of riparian vegetation are observed on the San Miguel at Placerville in late summer and fall. Much larger gaps exist on downstream segments of the San Miguel River across year types. The degree to which continued depletion of baseflows on the lower San Miguel River reduces the resiliency of riparian zones (e.g. in the face of climate change) is an open question that may deserve additional consideration in the future.

*Table 5. Peak streamflow ranges and baseflow minimums necessary to support riparian vegetation on alluvial reaches of the San Miguel River where flood disturbance exerts a strong control on riparian zone extent. The upper and lower bound flow recommendations correspond to the 90% confidence intervals associated with hydrological simulation model results.*

| Location | Recurrence Interval (yr) | Lower Peak Discharge (cfs) | Upper Peak Discharge (cfs) | Minimum Discharge (cfs) |
|---|---|---|---|---|
| San Miguel River near Placerville | 1.5 | 1078 | 1286 | 85 |
| | 2 | 1279 | 1528 | 85 |
| | 4 | 1729 | 2087 | 85 |
| | 5 | 1861 | 2263 | 85 |
| San Miguel below Cottonwood Creek | 1.5 | 1071 | 1668 | 85* |
| | 2 | 1335 | 2020 | 85* |
| | 4 | 1871 | 2714 | 85* |
| | 5 | 2018 | 2908 | 85* |
| San Miguel River near Naturita | 1.5 | 1797 | 2508 | 85* |
| | 2 | 2325 | 3190 | 85* |
| | 4 | 3517 | 4743 | 85* |
| | 5 | 3863 | 5213 | 85* |
| San Miguel River near Uravan | 1.5 | 2074 | 2748 | 85* |
| | 2 | 2564 | 3373 | 85* |
| | 4 | 3655 | 4810 | 85* |
| | 5 | 3971 | 5255 | 85* |

## 3.1 Notable Findings and Recommendations

The San Miguel watershed is home to unique and diverse riparian forests. Assessment of these forests indicates and increasing sensitivity to peak flow change and low flows among those forests in the lower portion of the watershed. Notable findings regarding riparian areas include:

- Peak flow magnitudes with a recurrence interval of 5-years correspond to the area of greatest vegetation diversity on floodplains in the lower watershed. All riparian vegetation in the lower reaches of the San Miguel River corridor exists within areas that are inundated at a frequency less than or equal to the lifespan of the oldest lived individual plants. This suggests that the extent of riparian communities is strongly mediated by flood behavior in the lower watershed. Riparian vegetation extent in the upper watershed appears weakly controlled by flood behavior. Thus,

riparian forests in the lower watershed are at greater risk for impact due to some change in peak flow behavior.

- Mortality inducing conditions for newly recruited cottonwood species tend to increase in dry years and are more extensive in the lower watershed. Drying conditions predicted under climate change scenarios C, D, and E may increase the frequency of mortality inducing conditions and, thus, limit the rate of recruitment of new woody vegetation in riparian forests.
- Significant water supply related to late season vegetation stress may exist between Cottonwood Creek and the Dolores River in average and dry years. Growing season baseflows at or above 85 cfs on the San Miguel River below Placerville may be required to avoid critical vegetation stress and xylem cavitation in cottonwoods. **Note:** The BLM identified critical water stress in riparian vegetation during late-summer at a study plot in Uravan but did not estimate the elevated flow condition necessary to avoid this condition. The study did provide a flow management target at a study plot near Placerville, however. Floodplain conditions generally get drier and hotter between Placerville and Uravan. Therefore, the flow target identified for Placerville was assumed relevant for lower sections of the San Miguel River. Stakeholders may elect to support additional study to verify this assumption.
- Colonization of riparian areas by invasive vegetation, tamarisk and Russian olive in particular, is an ongoing management concern in the lower watershed. Short-duration flood events produced by late-summer monsoon rainfall scour floodplain surfaces and provide preferential conditions for spread of invasive species with long seed dispersal windows.
- Reductions in peak flow magnitude predicted by climate change scenarios C, D, and E may lead riparian forests in the lower watershed to become less diverse and more dominated by mixes of cottonwood and upland woody, shrub, and herbaceous species.

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**SAN MIGUEL COUNTY**

**NOXIOUS WEED MANAGEMENT PLAN**

## I. Introduction

The Colorado Noxious Weed Act, Title 35 Article 5.5, requires that the Board of County Commissioners (BOCC), of each county in the state shall adopt a noxious weed plan for all of the unincorporated lands within a given county. These plans shall by reference or incorporation include all of the requirements and duties set forth in the Colorado Noxious Weed Act.

The San Miguel County BOCC accepts and supports the intent, guidance, and goals of the Colorado Noxious Weed Act and a copy is attached as support for the San Miguel County Noxious Weed Management Plan. The Colorado Noxious Weed Act is hereby incorporated by reference as an integral part of the San Miguel County Noxious Weed Management Plan. Any questions, ambiguities, disputes, or challenges that may arise from attempts to enforce the San Miguel County Noxious Weed Management Plan will be settled by reference to the Colorado Noxious Weed Act under guidelines set forth in section 35-5.5-109, subsections 4-7.

The San Miguel County Noxious Weed Management Plan is intended to govern weed management activities on unincorporated lands within San Miguel County. Incorporated municipalities within the county are required by the Colorado Noxious Weed Act to develop and enforce their own weed management plans. Any municipality that fails to develop and enforce a weed control plan, or relevant ordinance is in violation of section 35-5.5-106 of the Colorado Noxious Weed Act and by reference the San Miguel County Noxious Weed Management Plan.

Private landowners within the unincorporated portions of San Miguel County are responsible for noxious weed management on their lands as specified in section 35-5.5-109 of the Colorado Noxious Weed Act and by reference the San Miguel County Noxious Weed Management Plan.

State boards, departments, divisions, and agencies are required by the Colorado Noxious Weed Act and the San Miguel County Noxious Weed Management Plan to manage noxious weeds on lands under their jurisdiction as specified in section 35-5.5-110 of the Colorado Noxious Weed Act.

At least once eve1y three years as specified in section 35-5.5-107 of the Colorado Noxious Weed Act the Board of County Commissioners and concerned citizens will review the San Miguel County Noxious Weed Management Plan for modification. At that time weed management plans will be requested from local, state and federal entities that manage public lands for review by the San Miguel County Board of County Commissioners.

The BOCC may enter into cooperative agreements with federal land management agencies as specified in section 35-5.5-111 of the Colorado Noxious Weed Act to facilitate or compel effective noxious weed management on the substantial land base managed by federal agencies within San Miguel County.

The BOCC shall establish and maintain a local advisory board as specified in section 35-5.5-107 of the Colorado Noxious Weed Act.

The BOCC recognizes the need for and agrees to effectively engage in the management of all noxious weeds appearing on the San Miguel County Noxious Weed List. Species or class upgrades or changes in classifications of noxious weeds may be added to the list after giving 30-day notice and holding a public meeting to gain citizen input on the proposed new listing as specified in section 35-5.5-108 of Colorado Noxious Weed Act.

Noxious weeds are presently known to exist in San Miguel County. Weeds are classified according to a state noxious weed priority list: A: Eradication is a must. B: Manage and control the spread of these species. C: Support the use of integrated management methods and provide educational, research and biological control resources.

A prioritization list may be established and may be amended or modified as necessary. A local governing body may adopt eradication, containment, or suppression standards that are more stringent than the standards adopted by the state. CRS 35-5.5-108 (2)(Ill)(b).

Following are the weed species that are present or are of concern to San Miguel County.

**San Miguel County Weeds of Concern**

| Common Name | Scientific Name | State Class. | County Class |
|---|---|---|---|
| Meadow Knapweed | Centaurea nigrescens | A | A |
| Myrtle Spurge | Euphorbia myrsinites | A | A |
| Purple loosestrife | Lythrum salicaria | A | A (priority) |
| Yellow Starthistle | Centaurea solstitialis | A | A (priority) |
| | | | |
| Absinth wormwood | Aitemisia absinthium | B | B |
| Black henbane | Hyoscyamus niger | B | B |
| Bull thistle | Cirsium vulgare | **B** | B |
| Canada thistle | Cirsium arvense | B | B |
| Chinese Clematis | Clematis orientalis | B | B (priority) |
| Common tansy | Tanacetum vulgare | B | B |
| Dame's rocket | Hesperis matronalis | B | B (priority) |
| Diffuse knapweed | Centamea diffusa | B | B (priority) |
| Hoary cress | Cardaria draba | B | B |
| Houndstounge | Cynoglossum officinale | B | **B** |
| Jointed goatgrass | Aegilops cylindrica | B | B |

| | | | |
|---|---|---|---|
| Leafy spurge | Euphorbia esula | B | B (priority) |
| Musk thistle | Carduus nutans | B | B |
| Oxeye daisy | Leucanthemum vulgare | B | B (priority) |
| Perennial pepperweed | Lepidium latifolium | B | B |
| Plumeless thistle | Carduus acanthoides | B | B |
| Russian knapweed | Acroptilon repens | B | **B** |
| Salt cedar | Tamarix chinensis, parviflora, ramossima | B | **B** |
| Scotch thistle | Onopordum acanthium, tauricum | **B** | B |
| Spotted knapweed | Centaurea stoebe | **B** | B (priority) |
| Sulfur cinquefoil | Potentilla recta | B | B |
| Yellow toadflax | Linaria vulgaris | B | B (priority) |
| Common burdock | Arctium minus | C | B |
| Common mullein | Verbascum thapsus | C | **B** |
| Downy brome (cheatgrass) | Bromus tectorum | C | **B** |
| Halogeton | Halogeton glomeratus | C | **B** |
| Poison hemiock | Conium maculatum | C | **B** |
| Russian Thistle | Salsola kali ( Goosefoot family) | | C |

## II. Physical and Cultural Setting

San Miguel County is situated on the northern side of the western San Juan Mountains in Southwest Colorado. San Miguel County encompasses the headwaters of the San Miguel and Dolores rivers watersheds. Portions of four major ecological zones (not to be confused with the land use and building code zones) arc present in San Miguel County with elevations that range from 6,000' to 14,500'. These include the foothill and valley zones from approximately 6,320' to 7,000'; the montane zone from approximately 7,000' to 9,500'; the subalpine zone from approximately 9,500' to 11,500'; and the alpine zone from approximately 11,500' to 14,150'. Within this broad and variable range of ecological zones many habitat types exist that each support their own native plant communities as well as numerous invasive, non-native plants, many of which are now viewed as noxious weeds.

## III. Integrated Management of Noxious Weeds

It is widely accepted by noxious weed control professionals that an integrated management approach to weed infestations provides the greatest level of success. Complete reliance on a sole method of noxious weed management can result in outright failure of the effort or in damage to non-target organisms and the environment. The Colorado Noxious Weed Act requires that both government entities and private landowners develop integrated noxious weed management plans. Broadly speaking, there are five primary management options included in an integrated management plan:

### 1. Preventative

Prevention is the first and perhaps the most important step in a weed control program. In addition, preventative measures are probably the most cost effective method of weed control. Preventative weed control includes (among others) weed-free crop seed, weed-free manure and hay, clean (weed-free) harvesting and tillage equipment and the elimination of weed infestations in areas bordering cropland, irrigation ditches and canals. Cleaning is recommended for 4 wheel drive vehicles, ATVs, and other equipment, which may have been exposed to weed areas.

**2. Cultural**

Including, but not limited to; establishing and managing an adequate population of desirable vegetation to compete with the weeds, utilizing livestock when possible (cattle, goats, sheep), mulching, and burning when appropriate.

Many of the noxious weed infestations in San Miguel County are established on disturbed ground of some sort. Land use activities that limit the amount of ground disturbed at a given time, or that limit the amount of time ground remains disturbed without reestablishing a native vegetative cover, would result in fewer and less severe noxious weed infestations. All disturbed areas shall be reseeded as soon as possible after the disturbance.

**3. Mechanical**

Including but not limited to; hand pulling, hoeing, mowing and tillage.

**4. Biological**

Biological weed control involves the utilization of natural enemies for the control of specific weed species. Biological weed control is never one hundred percent effective and can take 5 to 10 years for partial control. Biological weed control is not acceptable as the sole control method for any particular or specific weed species targeted for eradication.

**5. Chemical**

Always **read the label** before using any herbicide. Weed control with herbicides is an effective tool for many target weed species. However, there are several aspects to consider when choosing a chemical program. These include; herbicide selection, timing of application, target weed, desirable crops or plant species being grown or that will be planted, number of applications per year and number of years a particular species will need to be treated for desired control. Also important are the health and safety factors involved, and the need to consider undesirable impacts.

All of these management options will be considered when evaluating a noxious weed infestation in San Miguel County.

## IV. Revegetation

As a noxious weed preventative measure San Miguel County will, through its relevant officials, agents, employees, permittees, and contractors, establish as a policy, the practice of reestablishing a stable community of native or other appropriate plants, primarily grasses, in all areas of the unincorporated County where County related or permitted projects disturb ground. This will include all areas where efforts to control and manage noxious weeds have left barren ground.

All permitted individuals and entities will also be held to reasonable re-vegetation standards whenever their activities disturb ground. Incorporated municipalities and Federal land management agencies will be encouraged by the County to incorporate similar provisions into their noxious weed management plans.

The BOCC may require weed control and revegetation bonds or other security from developers as well as weed management and revegetation plans for their projects.

The San Miguel County Weed Control Manager, may advise the BOCC with guidelines on the appropriateness of seed mixtures proposed within the various ecological zones of the County. The Weed Control Manager will also inspect revegetation sites and determine the rates of success and make recommendations regarding bond release or forfeiture.

## V. Herbicides

The careful and appropriate use of herbicides will continue to be a primary management option for the foreseeable future. In most large-scale infestations and for certain species of noxious weeds, herbicides are the only effective option.

The San Miguel County Noxious Weed Control Manager will adhere strictly to all health, safety, and environmental instructions and precautions for any and all herbicides that may be used.

Guidelines for avoiding health and environmental risks are available from manufacturers and government agencies. All herbicides will be applied according to manufacturer's label instructions and state law.

## VI. Duty to Manage Noxious Weeds

As stated in section 35-5.5-104 of the Colorado Noxious Weed Act and by reference the San Miguel County Noxious Weed Management Plan, "It is the duty of all persons to use integrated methods to manage noxious weeds if the same are likely to be materially damaging to the land of neighboring landowners." As used herein and in the Colorado Noxious Weed Act, "persons" means an individual, partnership, corporation, association, or federal, state, or local government or agency thereof owning, occupying, or controlling any land, easement, or right-of-way, including any city, county, state, or federally owned or controlled highway, drainage or irrigation ditch, spoil bank, borrow pit, gas and oil pipeline, high voltage electrical transmission line, or right-of-way for a canal or lateral. Weeds do not respect political, jurisdictional, or personal boundaries, they occur wherever opportunity exists. To effectively manage noxious weeds across such boundaries, a central weed authority must exist. Section 35-5.5-105 of the Colorado Noxious Weed Act effectively establishes the BOCC as that central authority regarding weeds in unincorporated San Miguel County.

The BOCC may consider any ordinance, rule, or regulation that would improve compliance with the San Miguel County Noxious Weed Management Plan and by reference the Colorado Noxious Weed Act. Noxious weeds, if left to spread without effective integrated management, threaten to cause material damage to indigenous flora and fauna and to all neighboring landowners. Any effective action by the BOCC designed to improve compliance with the Colorado Noxious Weed Act, and the San Miguel County Noxious Weed Management Plan, would necessarily have applicability across the range of land ownership categories found in the unincorporated portions of San Miguel County. San Miguel County will cooperate and assist municipalities in developing their Weed Management Plans so that there will be an effective Countywide plan.

## VII. Goals of the San Miguel County Noxious Weed Management Plan

The San Miguel County Noxious Weed Management Plan has been developed to comply with the Colorado Noxious Weed Act and to provide guidance and support for the long-term effort of effective control of noxious weeds in San Miguel County. It is clearly understood that noxious weeds will never be fully eradicated from San Miguel County.

The San Miguel County Noxious Weed Management Plan is intended to guide this and future generations in what will hopefully become a unified and concerted effort to bring these exotic invasive plants under the control of an effective management program. Citizen awareness of the value of native biodiversity is the key to success for this program.

The following are the general 10-year goals of the San Miguel County Weed Management Plan: 2010 to 2020:

- Eradication of "priority" species indicated as weeds of concern for San Miguel County.
- Control of noxious weeds to manageable levels of scattered occurrences.
- Restoration and enhancement of native rangeland with native or other appropriate seed/plants.
- Maintain the native biodiversity.
- Conduct educational and public awareness programs.
- Find additional sources of funding.

Serious infestations will be monitored on an annual basis. Weeds of lesser concern will be generally noted as time and resources permit with citizen volunteers encouraged to participate.

Accomplishment of these broad general goals will require a significant effort on the part of a great many individuals, agencies, and organizations. The coordination of the combined efforts of the San Miguel County BOCC, County Weed Manager, private citizens, municipalities, corporations, and land management agencies will not be a simple task. Increasing diversity in the local human community and a general lack of connection to a land based economy may increase the difficulty of managing this task. If, however, maintenance of a high level of native biodiversity becomes, and remains, a significant element of the local human culture then the task will be managed. Influencing the human community to adapt such cultural traits.

## VIII. Individual Management Plan and Enforcement

In an effort to support and accomplish goals of the San Miguel County Noxious Weed Plan, most specifically goals 1 and 2, individuals may he required to comply with an "Individual Management Plan". Those who may be required to comply with an individual management plan are:

1. Properties infested with noxious weeds that threaten productive agriculture.
2. A complaint filed with the San Miguel County Weed Manager from an adjacent property owner that noxious weeds are infesting or have the potential to infest their non- agricultural property.
3. Infestations of State listed "A" species noxious weeds or noxious weeds declared as "priority" species by the County.
4. Infestations of any noxious weed encroaching on county roads rights-of-way.

After formal notification by the County that noxious weeds are present, the landowner of such property shall be deemed to be responsible for an individual management plan. The primary component of this plan is to institute integrated management of the weeds on the property such that the following two objects are met annually:

The weeds shall not be allowed to produce seed or develop other reproductive propagules. The population of the weeds is diminished each year.

In the event a landowner fails to proceed with an individual management plan and/or fails to meet the two objectives, the County has and may exercise the authority to cause the objectives to be met and may assess the whole cost including up to 20% for inspections and other incidental costs to the landowner pursuant to C.R.S. 35-5.5-109(5)(a)(II).

The specific process to be followed by the County, requiring an individual management plan and the rights of appeal for the landowner are as outlined in 35-5.5-109 C.R.S., as may be amended from time to time.

As the State Commissioner develops rules and regulations pertaining to the management of weeds, the more stringent standard or that standard more likely to achieve the desired results, in the event of a conflict between State law and County Weed Management Plan, shall be the governing rule or regulation.

Please contact Janet Kask with any questions or concerns. She can be reached at 970-369-5469 or janetk@sanmiguelcountyco.gov.