

CRYSTAL RIVER, SEGMENT 2

Base of McClure Pass to the Roaring Fork River



Crystal River Segment 2: Looking upstream towards Chair Mountain from Reach 1.

Much of Segment 2 on the Crystal River is a human-dominated landscape heavily impacted by either the highway, ranching or residential development. Only a few places, such as Placita in the above photo, remain as natural landscapes.

6.13.1 Crystal River, Segment 2

Number of reaches: 10

Length of segment: 40.68 km.

General description: In this segment we assess the condition of the Crystal River from Placita to its confluence with the Roaring Fork River. On the upper 27 km of this segment the stream has cut a steep, narrow gorge into surrounding Paleozoic sandstone, limestone, and shale geologic formations with only an occasional and small floodplain occurring intermittently in an otherwise narrow canyon. Highway-induced channelization has eliminated most of these riparian benches and the potential for their re-development. Riparian habitat is dominated by narrowleaf cottonwood and Colorado blue spruce with a shrub canopy dominated by alder, river birch, red-osier dogwood and a variety of willow species. Adjacent uplands are dominated by a mosaic of Douglas fir forest, ponderosa pine, aspen woodlands and Gambel oak shrublands. Towards the bottom 13 km of the segment, the stream enters a wide, flat valley. Riparian habitat continues to be comprised primarily of narrowleaf cottonwood and blue spruce, but with box elder becoming abundant in the tree canopy. Birch, alder, willow and dogwood continue to be common in the shrub canopy but in these lower reaches silverberry, hawthorn and three-leaf sumac have become co-dominants. Adjacent upland habitat has transitioned to a mosaic of pinon-juniper woodland and sage shrubland.

Historic impacts from coal and marble mining-related activities, railroad operation and ranching, and more recent activities including residential and highway development, have impacted this entire segment of the Crystal River. However, a few areas are present that have not been subjected to recent human disturbance. Here historic impacts from ranching, mining, railroads and associated development have come some distance towards self-restoration. Because these areas are few, they are all the more important to protect from human disturbance.

Recent development has, on the other hand, frequently contributed to stream degradation. A highway that parallels the Crystal River channelizes the stream, fragments upland from riparian habitat, dissects the floodplain in numerous areas and is a major source of road-based pollutants and sediment. Additional development activities that impact the stream include cattle ranching, agriculture, residential development and golf courses, commercial development, commercial campgrounds and, planned for the near future, a paved recreational trail that will run the length of the valley.

Channel condition: The shape of the channel has been variably altered by channelization, downcutting and lateral erosion, and dewatering. Historical channelization occurred from the railroad grade and related development such as the building of the town of Janeway (CR2-7). The railroad grade was built along the East side of the Crystal along most of this segment. Impacts from the railroad grade included stream straightening and the elimination of riparian habitat, which then resulted in bank erosion with ensuing changes to the channel. Some of the stream bank and riparian habitat along the railroad grade has self-restored and is again well-vegetated with stable banks that help to improve channel condition.

Channelizing impacts from Highway 133 affects channel structure along the entire segment and results in loss of sinuosity with a consequent decrease in stream habitat heterogeneity, increased gradient and increased energy in the downstream direction. Highway channelization has also eliminated or severely decreased riparian zone width and degraded riparian habitat over much of the segment, which has contributed to channel alteration by resulting in bank erosion, downcutting and destabilization.

Development impacts the channel throughout the reach. Activities that have altered the channel by causing downcutting, lateral erosion and stream imbalance include: 1) agricultural development in the riparian zone and grazing on stream banks; 2) residential and golf development within the riparian zone that results in the removal and degradation of riparian vegetation; and 3) commercial development that has resulted in the removal of riparian vegetation and ripraping stream banks.

Hydrologic alteration: Water diversions and channel alteration has altered the natural flow regime. Hydrologic alteration from irrigation diversions dewater the stream especially during low flow season. Drought years on the lower reaches of this segment have witnessed insufficient water to sustain fish populations.

Channelization has diminished riparian functions such as energy dissipation, reduced the ability of the stream to overbank, fragmented riparian areas and interrupted ground water discharge - all which have contributed to altering the natural flow regime to result in higher flooding flows and lower base flows.

Riparian habitat: Both historic and current development have reduced the extent of riparian habitat and degraded much of the remainder by altering plant species composition, habitat structure and age class distribution. Much of

the historic riparian degradation that resulted from the railroad grade has undergone natural restoration and now makes a positive contribution to riparian functions, bank stabilization and wildlife habitat. More recent development activities have, however, typically resulted in riparian loss. These activities include highway construction, residential and golf course development and commercial development. Reduction in riparian habitat has also resulted in a commensurate reduction in riparian functions such as pollution filtration, energy dissipation and wildlife habitat.

Wildlife: Habitat fragmentation, both on land and in the stream, result from inappropriate development activities. Habitat loss occurs on land due to development and, in the stream, due to dewatering. Native cutthroat trout populations occur in Avalanche creek but dewatering in the Crystal River limits the potential for population expansion and genetic exchange. Dewatering of the river essentially fragments cutthroat habitat. Dewatering also reduces the amount of sustainable habitat available to fish and aquatic insects (macroinvertebrates), thereby reducing abundance of macroinvertebrates and the size of the fish population.

Highway, residential, and commercial development fragments wildlife habitat and reduces the total amount of habitat available to native wildlife. In addition, human disturbance that is associated with development selects for wildlife that is tolerant of disturbance, thereby altering the natural community. For example, on this section of the Crystal River and elsewhere in the watershed, brown-headed cowbirds were associated with domestic livestock, especially horses, llamas and cattle. Cowbirds have expanded their range, commensurate with human agricultural development, across the west. Cowbirds parasitize songbirds, further threatening the survivability of many native songbirds whose existence is already jeopardized by habitat loss. Other opportunistic human-tolerant species, such as American crows and black-billed magpies, are more common in developed areas and impact songbirds through nest and fledgling predation.

Threats and management recommendations: We have used the following premises to define threats and identify corresponding management actions that should be taken to remediate threats:

1. To protect and conserve stream resources, the ecological processes that support the stream ecosystem must be preserved.
2. Management strategies should take into consideration the differential potential for disturbance and degradation based on stream class, surrounding geology and native riparian ecosystems.

Threats

- Instream diversions
- Highway-induced channelization, riparian degradation, bank destabilization and wildlife mortality.
- Agricultural development and grazing in the riparian zone; Residential and golf course development in the riparian zone; Commercial development in the riparian zone.
- Recreation-induced disturbance and habitat degradation
 - Trails that traverse or intrude into sensitive wildlife habitat disturb wildlife, effectively resulting in habitat loss.
 - Trampling and social trails result in the destruction of rare plants, degradation of bank stabilizing plants and disturbance to wildlife especially during breeding season (which for many bird species is the entire summer).
 - Trails are a conduit for the expansion of noxious weeds that often out-compete native plant species.
- Noxious weeds are ubiquitous throughout the segment and threaten further loss of ecological integrity.

Management Recommendations: To help prevent further loss of ecological integrity the following general recommendations are applicable throughout the reach.

- Restore a natural hydrologic cycle
 - Work with water rights holders to acquire water for wildlife
 - Restore connectivity between upland and stream ecosystems to enable ground water recharge and discharge
- Work with ranchers to implement sustainable riparian setbacks or purchase riparian conservation easements for wildlife.
- Work with the County to develop and enforce sustainable riparian setback regulations.
- Highway impacts severely disrupt the ecological connection between upland and stream ecosystems. The highway alters ground water discharge, contributes road-based pollutants and sediment to the stream and is a lethal barrier to daily and seasonal wildlife migration.
 - Require the CDOT to mitigate highway-induced water quality and stream and riparian habitat degradation.
 - Revegetate stream banks where the road cut and development have removed riparian vegetation.

- Install sediment barriers and/or sediment ponds to prevent road-based sediment and pollutants from moving into the stream.
- Require the CDOT to mitigate highway-induced habitat fragmentation that results in wildlife mortality
 - Identify wildlife crossing areas and install warning lights that are triggered when wildlife crosses the road, Install wildlife-appropriate underpasses for both large and small mammals
- Only a very few areas remain in a somewhat natural condition; manage these areas for wildlife
 - Avoid disturbing more habitat
 - Maintain undisturbed areas as human-free habitat
 - Route trails out of riparian areas and into existing transportation corridors or already disturbed habitat
- Implement an aggressive program to eradicate noxious weeds.

Conservation Areas of Concern: We feel that the following Conservation Areas of Concern are, or have the potential to be, especially valuable to wildlife. We have singled out these areas due to current or potential future threats to stream and wildlife values. Some of these areas are currently in ecologically sustainable condition; others are not and are in need of management action to restore ecological health. Regardless of the current condition, each area has especially important wildlife potential

Opportunities for conservation and restoration exist throughout the Crystal watershed. Some of those opportunities are as follows.

CR2-1: Placita - Conservation.

CR2-5: Filoha meadows - Conservation and restoration.

CR2-6: East bank of the Crystal River upstream of the confluence with Avalanche Creek - Conservation.

CR2-7: Janeway - Restoration and conservation.

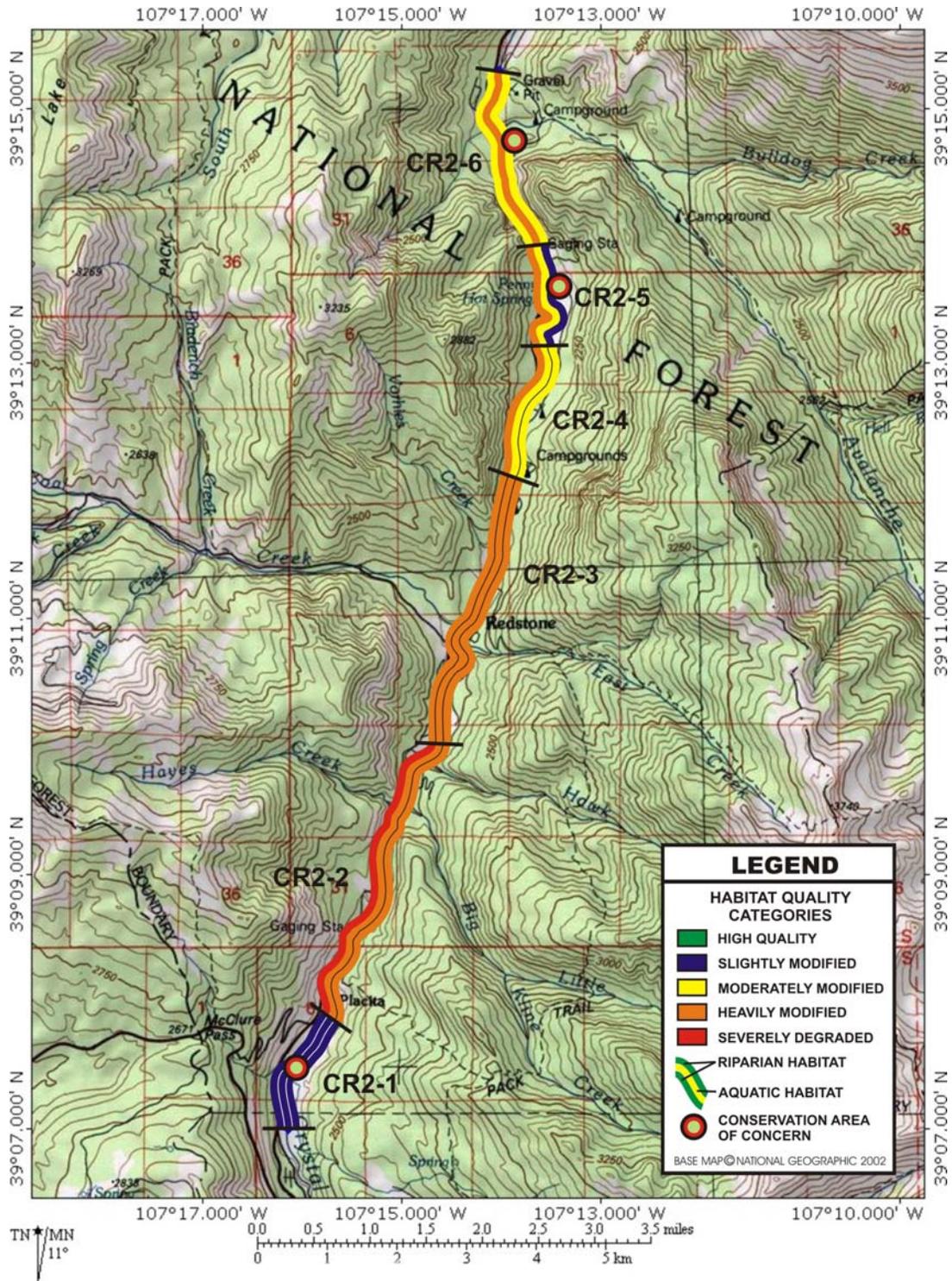
CR2-8: Red Wine Point - Restoration and conservation.

CR2-9: Downstream of "BRB" Campground - Restoration and conservation

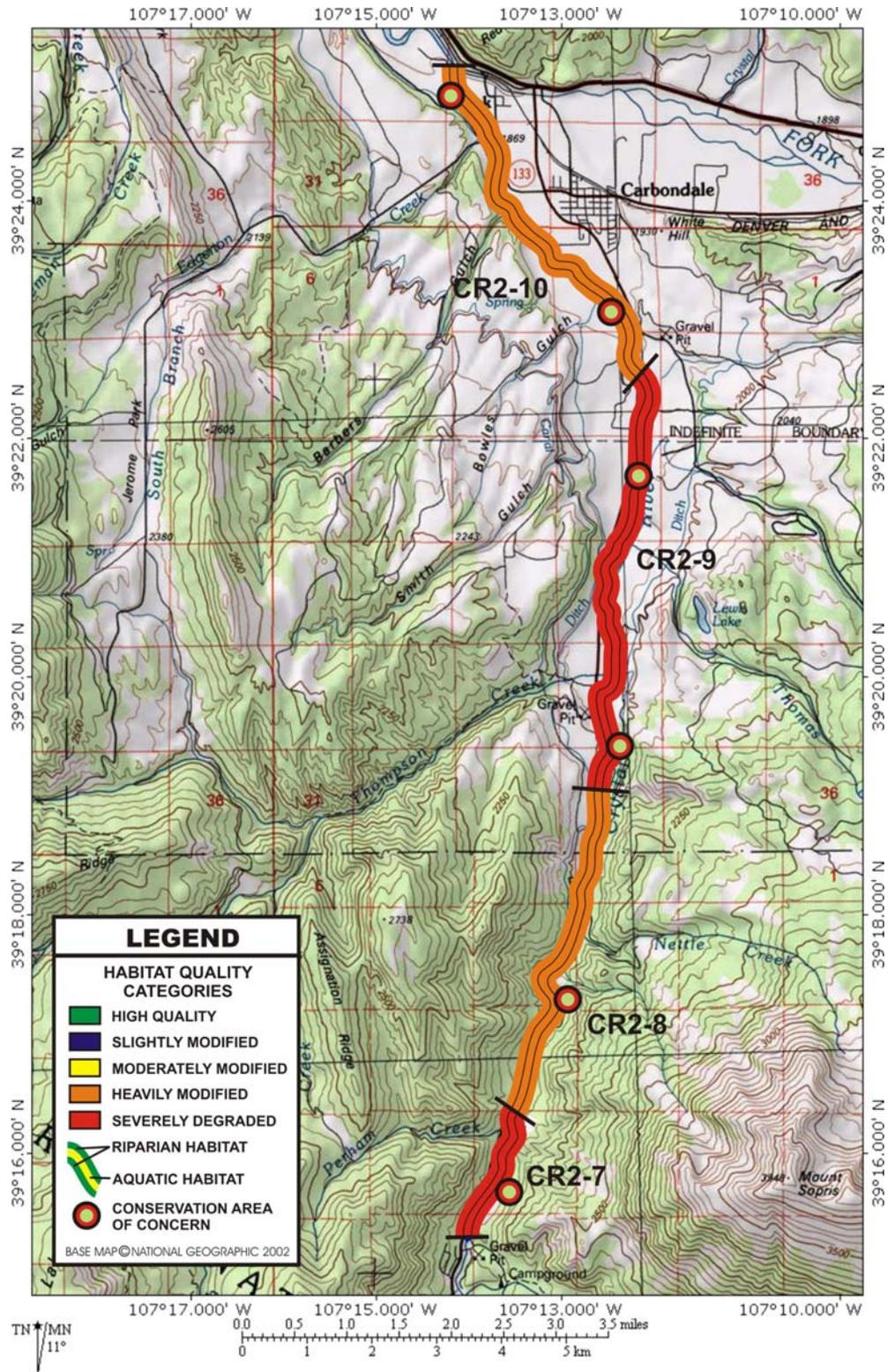
CR2-9: Expansive hay meadows - Restoration. Potential breeding bird habitat and winter bald eagle roost habitat is undermined by current agricultural practices that have greatly decreased the width of the riparian zone and inhibit cottonwood recruitment. Recommendation: work with landowner to develop wider, more sustainable riparian setbacks.

CR2-10: River Valley Ranch home and golf course development - Restoration. Golf and home development occurs in the riparian zone and on stream banks in most of the development. However, an area on the west bank at "RVR" has been maintained as wildlife habitat and provides good resource potential for raptors, wading birds and songbirds. This model should be implemented throughout the development.

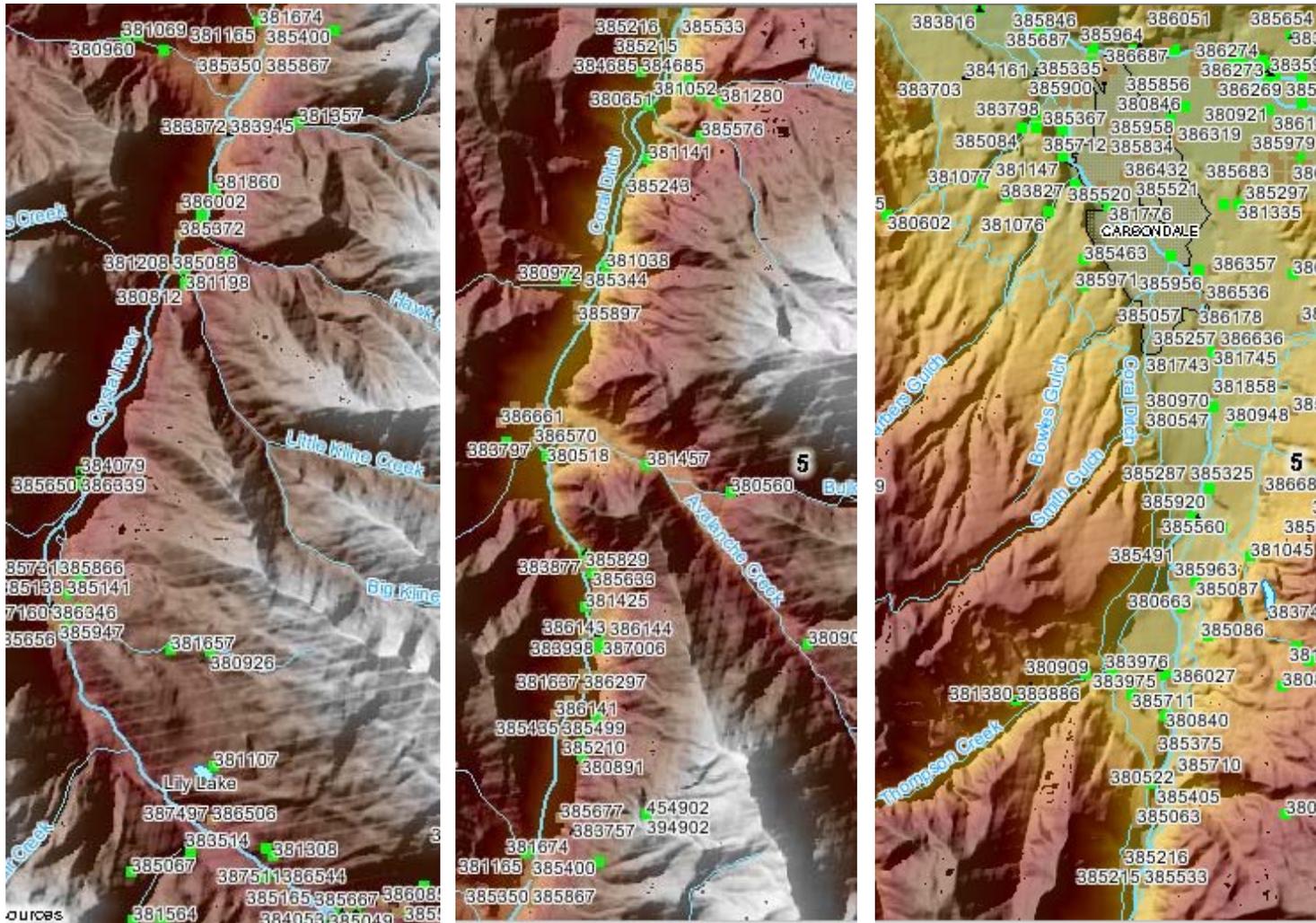
CR2-10: Sutank - Restoration and conservation. CNHP has identified a Potential Conservation Area at Sutank just above the confluence with the Roaring Fork on the west bank of the floodplain of the Crystal due to the occurrence of two rare plant species (G5S2 ranking) and a vulnerable montane riparian plant community (G3S3 ranking). Their recommendations include weed eradication and re-routing of trails to prevent trampling.



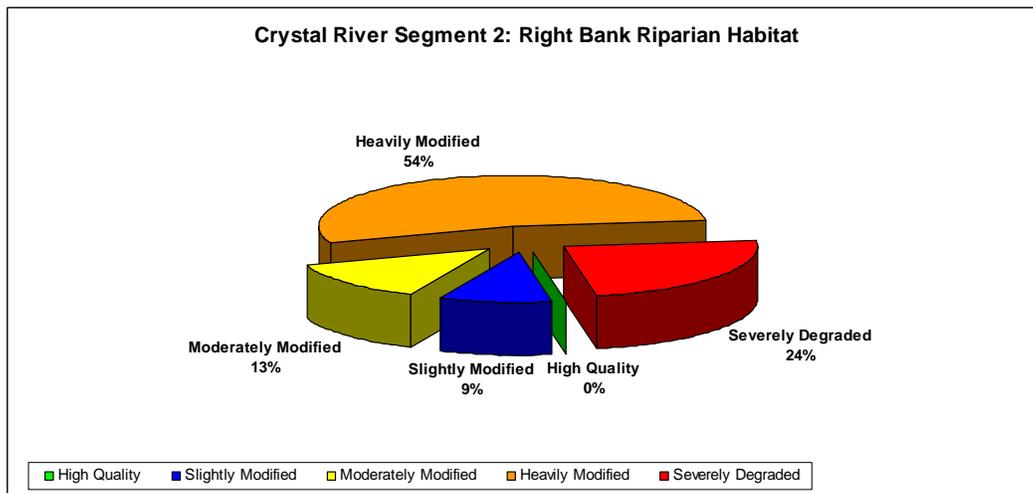
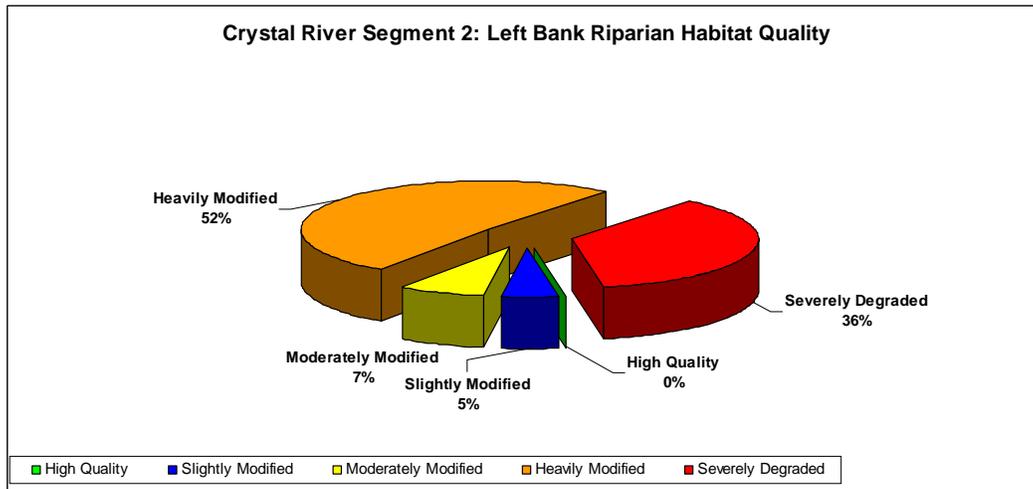
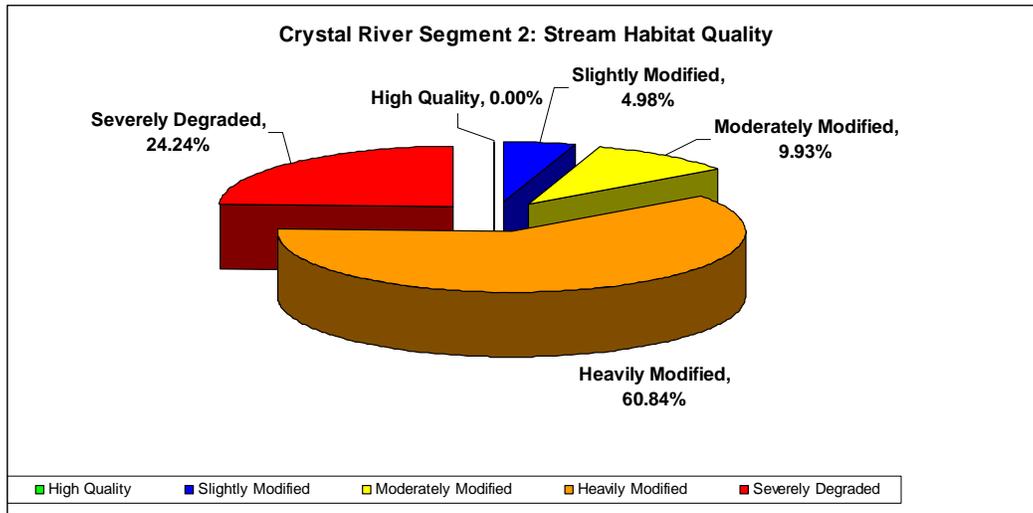
Crystal River Segment 2 (south) habitat assessment results.



Crystal River Segment 2 (north) habitat assessment results.



Lower Crystal River watershed: green dots indicate location of diversions (panels are ordered left to right from upstream to downstream).



Segment 2, Crystal River: Stream habitat assessment results.
 See appendix for habitat parameters and ranking criteria.

Stream Habitat Parameters	CR2-1 N39 07.004 W107 16.145	CR2-2 N39 07.869 W107 15.711	CR2-3 N39 10.019 W107 14.622	CR2-4 N39 12.115 W107 13.897	CR2-5 N39 13.146 W107 13.562
1. Epifaunal Substrate/Cover (0-20)	16	13	13	16	11
2a. Embeddedness (0-20)	18	13	15	13	16
2b. Pool Substrate Characteristics (0-20)	NA	NA	NA	NA	NA
3a. Velocity/Depth Regime (0-20)	16	16	16	16	14
3b. Pool Variability (0-20)	NA	NA	NA	NA	NA
4. Sediment Deposition (0-20)	16	10	9	15	13
5. Channel Flow Status (0-20)	16	16	9	16	16
6. Channel Alteration (0-20)	16	8	9	11	12
7a. Riffle Frequency (0-20)	19	18	16	18	15
7b. Channel Sinuosity (0-20)	NA	NA	NA	NA	NA
8. Bank Stability (LB: 0-10/RB: 0-10)	8/7	9/7	7/7	5/7	7/9
9. Bank Veg. Protection (LB: 0-10/RB: 0-10)	7/7	2/3	4/6	5/6	5/8
10. Riparian Zone Width (LB: 0-10/RB: 0-10)	8/8	3/4	4/5	5/7	5/9
Reach Total	162	122	120	140	140
Habitat Condition	SM	HM	HM	MM	MM

High Quality: 180-200
Slightly Modified: 160-179
Moderately Modified: 140-159
Heavily Modified: 120-139
Severely Degraded: Below 120

Segment 2, Crystal River: Stream habitat assessment results.
 See appendix for habitat parameters and ranking criteria.

Stream Habitat Parameters	CR2-6 N39 13.919 W107 13.635	CR2-7 N39 15.299 W107 14.028	CR2-8 N39 16.362 W107 13.517	CR2-9 N39 19.066 W107 12.613	CR2-10 N9 22.545 W107 12.159
1. Epifaunal Substrate/Cover (0-20)	15	11	11	11	13
2a. Embeddedness (0-20)	16	16	16	13	14
2b. Pool Substrate Characteristics (0-20)	NA	NA	NA	NA	NA
3a. Velocity/Depth Regime (0-20)	16	15	15	15	15
3b. Pool Variability (0-20)	NA	NA	NA	NA	NA
4. Sediment Deposition (0-20)	11	9	10	8	10
5. Channel Flow Status (0-20)	18	10	15	14	13
6. Channel Alteration (0-20)	10	8	9	11	12
7a. Riffle Frequency (0-20)	17	16	16	13	16
7b. Channel Sinuosity (0-20)	NA	NA	NA	NA	NA
8. Bank Stability (LB: 0-10/RB: 0-10)	4/3	4/4	6/5	5/5	7/5
9. Bank Veg. Protection (LB: 0-10/RB: 0-10)	4/3	2/2	4/5	5/5	7/5
10. Riparian Zone Width (LB: 0-10/RB: 0-10)	5/4	3/5	3/6	5/5	7/5
Reach Total	126	105	121	115	129
Habitat Condition	HM	SD	HM	SD	HM

High Quality: 180-200
Slightly Modified: 160-179
Moderately Modified: 140-159
Heavily Modified: 120-139
Severely Degraded: Below 120

Segment 2, Crystal River: Riparian habitat assessment results.
 See appendix for habitat parameters and ranking criteria.

Riparian Habitat Parameters	CR2-1 N39 07.004 W107 16.145	CR2-2 N39 07.869 W107 15.711	CR2-3 N39 10.019 W107 14.622	CR2-4 N39 12.115 W107 13.897	CR2-5 N39 13.146 W107 13.562
1. Stream Incisement (0-8)	6	8	4	4	6
2. Lateral Cutting (0-6)	4	4	3	3	4
3. Stream Balance (0-6)	4	4	4	4	4
4. Sufficient Soil (LB: 0-3/RB: 0-3)	3/3	2/2	2/2	1/2	2/3
5. Stream bank Veg. Composition (LB: 0-6/RB: 0-6)	6/6	6/6	6/6	6/6	6/6
6. Weeds (LB: 0-3/RB: 0-3)	1/1	0/0	1/1	2/2	1/2
7. Disturbance-caused Undesirable Plants (LB: 0-3/RB:0-3)	1/1	0/0	0/0	2/2	2/2
8. Woody Species Establishment & Regeneration (LB: 0-8/RB: 0-8)	8/8	4/4	8/8	8/8	4/8
9. Browse/Utilization of Trees and Shrubs (LB: 0-4/RB: 0-4)	4/4	3/3	4/4	4/4	4/4
10. Veg. Cover in Rip., Floodplain & Stream bank Zone (LB: 0-8/RB: 0-8)	7/7	2/2	2/2	4/4	2/8
11. Riparian Energy Dissipation (LB: 0-6/RB: 0-6)	5/5	2/2	3/3	4/4	2/6
Reach Total (LB/RB)	49/49	35/37	37/37	42/43	38/53
Riparian Habitat Condition	SM/SM	SD/HM	HM/HM	HM/MM	HM/SM

High Quality: 55-61

Slightly Modified: 49-54

Moderately Modified: 43-48 scores below 49 indicate riparian/stream habitat that is at risk.

Heavily Modified: 37-42

Severely Degraded: <37 scores below 37 indicate riparian/stream habitat that is not sustainable.

Segment 2, Crystal River: Riparian habitat assessment results.
 See appendix for habitat parameters and ranking criteria.

Riparian Habitat Parameters	CR2-6 N39 13.919 W107 13.635	CR2-7 N39 15.301 W107 14.028	CR2-8 N39 16.362 W107 13.517	CR2-9 N39 19.068 W107 12.613	CR2-10 N39 22.545 W107 12.159
1. Stream Incisement (0-8)	8	2	6	6	6
2. Lateral Cutting (0-6)	3	2	2	2	4
3. Stream Balance (0-6)	4	2	3	2	3
4. Sufficient Soil (LB: 0-3/RB: 0-3)	2/2	2/2	1/1	1/1	2/2
5. Stream bank Veg. Composition (LB: 0-6/RB: 0-6)	6/6	6/6	6/6	6/6	6/6
6. Weeds (LB: 0-3/RB: 0-3)	0/1	0/0	1/1	2/2	0/0
7. Disturbance-caused Undesirable Plants (LB: 0-3/RB:0-3)	1/1	1/1	2/1	0/0	0/0
8. Woody Species Establishment & Regeneration (LB: 0-8/RB: 0-8)	8/8	4/4	8/8	4/4	4/4
9. Browse/Utilization of Trees and Shrubs (LB: 0-4/RB: 0-4)	4/4	4/4	4/4	0/0	4/4
10. Veg. Cover in Rip., Floodplain & Stream bank Zone (LB: 0-8/RB: 0-8)	3/2	2/2	2/2	2/2	4/4
11. Riparian Energy Dissipation (LB: 0-6/RB: 0-6)	4/4	2/2	3/3	2/2	4/4
Reach Total (LB/RB)	43/43	27/27	38/37	29/29	37/37
Riparian Habitat Condition	MM/MM	SD/SD	HM/HM	SD/SD	HM/HM

High Quality: 55-61

Slightly Modified: 49-54

Moderately Modified: 43-48 scores below 49 indicate riparian/stream habitat that is at risk.

Heavily Modified: 37-42

Severely Degraded: <37 scores below 37 indicate riparian/stream habitat that is not sustainable.

Crystal River Segment 2, Reach 1.

Habitat Condition: Stream – slightly modified; LB/RB Riparian – slightly modified/slightly modified.
Stream Class (Rosgen) – E3. Stream Order – 3rd. Reach Length – 2.02 km.

Summary

Hydrologic considerations: At the top of this segment, the stream comes out of a narrow canyon to enter a wide, low-gradient valley characterized by a willow carr ecosystem. Over most of this reach good quality native riparian vegetation and beaver activity help create a stable, widely meandering stream with numerous mid-channel islands, ponds and backwaters that provide excellent wildlife habitat, stream water storage and cleansing functions.

Channel Condition: On 80% of the reach the channel is in good condition; sinuosity is high, bank vegetation has not been altered, and a relatively diverse flow regime is present reflecting fairly diverse channel morphology. On 20% of the reach channelization is present. On the top 20% of the left bank home development and the Highway 133 road cut has resulted in bank failure and riprapped banks; on the top 20% of the right bank, agricultural development with coincident vegetation alteration has resulted in bank failure and consequent stream straightening.

Instream heterogeneity: Sinuosity is appropriate over 80% of the reach but reduced where the highway and pastures channelize the stream. Without the habitat-diversifying effects of numerous mid-channel islands, instream habitat variety would be sub-optimal, predominated by fast-shallow and fast-deep velocity/depth regimes. Mid-channel islands create side channels, deep pools on the lee side of irregular edges, and overflow channels and backwater pools where a slow-shallow velocity/depth regime often occurs. Thus, although both shallow and deep pools are underrepresented, their frequency is increased by the development of stable, mid-channel islands; a fast-deep regime occurs on 40% of the reach, fast-shallow on 35%, slow-deep on 15% and slow-shallow on 10%.

Hydrologic Alteration: Width/depth ratio is inappropriately high and 20-25% of the channel substrate is exposed. These conditions may be partly due to small but numerous upstream and tributary irrigation diversions that affect base flows and partly due to channel widening where lateral erosion occurs. However, a natural hydrologic regime with bank-full flows and overbanking occurs regularly. Thus the flood plain is frequently inundated on all but the 20% of the reach that is downcut or riprapped. Dense riparian vegetation enhances infiltration of overbanking flows, which increases ground water recharge. Then, during the dry season, ground water discharge contributes to maintaining sustainable base flows. A moderate amount of beaver activity provides some flow modification and water storage utility.

Stream balance / Erosion – deposition: On 80% of the reach, erosion and deposition is in balance, pointbars are revegetating, and the stream system is both laterally and vertically stable. However, at the top 20% of the reach active lateral erosion and downcutting occur. Undue erosion produces sediment loads in excess of what the stream can carry with consequences that include large deposits of cobble and gravel that are not revegetating.

Upland contribution to degradation

Highway 133 fragments habitat and creates a lethal barrier to wildlife that are attempting to move between upland and riparian habitat. Road kill is very high along the length of this highway but especially so here where good riparian habitat, with abundant resources, is available just by crossing the road. During winter, the highway cuts through a daily migratory corridor between west- and east-facing slopes



Above: High quality riparian habitat and diverse instream habitat provide good wildlife potential.

Middle: Highway 133 channelizes the stream and fragments wildlife habitat.

Below: Large, unstable deposits of cobble and gravel indicate stream imbalance

Not as immediately lethal but still impactful is a recreational access dirt road that parallels the river on the left bank. The road introduces human disturbance, dissects the floodplain, has resulted in eroding banks and trampled vegetation, alters flows, and provides opportunity for weed invasion.

Vegetation considerations

Riparian Zone: Width of the riparian zone is >30 m on 80% of the reach, most of which is unimpacted by human activities. In only a few small areas, where social/fishermen trails result in trampling, is the riparian zone degraded. In the top 20% of the reach, due to human activities, riparian zone width is typically <1m on the left and right bank.

In 80% of the reach there is both a diverse composition of native riparian vegetation and an even distribution of age-classes of trees and shrubs, characteristics that increase the potential for ecosystem resilience and sustainability. In the upper 20% of the reach, human development impacts have altered these characteristics; plant species diversity is decreased and the plant community is comprised of mainly of mature species or of disturbance induced species.

In natural areas the reach is characterized by a mosaic of riparian forest, willow carrs, wet meadows and open water ponds. Forest habitat is dominated by narrowleaf cottonwood, Colorado blue spruce, river birch, thinleaf alder, hawthorn and shrubby potentilla. Willow carrs are dominated by a variety of willow species, bog birch and thinleaf alder. Wet meadows are dominated by sedges, rushes and moisture-loving forbs such as bog orchid.

Vertical habitat structure is high due to the diverse composition and an even distribution of age classes of trees and shrubs. Horizontal patchiness is high due to the variety of habitat types and to canopy openings created by deadfall and beaver activity. Cottonwood recruitment is good due to the occurrence of a natural flooding regime and natural channel configuration, which allows the development of pointbars where seedlings can germinate.

On each bank the tree canopy is comprised of three layers and has a total cover of 20%; the upper tree layer contributes 2% cover and is dominated by blue spruce; the middle layer contributes 13% cover and is dominated by blue spruce and narrowleaf cottonwood; the lower tree layer contributes 5% cover and is dominated by spruce and cottonwood.

Shrub canopy cover on each bank totals 40% and is comprised of three layers; the upper layer contributes 10% cover and is dominated by willow species (strapleaf, coyote, beaked, mountain and whiplash), thinleaf alder, river birch, hawthorn and saplings (spruce and cottonwood); the middle layer contributes 15% cover and is dominated by willow species, bog birch and thinleaf alder; the lowest layer contributes 15% cover and is dominated by willow species, potentilla, snowberry, Wood's rose, hawthorn and seedlings (spruce and cottonwood).

Overall, 75-80% of the stream banks are protected by native riparian vegetation. However, disruption is evident along the road cut and pastures where upland vegetation, non-natives and noxious weeds dominate. Although sufficient kinds of riparian plant species occur on both banks to prevent erosion and hold onto water, limitations occur due to the reduced abundance and uneven distribution of these species; 85% of the riparian canopy cover has a stability rating >6.

Stream bank Stability: Stream banks are moderately stable. Bank erosion occurs on 15% of the left and 20% of the right bank.

Floodplain characteristics: Habitat characteristics that enable flood energy dissipation and sediment trapping are present in sufficient abundance in the lower 80% of the reach. These characteristics include dense riparian vegetation, woody debris and mid-channel islands. However, because these characteristics are reduced on the top 20% of this reach, overall effectiveness is limited.

Weedy and undesirable species: Noxious weeds occur on up to 10% of the riparian zone. Weedy species include oxeye daisy, Canada and bull thistle, common mullein, black medic, yellow sweetclover, yellow dock, Dutch clover, reed canarygrass and houndstongue. Undesirable plant species occur on up to 15% of the riparian area and primarily include pasture grasses such as smooth brome, orchard grass, Timothy and red top.



Above: Mid-channel islands provide elk with protected habitat for calves and create side channels where fish find protective cover. Below: Where native plants have been removed and replaced with pasture grasses bank failure occurs.

Wildlife considerations

Instream: Limits to aquatic wildlife potential include a reduced amount of large woody debris, submerged logs, and deep pools. However, other characteristics important to wildlife are present in sufficient abundance such as overhanging vegetation, stable undercut banks, backwater pools and cobble and gravel that is stable and unembedded.

Mid-channel islands improve instream habitat by creating both deep and shallow pools, side channels and backwater pools, thereby providing a greater variety of habitat for aquatic wildlife. Additionally, islands increase channel sinuosity that, in combination with high quality, bank-stabilizing vegetation, further increases instream habitat diversity.

Riparian: Diverse native plant communities with high structural heterogeneity provide a variety of resources sufficient to support a natural community of wildlife. Although deer and elk are abundant, browse is light and spread over a very large area so that plant vigor is not affected. Elk currently use this area for calving, particularly the mid-channel islands, which provide calves refuge from predators. Reintroduced Canada lynx have been actively using the stream corridor as a travel corridor. Their activity here indicates the presence of sufficient food resources and cover. Breeding bird abundance and richness is moderately high and assemblage includes numerous disturbance-sensitive species indicating the presence of good quality breeding habitat.



Beaver have built dams that create open water ponds where waterfowl, shorebirds and others find refuge.

Management Recommendations:

- Close and revegetate the unpaved road that parallels the stream leaving a parking area to access the stream.
- Revegetate stream banks below the highway road cut.
- Stabilize and revegetate banks on private pasture with native riparian vegetation.
- Weed management is essential to the stability of the entire reach.
- Close this area to recreational and all use during elk calving season.
- To reduce road kill;
 - Build wildlife underpasses/overpasses where wildlife are known to cross the road,
 - Install a warning light system whereby drivers are alerted when wildlife is on the road.

General Characteristics

Location CR2-1: N39 07.004/W107 16.145; 39 07.869/107 15.711.

Elevation: 7465'. **Life Zone:** Montane.

Ecosystem: blue spruce-cottonwood-alder-willow riparian forest/willow carr/sedge wet meadows.

Watershed Features: predominant surrounding land use – Forest; local watershed NPS pollution – some potential sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Colorado blue spruce, narrowleaf cottonwood, willow spp., thinleaf alder, river birch, bog birch, sedges and rushes. Upland – Douglas fir/Ponderosa pine forest-aspen forest- oak shrubland.

Instream Features: stream width – 27 m; stream depth – 0.80 m; canopy cover – 10%; high water mark – 0.75 m; stream morphology types – riffles 35%, pools 25%, runs 40%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 2 (common).

Dominant Aquatic Vegetation: dominant species – periphyton: estimated abundance – 1 (rare).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – sand; undersides of unembedded stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 10; cobble 55; gravel 25; sand 10; silt 0; clay 0.

Organic Substrate Components %: detritus (CPOM) 10; muck-mud (FPOM) 0; marl 0.

Assessment Data

EPA Habitat Assessment Score: 162/200.

NRCS Habitat Assessment Score: left bank – 49/61; right bank – 49/61.

Weedy species: oxeye daisy, canada and bull thistle, common mullein, houndstongue, reed canarygrass, yellow sweetclover, Dutch clover, black medic, yellow dock.

Disturbance-caused undesirable plants: smooth brome, orchard grass, timothy grass, red top grass.

Dominant Native Riparian Vegetative Species:

Trees: Colorado blue spruce, narrowleaf cottonwood.

Shrubs: willow spp. (strapleaf, coyote, beaked, mountain and whiplash), thinleaf alder, bog birch, river hawthorn, shrubby cinquefoil, snowberry, Wood's rose.

Grasses and Forbs: sedge and rush spp., equisetum.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - L; Maint. Lawns - L; Pipes, drains - L; Roads - M; Culverts - L.

Recreational: Hiking trails - L; Park, campground - L.

Agricultural: Pasture - L; Livestock use - L; Irrigation equipment - L; Water withdrawal - L.

Stream management: Angling - L; Channelization - M; Water fluctuation - M.

Other Human Influences:

Nutrient enrichment: clear water along entire reach, little algal growth.

Barriers to fish movement: none.

Manure presence: evidence of livestock access to riparian zone.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 4/4.

Beaver: beaver sign – moderate; flow modification – moderate.

Dominant Land Use – forest; forest age class – >75.

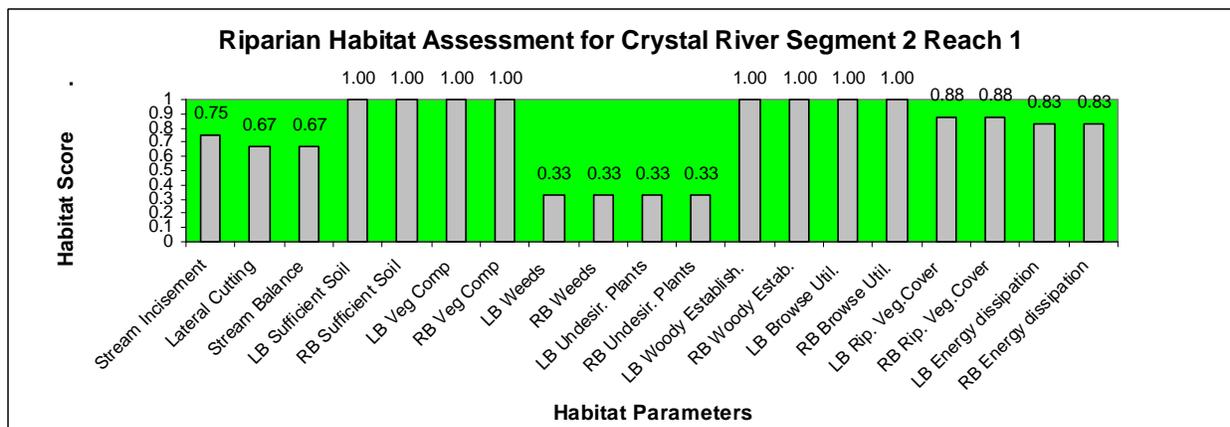
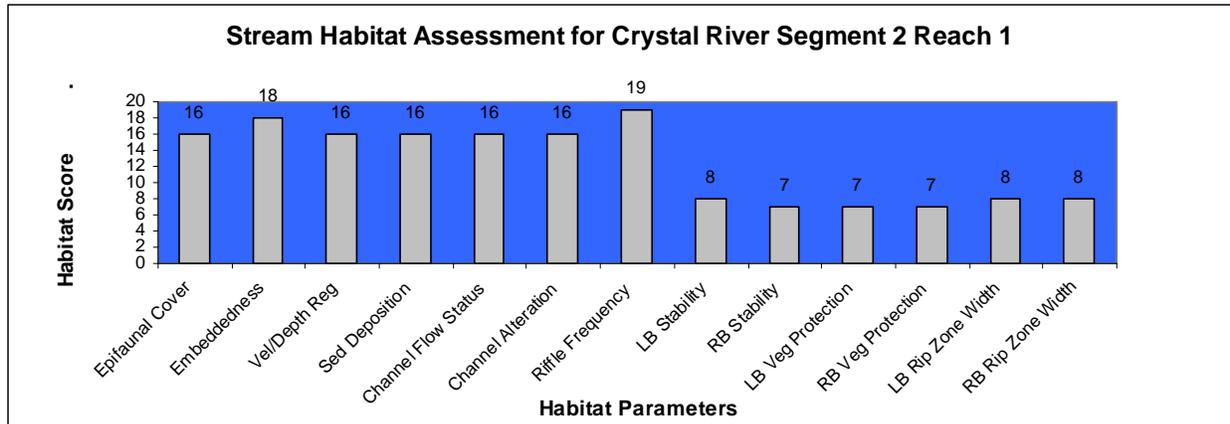
Functional Rating: sustainable.

Janis Huggins (project botanist) is writing up her field notes while sitting on a stream bank that has been severely degraded by trampling.



Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 45/28/0 indicating good water quality.
- Two American dippers were observed in the survey area indicating sufficient forage and nesting resources.
- A survey of the breeding bird community recorded 74 individuals in 25 species for a biodiversity score of 2.926 and an evenness score of 0.680. Bird community diversity and composition is indicative of sustainable riparian habitat.
- Estimated abundance of periphyton was “1” (rare) indicating appropriate levels of nutrient enrichment. Filamentous algae and macrophytes were commonly present in beaver ponds but absent in the stream pointing to the importance of the nutrient/pollutant filtration function of beaver ponds.



Crystal River Segment 2, Reach 2.

Habitat Condition: Stream – heavily modified; LB/RB Riparian – severely degraded/heavily modified.
Stream Class (Rosgen) – A2/A3. **Stream Order** – 3rd. **Reach Length** – 4.93 km.

Summary

Hydrologic considerations: At the top of the reach the stream enters a narrow, steep gradient canyon. Bedrock controls 15% of the left bank and 25% of the right bank. Those stream banks that are not bedrock controlled have been destabilized by road building or home development.

Channel Condition: Channelization-related impacts from Highway 133, which is built in the riparian zone over most of this reach, affect the entire stream channel. In this narrow and moderately steep canyon, road building has channelized the stream on 62% of the left bank and on 31% of the right bank. Where the road cut has destabilized or replaced stream banks, bank armoring has been installed to prevent erosion, which coincidentally prevents the stream from meandering. Additional road-related impacts also occur to the banks opposite the armored banks. Riprapped banks and channel straightening increases the stream's energy, which then contributes to greater than normal erosional forces that excessively erode the unprotected banks.

Channelization from home development occurs on 3% of the left bank and 24% of the right bank. In conjunction with home building, native riparian vegetation has been replaced with lawns and ornamental plants that typically do not have sufficient bank stabilizing capacity. Thus, bank erosion with consequent changes to channel shape has typically resulted where riparian vegetation has been removed.

Instream heterogeneity: Habitat variety is reduced by channelization. Sinuosity is less than appropriate for this landscape and stream habitat morphology is dominated by riffles and runs with only a few pools. Although all four velocity/depth regimes occur, representation is not evenly distributed; a fast-deep regime occurs on 40% of the reach, fast-shallow on 40%, slow-deep on 10% and slow-shallow on 10%. Thus, although riffles are frequent, habitat variety is suboptimal due to the lack of shallow or deep pools.

Hydrologic Alteration: Width/depth ratio and gradient are appropriate to the stream class. Bank full flows occur regularly but the flood plain is rarely inundated due to riprapped banks. Recent beaver sign was absent but historic sign was common. Historically, beaver activity probably provided important water storage, sediment trapping and energy dissipation functions. The likelihood of their return has been virtually eliminated by road-induced channelizing effects.

Stream balance / Erosion – deposition: The stream is vertically stable but lateral erosion is excessive. Lateral erosion occurs where lawns have replaced bank vegetation and at stream banks where opposite road cuts have focused excessive channelization-induced energy. Channelization has resulted in stream imbalance whereby there is insufficient water to carry the increased sediment load.

Consequently, deposition of sediment impacts the entire reach. Excessive sedimentation initiates from bank erosion, road gravel and road cuts. Pools are filling with sediment and 50% of the bottom is affected by sedimentation. Cobble and gravel are 30% embedded by fine sediment.

Upland contribution to degradation

Surrounding uplands are in good ecological condition and make a positive contribution to stream health. Plant communities are intact and sustainable, soils are deep with a thick layer of humus, and the habitat is mostly undisturbed by human intrusion. Consequently, precipitation infiltration and ground water recharge is optimal thereby enhancing the potential for sustainable stream flows. However, highway impacts severely disrupt the ecological connection between upland and stream ecosystems. The highway alters ground water discharge,



Left: Bedrock controls the right bank but the highway confines the left bank and inhibits meandering.

Right: Road-base gravel has been flushed into the stream by runoff, filling pools and embedding cobbles.

contributes road-based pollutants and sediment to the stream, and is a lethal barrier to daily and seasonal wildlife migration.

Vegetation considerations

Riparian Zone: Riparian zone width is naturally narrow due to topography but zone width and extent has been further reduced by human activities. Riparian potential width is reduced by >60%, from 6-12 m to <2 m, on 65% of the left and 55% of the right bank. Bedrock controls 15% of the left and 25% of the right bank so that riparian vegetation is not needed in these areas for bank stability. However, shrubs and trees do manage to grow in crevices along the bedrock cliff walls providing good nesting and foraging habitat for a variety of songbirds.

Remnant stands of naturally diverse plant communities remain on <50% of the reach. In these remaining natural areas there is both a diverse composition of vegetation and a diverse age-class distribution to enable habitat maintenance and recovery. However, on >50% of the reach, the riparian plant community is severely degraded by the road cut or by housing development. Along the road cut, upland plant species and noxious weeds dominate and there is very little potential for recovery. Where housing development has occurred, younger trees and most of the shrub canopy have been removed thereby altering age class distribution and reducing ecosystem resilience.

Overall tree canopy cover on each bank is comprised of three layers and totals 10% on the left and 15% on the right bank; on each bank the upper tree layer contributes 2% cover and is dominated by Colorado blue spruce; the middle layer contributes 5% cover on the left and 8% cover on the right bank and on each bank is dominated by narrowleaf cottonwood and blue spruce and on the right bank with ponderosa pine as a co-dominant; the lower layer contributes 3% cover on the left and 5% cover on the right bank and is dominated on each bank by cottonwood, blue spruce, and chokecherry and on the right bank including serviceberry as a co-dominant.

Shrub canopy cover on each bank is comprised of three layers and totals 15% on the left and 20% on the right bank. The left bank upper layer contributes 3% cover and is dominated by thinleaf alder, cottonwood, Rocky Mountain juniper, strapleaf willow, and river hawthorn; the right bank upper shrub layer contributes 3% cover and is dominated by thinleaf alder, beaked willow, and serviceberry; the middle shrub layer contributes 7% cover on the left and 10% cover on the right bank and on each bank is dominated by red-osier dogwood, twinberry honeysuckle, Rocky Mountain maple, and coyote willow and on the right bank with spruce saplings as a co-dominant; the lower layer contributes 5% cover on the left and 7% cover on the right bank and is dominated on each bank by mountain spray (cliffs), mountain gooseberry, serviceberry, common juniper, Wood's rose, coyote willow and cottonwood seedlings.

Stream bank Stability: Bank stability is generally good due to the combination of bedrock and riprapping at road cuts but there is little to no native riparian vegetation or energy dissipation associated with this stabilization strategy. Consequently the left bank is fairly stable with only 5-10% of the banks having evidence of erosion. The right bank is moderately unstable with 25% of the banks having areas of erosion. Increased erosion is due in part due to homes with lawns "to the edge", which replace riparian vegetation

Floodplain characteristics: Channelization impacts from stream straightening, vegetation alteration, and riprapped banks have degraded the characteristics that are important to accomplish energy dissipation and sediment trapping. Thus there is little evidence of sediment capture or energy dissipation. Consequently, due to a combination of factors including increased stream energy, increased sediment load and vegetation removal, stream banks are excessively eroding.

Weedy and undesirable species: Noxious weeds occur on over 10% of the riparian area. Weedy species include oxeye daisy, common tansy, Canada thistle, tarweed, yellow sweetclover and reed canarygrass. Undesirable plant species occur on over 15% of the riparian area and include smooth brome, and orchard and Timothy grasses.

Wildlife considerations

Instream: Although flow status is adequate to support aquatic wildlife, habitat potential is limited by excess sedimentation, reduced cover and diminished habitat variety. Over most of the reach, there is very little overhanging vegetation, undercut banks, submerged logs or woody debris, and no backwater pools or overflow channels to



By confining the channel, the highway has inhibited the development of pointbars where riparian habitat could flourish. Trees that gain a toehold in the bedrock crevices provide good nest sites for songbirds.

provide protective cover for fish. Deep pools and riffles are common but are degraded by excessive sediment deposits.

Riparian: Wildlife potential is limited due to decreased vegetative cover and diminished structural complexity and to a high level of disturbance from the highway. The highway is a lethal barrier to large and small mammals and even songbirds. In those few areas where the highway is away from the stream and native vegetation is intact, wildlife potential is increased. These areas are small and disconnected from the rest of the stream corridor and so do not provide sufficient resources to sustain a natural community of wildlife. However, they do provide “stepping-stone” habitat for bird migration and also protected areas where wildlife can access the stream.



Noxious weeds find a path for invasion along road cuts.

Management Recommendations:

- Revegetate the road cut with soil moisture-appropriate native plant species.
- Revegetate stream banks with native riparian vegetation where they are rip rapped.
- Weed eradication is essential to restore some function to this reach and to prevent the further spread of weeds.
- Mitigate highway impacts to wildlife:
 - Enforce the speed limit,
 - Install a warning light system to warn drivers when wildlife is on the road,
 - Build wildlife overpasses/underpasses in migration corridors.

General Characteristics

Location CR2-2: N39 07.869/W107 15.711; 39 10.019/107 14.622. **Elevation:** 7425'. **Life Zone:** Montane.

Ecosystem: Conifer-cottonwood riparian forest.

Watershed Features: predominant surrounding land use – Forest; local watershed NPS pollution – obvious sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Colorado blue spruce, narrowleaf cottonwood, alder, willow, dogwood, mountain spray, serviceberry. Upland – Douglas fir/Ponderosa pine forest/aspens forest/oak shrubland.

Instream Features: stream width – 20 m; stream depth – 1.3 m; canopy cover – 0%; high water mark – 1.1 m; stream morphology types – riffles 40%, pools 20%, runs 40%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: dominant species – periphyton: estimated abundance – 2 (common).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – road gravel; undersides of stones black – no.

Inorganic Substrate Components %: bedrock 17; boulder 20; cobble 30; gravel 18; sand 15; silt 0; clay 0.

Organic Substrate Components %: detritus (CPOM) <5; muck-mud (FPOM) 0; marl 0.

Assessment Data

EPA Habitat Assessment Score: 122/200.

NRCS Habitat Assessment Score: left bank – 35/61; right bank – 37/61.

Weedy species: oxeye daisy, common tansy, Canada thistle, tarweed, yellow sweetclover, reed canarygrass.

Disturbance-caused undesirable plants: smooth brome, orchard & timothy grasses.

Dominant Native Riparian Vegetative Species:

Trees: Colorado blue spruce, narrowleaf cottonwood, ponderosa pine.

Shrubs: willow spp. (mountain, strapleaf, beaked, coyote), serviceberry, chokecherry, thinleaf alder, red-osier dogwood, Rocky Mountain juniper, Rocky Mountain maple, twinberry honeysuckle, mountain spray, mountain gooseberry, common juniper, Wood's rose, snowberry, mountain gooseberry, buffaloberry.

Grasses and Forbs: equisetum, sedges, rushes, strawberry, pink pyrola, cowbane, solidago spp., mertensia, baneberry, sweet cicely, yarrow, cow parsnip, monkshood, star solomonplume, harebell, cliff anemone, woodrush, edible valerian, Porter's lovage, Northern bedstraw, goldenglow.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

- Residential: Residences - L; Maint. Lawns - L; Roads - M; Bridges/Culverts - M.
- Recreational: Trash/Litter - L.
- Agricultural: Water withdrawal - L.
- Stream management: Angling - L; Channelization - H.
- Other Human Influences:
 - Nutrient enrichment: moderate algal growth on substrate.
 - Barriers to fish movement: none.
 - Manure presence: none.
- Site Characteristics:
 - Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 2/3.
 - Beaver: beaver sign – absent; flow modification – none.
 - Dominant Land Use – forest & rural; forest age class >75.

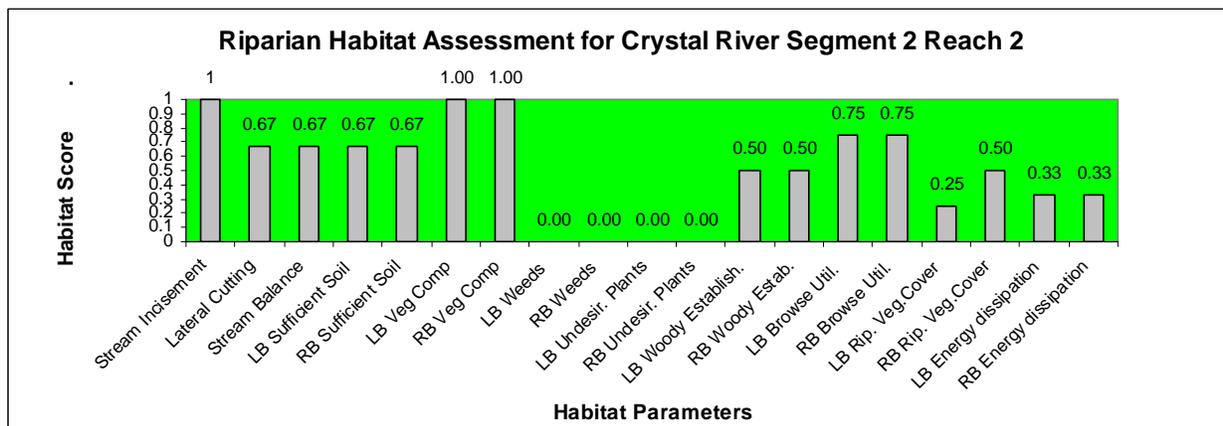
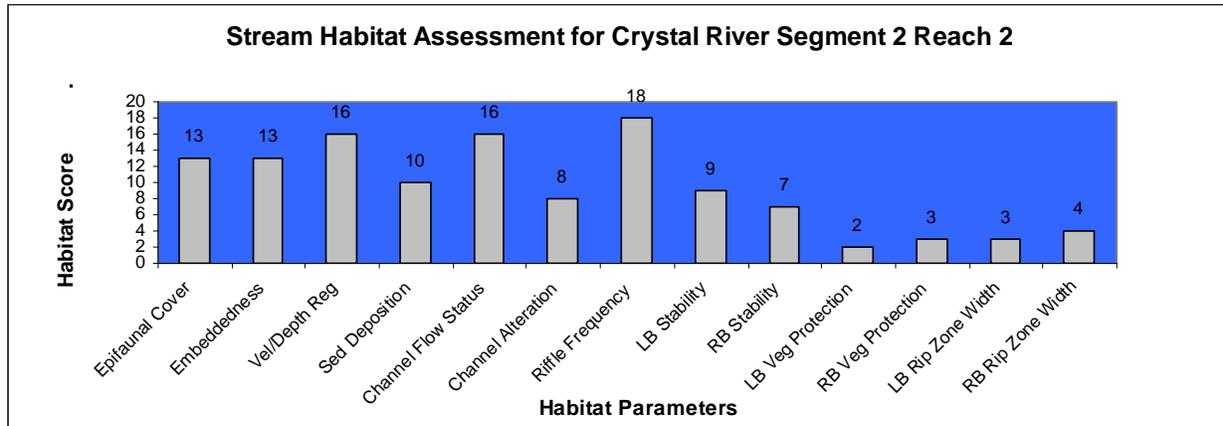


Without riparian vegetation to act as a filter, road-based pollutants are carried directly into the stream with precipitation runoff.

Functional Rating: not sustainable.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 26/22/1, indicating potential habitat impairment.
- One American dipper was observed in the survey area indicating habitat impairment.
- A survey of the breeding bird community recorded 20 individuals in 10 species for a biodiversity score of 2.181 and an evenness score of 0.728. Reduced abundance and richness indicates habitat impairment.
- Estimated abundance of periphyton was “2” (common) indicating excessive nutrient enrichment.



Crystal River Segment 2, Reach 3.

Habitat Condition: Stream – heavily modified; LB/RB Riparian – heavily modified/heavily modified.
Stream Class (Rosgen) – C3. Stream Order – 4th. Reach Length – 4.65 km.

Summary

Hydrologic considerations

Channel Condition: The channel and riparian habitat have been altered by a variety of human activities along this reach. Highway 133 runs along the left bank and directly channelizes and straightens 35% of the reach with riprapped banks. Further, the road grade dissects a historically wide riparian zone and disconnects the stream from the riparian zone, which has additional hydrologic affects such as greatly reducing floodplain width from between 247-553 m to between 92-130 m, isolating a part of the floodplain from its hydrologic connection with the river, and interrupting ground water discharge from uplands to the river.

In the town of Redstone, housing and commercial development encroaches into the riparian zone and floodplain on 21% of the right bank of the river. Commensurate with development has been the removal of riparian vegetation, consequent erosion and the need for bank armoring to prevent erosion.

Historic mining-related alterations to Coal Creek, which has its confluence with the Crystal River in this reach, contribute to greatly increased sediment loads in the Crystal River. Other numerous small alterations have impacted the river channel, including two bridges, one at the top and another at the bottom of the reach and two unpaved roads, one at the top of the reach and one at the bottom that have been built through the riparian zone and parallel the stream.

Instream heterogeneity: Habitat variety has been diminished by channelization. Channelizing effects include reduced sinuosity (currently 1.001), which has contributed to a reduction in the diversity of instream habitat. Stream morphology is dominated by runs and riffles with only a few pools. Although all four velocity/depth regimes occur, representation is uneven. A fast-deep regime occurs on 53% of the reach, fast-shallow on 35%, slow-deep on 7% and slow-shallow on 5%. Thus, even though riffles are frequent, the variety of instream habitat is poor.

Most mid-channel islands in this reach are transient, cobble deposits. However, those that are well-vegetated and stable increase the variety of instream habitat. Deep and shallow pools develop in the lee of these islands and downstream of the large woody debris that is deposited on the banks of these islands

Hydrologic Alteration: Channelization has eliminated access to the floodplain and resulted in hydrologic alteration. Flooding flows are increased and base flows are decreased due, in part, to channelization. Riprapping, downcutting, and a road grade that inhibits access to the floodplain have resulted in increased stream energy and greater flooding flows. Base flows are highly dependent on ground water discharge from adjacent uplands and the riparian zone. Because the functional area of the riparian zone has been reduced by the road grade, ground water recharge has likely also been reduced, which then affects base flows. Consequences of hydrologic alteration include a width/depth ratio that is inappropriately high (43:1), and 25-50% of channel substrate exposed, including riffle substrate that is frequently exposed. These alterations result in the loss of aquatic wildlife habitat.



Above: At the top of the reach Highway 133 is typically >50 m away from the stream and only channelizes small parts of the reach – riprapped road cut is at the left of the photo.

Below: Just upstream from the Town of Redstone, an unpaved road contributes to channelization and stream sedimentation.

Stream balance / Erosion – deposition: The channel is incised, unstable and actively widening. Lateral erosion occurs on each bank wherever riparian vegetation has been removed. Additionally, about 10% of well-vegetated banks are eroding, likely due to amplified scouring that occurs as a result of increased stream together with increased sediment load.

Bank erosion has resulted in stream widening and shallowing, which has effectively reduced the amount of water available to move sediment through the channel. Excessive bank erosion, road gravel, and excessive sediment from destabilized tributary streams, especially Coal Creek, all contribute to a disproportionate sediment load in relation to the amount of flow. Together these factors have created a stream imbalance that can be observed in the enlargement of point bars and the formation of new bars.

Upland contribution to degradation

Home development on the surrounding hillsides and roads interrupt wildlife migratory patterns, increase impermeable surfaces and contribute polluted runoff to the stream.

Vegetation considerations

Riparian Zone: Riparian zone width on both banks has been reduced by human activities. On the left bank, riparian zone width is up to its potential of 10-15 m on 48% of the reach; highway impacts have reduced zone width to <1m on 35% of the reach; and development impacts have reduced zone width to <5 m on 17% of the reach. On the right bank, road impacts and development reduced zone width to <1m on 35% of the reach; 4% is bedrock controlled; and on 61% of the right bank, zone width is up to the potential width of 10-15m. However, of this latter right bank category, only 22% is in good condition, the remaining 39% is degraded by recreational trails and dirt roads.

In natural areas where the riparian zone is undeveloped (48% of the left bank and 61% of the right bank) there is both a diverse composition and a fairly even age-class distribution of native riparian plant species. Riparian habitat is characterized by narrowleaf cottonwood and Colorado blue spruce and a variety of willow species. In natural areas these species are well represented in all tree and shrub canopy layers. In developed areas, both vegetation community composition and age-class distribution is altered. Non-native and upland tree, shrub and herbaceous species frequently replace riparian vegetation, and younger trees and shrubs have frequently been removed so that the plant community is dominated by older, mature individuals.

Plant species composition and tree and shrub cover percentage are similar on each bank with a few exceptions. On the left bank upland tree and shrub species, such as box elder and Gambel oak, were frequent, indicating drying soils. On the right bank blue grass lawns are common and correspond with housing and commercial development.

Tree canopy cover on each bank is comprised of three layers and totals 13% on the left bank and 20% on the right bank. On the left bank the upper tree layer contributes 3% cover and is dominated by Colorado blue spruce; the middle layer contributes 5% cover and is dominated by narrowleaf cottonwood and blue spruce; and the lower layer contributes 5% cover and is dominated by river hawthorne, thinleaf alder, cottonwood, blue spruce and Douglas fir. On the right bank, the upper layer contributes 5% cover and is dominated by blue spruce and ponderosa pine; the middle layer contributes 9% cover and is dominated by narrowleaf cottonwood, blue spruce and ponderosa; the lower tree layer contributes 4% cover and is dominated by blue spruce, cottonwood, ponderosa, thinleaf alder, and Douglas fir.

On each bank, shrub cover is comprised of three layers and totals 20% on the left and 17% on the right bank. The upper layer contributes 6% cover on the left and 5% cover on the right bank and is dominated on each bank by willow (coyote, strapleaf, mountain, whiplash, beaked, and Drummonds), saplings (cottonwood and blue



Above: Removal of riparian vegetation along the majority of stream banks in the Town of Redstone has contributed to bank instability and erosion.

Below: Large, unvegetated deposits of cobble, sand, and silt signal stream imbalance.

spruce), and thinleaf alder. The middle shrub layer contributes 9% cover on the left and 8% cover on the right bank and is dominated on each bank by willow (all of the above), thinleaf alder, Rocky Mountain maple, red-osier dogwood, and saplings (cottonwood and blue spruce). The lower shrub layer contributes 5% cover on the left and 4% cover on the right bank and is dominated on each bank by twinberry honeysuckle, potentilla, Wood's rose, mountain gooseberry, and seedlings (willow, spruce, cottonwood).

Native riparian vegetation protects only 50-60% of each bank. Although sufficient kinds of plant species are present to stabilize banks and hold onto water, abundance and distribution is inadequate to effectively accomplish these functions throughout the reach; only 55-65% of riparian canopy cover has a stability rating > 6.

Stream bank Stability: Erosion occurs on 20-30% of each bank. Although riprapping has increased the extent of bank area that is locally stable, this extensive armoring has contributed to increased downstream erosion in this same reach.

Floodplain characteristics: Habitat characteristics, such as boulders, vegetation, and complex stream structure, which enable flood energy dissipation and sediment capture, are inadequate to accomplish these functions. Consequently, there is very little evidence of sediment capture, and stream bank erosion and headcuts are common throughout the reach.

Weedy and undesirable species: Noxious weeds are present on up to 10% of the riparian area. Weedy species include oxeye daisy, Canada, plumeless and bull thistle, yellow toadflax, houndstongue, common mullein, common tansy, reed canarygrass, curly dock, and yellow sweetclover. Undesirable plant species occur on over 15% of the riparian area. Species include Kentucky bluegrass, orchard, Timothy, and smooth brome grasses, red clover, and bladder campion.

Wildlife considerations

Instream: Aquatic wildlife potential is limited by reduced canopy cover, unstable stream substrate due to torrential flows, reduced base flows and reduced habitat variety. Consequently, epifaunal habitat is suboptimal due to a dearth of deep pools, overhanging vegetation, backwater pools or undercut banks. However, riffles and woody debris are common and provide some invertebrate habitat.

Riparian: In undeveloped areas habitat structure and plant community composition provides good quality wildlife habitat. Stable mid-channel islands provide habitat for nesting shorebirds such as spotted sandpipers. However, in about 50% of the reach, human-induced habitat simplification and disturbance limits wildlife potential. In developed areas, the understory has been removed so that plant community age-class distribution is characterized by mainly mature individuals. Age-class simplification reduces ecosystem resilience and wildlife resources, such as food, nesting and protected habitat.

Management Recommendations:

- Stabilize the stream channel by installing structures, such as large woody debris, that reduce stream velocity.
- Increase instream habitat variety with large boulders, root wads, submerged logs and other large woody debris.
- Stabilize stream banks;
 - Revegetate road cuts with appropriate native species
 - Revegetate riparian zone and stream banks in developed areas with native vegetation
- Enforce stream setbacks for development and vegetation alteration.
- Close and revegetate the unpaved road that parallels the stream on the right bank..
- Weed management is essential to restore stability.



Above: Excessive bank erosion has resulted from increased stream energy and excessive sediment loads.

Below: Stream habitat is dominated by riffles and runs with very few pools.

General Characteristics

Location CR2-3: N39 10.019/W107 14.622; 39 12.115/107 13.897.

Elevation: 7235'. **Life Zone:** Montane.

Ecosystem: Blue spruce-cottonwood riparian forest/willow carr.

Watershed Features: predominant surrounding land use – Residential/Forest; local watershed NPS pollution – obvious sources; local watershed erosion – heavy.

Dominant Native Vegetation: Riparian – Narrowleaf cottonwood, blue spruce, alder, willow, hawthorne, dogwood. Upland – Douglas fir/Ponderosa pine forest/aspens forest/oak shrubland.

Instream Features: stream width – 37 m; stream depth – 0.85 m; canopy cover – 5%; high water mark – 0.35 m; stream morphology types – riffles 35%, pools 12%, runs 53%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 2 (common).

Dominant Aquatic Vegetation: dominant species – periphyton/filamentous algae: estimated abundance – 1 (rare).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – marble dust & silt; undersides of stones black – no.

Inorganic Substrate Components %: bedrock 5; boulder 15; cobble 55; gravel 10; sand 10; silt 5; clay 0.

Organic Substrate Components %: detritus (CPOM) 15; muck-mud (FPOM) 0; marl 0.



At the confluence of Coal Creek and the Crystal River, bank erosion and frequent movement of stream substrate degrades wildlife habitat.

Assessment Data

EPA Habitat Assessment Score: 120/200.

NRCS Habitat Assessment Score: left bank – 37/61; right bank – 37/61.

Weedy species: oxeye daisy; Canada, plumeless and bull thistles, yellow toadflax, houndstongue, common mullein, common tansy, reed canarygrass, curly dock, yellow sweetclover.

Disturbance-caused undesirable plants: Kentucky bluegrass, orchard and timothy and smooth brome grasses, dandelion, red clover, bladder campion.

Dominant Native Riparian Vegetative Species:

Trees: narrowleaf cottonwood, Colorado blue spruce, Ponderosa pine, Douglas fir, box elder.

Shrubs: willow spp. (coyote, strapleaf, mountain, whiplash, beaked, Drummond's), river hawthorne, thinleaf alder, Rocky Mountain maple, serviceberry, red-osier dogwood, twinberry honeysuckle, potentilla, Wood's rose, red elderberry, mountain gooseberry, common juniper.

Grasses and Forbs: sedge and rush spp., equisetum, star solomonplume, broomrape, wild strawberry, geranium spp., chiming bells.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - M; Maint. Lawns - M; Roads - H; Bridges/Culverts - M.

Recreational: Hiking trails - L; Campground - M

Agricultural: Water withdrawal - L.

Stream management: Angling - M; Channelization - H.

Other Human Influences:

Nutrient enrichment: fairly clear or slightly greenish, moderate algal growth on stream substrates.

Barriers to fish movement: none.

Manure presence (evaluated only if livestock or human waste discharges are present): none.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

Beaver: beaver sign – rare; flow modification – minor.

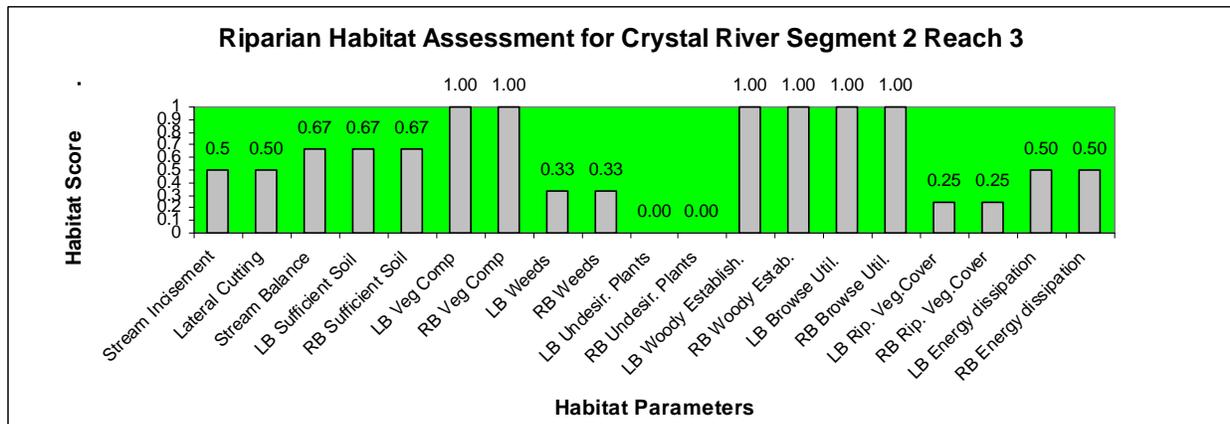
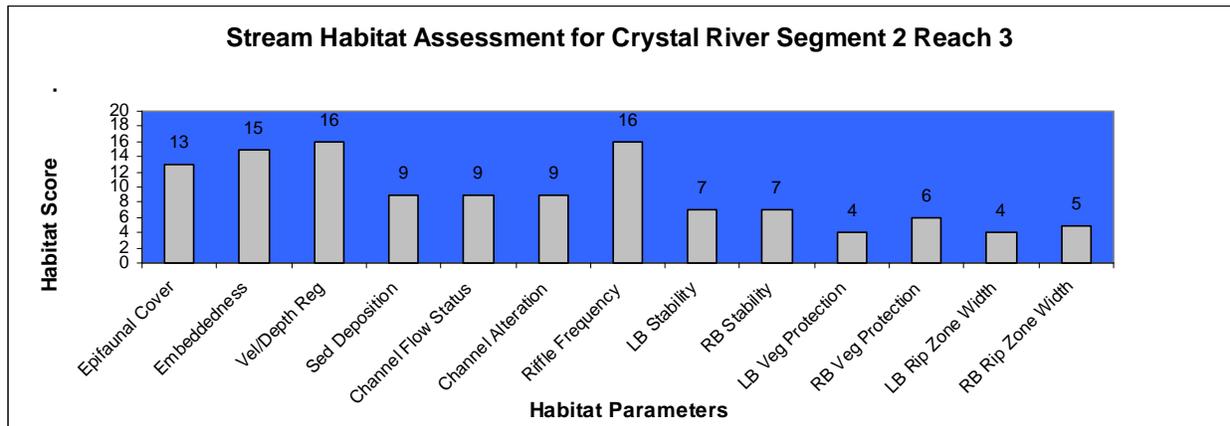
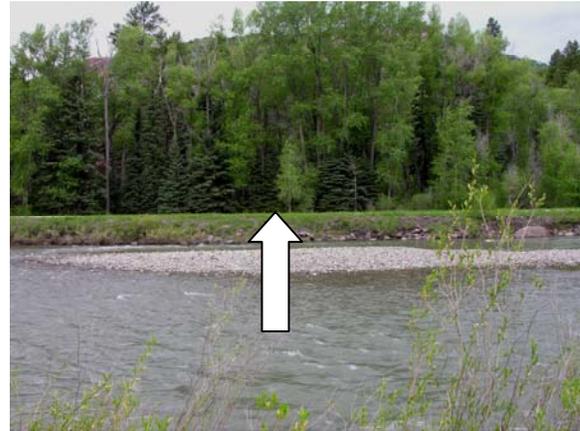
Dominant Land Use – rural/suburban & forest; forest age class >75 years.

Functional Rating: not sustainable.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 31/23/0. This ratio indicates good water quality but the somewhat low abundance may be reflective of substrate disturbance.
- One American dipper was observed in the survey area indicating limited resources.
- A survey of the breeding bird community recorded 43 individuals in 19 species for a biodiversity score of 2.703 and an evenness score of 0.703. Reduced abundance and richness scores indicate disturbed habitat.
- Estimated abundance of each periphyton and filamentous algae was “1” (rare) indicating appropriate levels of nutrient enrichment.

The Highway 133 road grade fragments the stream ecosystem by disrupting the connection between the stream and the riparian habitat that is on the other side of the road. The highway is a lethal barrier to wildlife and contributes road-based pollutants to the stream.



Crystal River Segment 2, Reach 4.

Habitat Condition: Stream – moderately modified; LB/RB Riparian – heavily modified/moderately modified.
Stream Class (Rosgen) – B2/B3. Stream Order – 4th. Reach Length – 2.23 km.

Summary

Hydrologic considerations

Channel Condition: At the top of this reach the stream enters a steep, narrow canyon. Highway 133 runs adjacent to the left bank and an old railroad grade, now an unpaved road, runs adjacent to the right bank, effectively channelizing the top of the reach. The road and the railroad grade eventually move away from the stream on the lower two thirds of the reach, but here rural home development has channelizing impacts on both sides of the channel. Consequently, channelization is extensive with 30% of each bank altered by riprap and shoring structures, and another 30% channelized by the consequences of riparian vegetation destruction. Bridge abutments also contribute to channelization but their impact is relatively minor.

Instream heterogeneity: Instream habitat variety is moderate but historically was likely much greater. Both historic and recent channelizing activities have reduced stream habitat heterogeneity. Channelization has reduced sinuosity (currently 1.06), which has resulted in decreased habitat heterogeneity by altering the ratio of riffles, pools and runs. Currently riffles and runs dominate stream structure and pools are reduced. However, some deep and shallow pools still form in the lee of numerous large boulders that occur throughout the reach. Consequently although all four velocity/depth regimes occur, represented is uneven; a fast-deep regime occurs on 35% of the reach, fast-shallow on 40%, slow-deep on 15% and slow-shallow on 10%.

Hydrologic Alteration: Bank-full flows occur yearly with spring melt. Overbanking flows also occur regularly but only where the channel is not downcut or riprapped. Downcutting occurs on 30-40% of the channel due to housing development and approximately 30% of the channel is riprapped due to roads – in these areas overbanking rarely occurs.

At base flows, width/depth ratio is inappropriately high and about 20% of the channel substrate is exposed. Although this percentage of exposure is only slightly suboptimal, hydrologic alteration is indicated. Beaver sign is rare and there is no flow modification due to their activity.

Stream balance / Erosion – deposition: A moderate amount of human-induced lateral bank erosion and downcutting occurs throughout the reach. Consequently, sinuosity is reduced and there is some new increase in pointbar formation. Sediment initiates from both bank erosion and road gravel that washes into the stream, filling pools and embedding boulders cobble and gravel up to 30% with fine sediment.

In this stream reach, water and sediment are not in balance. Excess sediment in combination with channel widening and stream shallowing that result from human-induced disturbances has decreased the stream energy needed to move the increased amount of sediment through the channel.

Upland contribution to degradation

A large developed campground with paved roads and bathroom facilities greatly increases impermeable surface and contributes runoff laden with road-based pollutants and sediment to the stream. Rural home development has resulted in an increased number of roads, and a greater area of impermeable surfaces and number of leach fields. Impacts include increased



Above: At the top of the reach the stream is channelized by Highway 133 on the left bank (photo right) and by a railroad grade on the right bank.

Below: The stream enters a steep gradient canyon in this reach.

runoff, decreased infiltration, and a potential increase in the stream's nutrient load. Also, here, as along most of this corridor, Highway 133 is a lethal barrier to wildlife and a contributor of pollutant- and sediment-laden runoff to the stream.

Vegetation considerations

Riparian Zone: Due to site geology, the riparian zone is naturally narrow with a 6-10 m potential width. In developed areas this already narrow riparian zone has been further reduced to typically <3 m wide. Home development impacts the left bank more than the right bank; 40% of the left and 30% of the right bank riparian habitat has been removed and typically replaced with bluegrass lawns. Along unaltered banks, well-vegetated 5 to 25-m-wide point bars have developed throughout the reach, adding both area and function to riparian habitat.

In unaltered areas (30% of the left and 40% of the right bank) and on mid-channel islands, plant community composition is diverse, structure is complex, and a good distribution of all age-classes of trees and shrubs are present providing the potential for maintenance, recovery and sustainability. In developed areas, these characteristics are degraded: plant diversity is reduced, structure is simplified, and age-classes are generally confined to mature trees and shrubs.

Tree canopy cover totals 20% on the left and 30% on the right bank and is comprised of two layers with similar species composition on each bank. The upper layer contributes 15% cover on the left and 20% cover on the right bank and is dominated by Colorado blue spruce, narrowleaf cottonwood, ponderosa pine and Douglas fir. The lower layer contributes 5% cover on the left and 10% cover on the right bank and is dominated by cottonwood and blue spruce.

Shrub canopy cover totals 20% on the left and 35% on the right bank and is comprised of three layers with similar species composition on each bank. On each bank the upper shrub layer contributes 10% cover and is dominated by thinleaf alder and river birch. The middle shrub layer contributes 5% cover on the left and 15% cover on the right bank and on each bank is dominated by red-osier dogwood, coyote willow and Wood's rose. The lower layer contributes 5% cover on the left and 10% cover on the right bank and is dominated by snowberry and Wood's rose. Sedges, rushes and equisetum dominate the herbaceous cover in undeveloped areas but where development has occurred bluegrass lawns dominate.

Overall, native riparian vegetation protects 60-70% of stream bank surfaces, disruption is evident and bare soil and closely cropped vegetation is common. Although sufficient kinds of plant species occur to stabilize soil and hold onto water, abundance and distribution is insufficient to accomplish these functions; only 65-75% of riparian canopy cover has a stability rating >6.

Stream bank Stability: The left bank is moderately unstable; 40% of the bank has areas of erosion and there is high erosion potential during floods. The right bank is moderately stable; small areas of erosion occur on 30% of the bank.

Floodplain characteristics: Floodplain and channel characteristics are inadequate to dissipate energy. Although numerous large boulders are present throughout the reach, quantity and quality of riparian vegetation and woody debris is below that required to dissipate energy.

Weedy and undesirable species: Noxious weeds are present on 5% of the riparian area. Weedy species include common tansy, oxeye daisy and yellow sweetclover. Undesirable plant species are present on >15% of the riparian area and include Kentucky bluegrass and smooth brome.



Above: Housing development with commensurate removal of riparian vegetation has resulted in bank erosion.

Below: Large boulders increase stream habitat diversity by creating deep pools and help abate flood energy.

Wildlife considerations

Instream: Limits to aquatic wildlife potential include reduced canopy cover, cobble and gravel that are embedded, and a dearth of protected or resting habitat. Habitat characteristics that are present with adequate frequency and that enhance wildlife potential include stable undercut banks, overhanging vegetation, and overflow channels (due to pointbars and mid-channel islands).

Riparian: Undeveloped riparian areas have high wildlife value, but the potential in developed areas is degraded. In undeveloped areas diverse plant community composition and complex structure provide a high variety of foraging and nesting resources.

On the left bank the highway isolates upland from riparian habitat. On the right bank, wildlife continue to have somewhat unimpeded access to the stream from upland habitat. Although a few homes are present, housing density (and human population density) is very low and intervening habitat is in good condition, providing good cover, high quality forage and protected nesting and breeding habitat.

Management Recommendations:

- Stabilize stream banks; revegetate stream banks with native vegetation where home and road development has resulted in the removal of native riparian vegetation
- Revegetate riprapped banks with soil-moisture appropriate native vegetation.
- Install ponding basins or similar structures to prevent road based sediment and pollutants from moving into the stream.
- Enforce stream building and riparian vegetation setbacks.

General Characteristics

Location CR2-4: N39 12.115/W107 13.897; 39 13.146/107 13.562.

Elevation: 7120'. **Life Zone:** Montane.

Ecosystem: Blue spruce-cottonwood forest.

Watershed Features: predominant surrounding land use – Rural residential; local watershed NPS pollution – some potential sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Narrowleaf cottonwood-blue spruce, thinleaf alder, willow, red-osier dogwood, equisetum. Upland – Douglas fir/Ponderosa pine forest/aspens forest/oak shrubland.

Instream Features: stream width – 22 m; stream depth – 0.70 m; canopy cover – 10%; high water mark – 0.80 m; stream morphology types – riffles 45%, pools 15%, runs 40%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: periphyton: estimated abundance – 2(common).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – sand & silt; undersides of stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 20; cobble 40; gravel 15; sand 15; silt 10; clay 0.

Organic Substrate Components %: detritus (CPOM) 15; muck-mud (FPOM) 5; marl 0.

Assessment Data

EPA Habitat Assessment Score: 140/200.

NRCS Habitat Assessment Score: left bank – 42/61; right bank – 43/61.

Weedy species: common tansy, oxeye daisy, yellow sweetclover.



Above: Mid-channel islands trap sediment, dissipate stream energy and provide wildlife habitat.

Below: In steep gradient canyons where stream energy is increased, stable riparian habitat is especially important in stream bank stabilization.

Disturbance-caused undesirable plants: Kentucky bluegrass, smooth brome, orchard grass, ornamentals.

Dominant Native Riparian Vegetative Species:

Trees: narrowleaf cottonwood, Colorado blue spruce, Ponderosa pine, Douglas fir.

Shrubs: willow spp. (coyote, beaked, strapleaf), thinleaf alder, river birch, hawthorn, red-osier dogwood, chokecherry, snowberry, mountain mahogany, twinberry honeysuckle, Rocky Mountain maple, Wood's rose, kinnikinnick, common juniper, Wood's rose.

Grasses and Forbs: sedge and rush spp., equisetum spp., star solomonplume, American vetch, blue clematis, meadow rue, edible valerian, pussytoes, pink pyrola, green gentian.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - M; Maint. Lawns - M; Roads - M; leach fields - M.

Recreational: Campground -H.

Agricultural: Water withdrawal - L.

Stream management: Channelization - M.

Other Human Influences:

Nutrient enrichment: fairly clear or slightly greenish, moderate algal growth on stream substrates.

Barriers to fish movement: none.

Manure presence: evidence of livestock access to riparian zone; leach fields.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

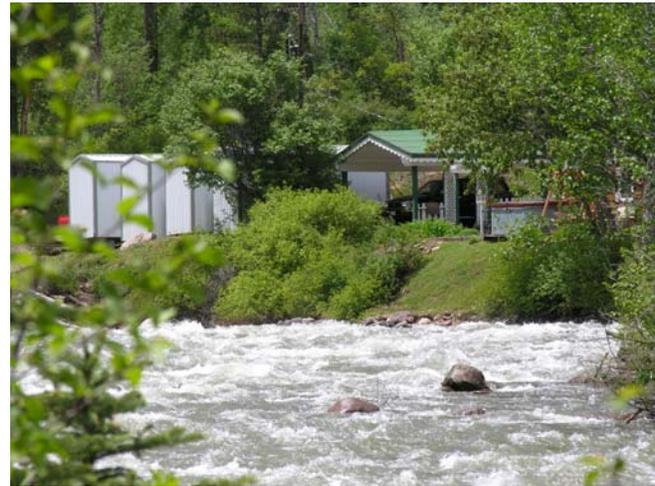
Beaver: beaver sign – rare; flow modification – none.

Dominant Land Use – rural & forest; forest age class >75.

Functional Rating: at risk.

Biological Indicators of Stream and Riparian Condition:

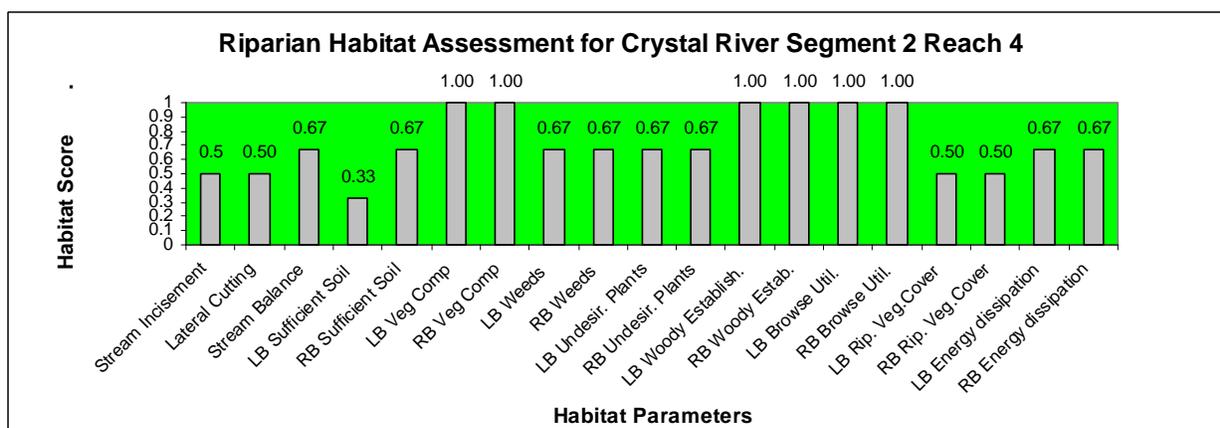
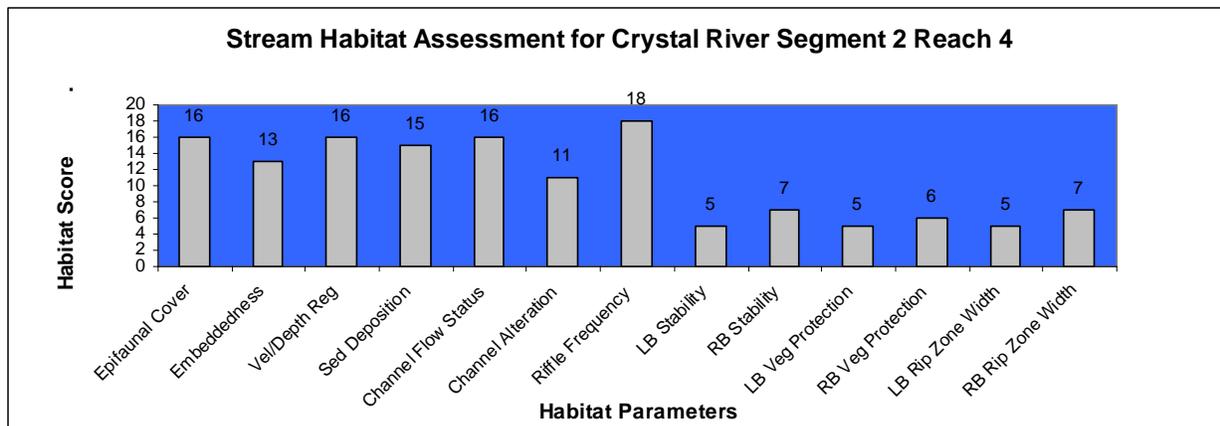
- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 27/71/0 indicating potentially impaired water quality.
- Two American dippers were observed in the survey area indicating sufficient nesting and foraging resources.
- A survey of the breeding bird community recorded 48 individuals in 25 species for a biodiversity score of 3.142 and an evenness score of 0.812. Abundance and richness is moderate. A reduced amount of appropriate nesting habitat has likely suppressed both parameters.
- Estimated abundance of periphyton was ‘2’ (common) and filamentous algae was ‘1’ (rare). Periphyton abundance shows a rapid increase from the previous reach (rare) and may indicate excessive nutrient enrichment.



Home development on stream banks has decreased bank stability.



Well-vegetated pointbars and mid-channel islands are important sediment traps. Stream flow is slowed as it flows over these islands and point bars. Sediment drops out of the stream, improving water quality, and onto point bars where it provides soil for vegetative growth.



Crystal River Segment 2, Reach 5.

Habitat Condition: Stream – moderately modified; LB/RB Riparian – heavily modified/slightly modified.
Stream Class (Rosgen) – C3. **Stream Order –** 4th. **Reach Length –** 1.81 km.

Summary

Hydrologic considerations

Channel Condition: At the top of this reach, the stream enters a wide valley with a low gradient. Evidence of historic and recent channelization is present throughout the reach. On the upper 40% of the reach the stream meanders widely across the valley, but in the lower 60% of the reach the channel runs straight, likely as a result of agricultural development. Recent channelizing impacts occur from Highway 133 on the lower 30% of the reach where the road cut and riprapped banks on the left bank have altered the natural shape of the channel. Additionally, albeit relatively minor, home development contributes to channelization by removing native riparian vegetation, building bridges and diverting water.

Instream heterogeneity: On the upper 40% of the reach, stream structure is heterogeneous. The channel meanders widely (sinuosity = 1.6) creating pools, riffles and runs and stream substrate is varied. Stream structure is simplified in the lower 60% of the reach; the channel runs fairly straight (sinuosity = 1.03), which has resulted in riffle habitat dominating the stream structure and uniform substrate. Consequently, on the upper part of the reach instream habitat diversity is high while on the lower section instream habitat is simplified.

Hydrologic Alteration: Bank-full flows occur regularly with spring melt. Overbanking flows also occur regularly so that the floodplain is frequently inundated, except in those places where downcutting prevents access to the floodplain. Downcutting is present on approximately 20% of the left bank but on <10% of the right bank. At base flow, width/depth ratio is excessively high (38:1) indicating hydrologic alteration that may be due to the cumulative impact of numerous upstream irrigation diversions.

Over 60-70% of right bank riparian habitat is dominated by sedge and rush wet meadows that are created and maintained by both stream overbanking and ground water discharge. These meadows also help maintain stream flow. Springtime overbanking replenishes ground water, which is discharged later in the season to help maintain base flows. Upland ground water discharge also plays a critical role in maintaining this ecosystem by supplying moisture to wetland vegetation before moving into the stream.

At the top of this reach on the right bank a large beaver dam complex is essential in maintaining the wetlands that have been created by the dams. The water storage function that results from this beaver complex also makes an important contribution toward maintaining sufficient instream flows.

Stream balance / Erosion – deposition: Numerous impacts have cumulatively produced stream imbalance. Old downcutting is apparent, although a new stable riparian area is developing within the incised channel. A small amount of human-induced lateral bank erosion contributes excess stream sediment, as do highway impacts. Results include 30% of the stream bottom affected by sediment deposition, slight deposition in pools, and gravel and cobble that are 25% embedded by fine sediment.



Above: At the top of the reach both stream and riparian habitat are in good condition. Riparian vegetation is healthy, banks are stable and stream habitat is diverse.

Below: On the lower part of the reach road cut impacts have degraded the riparian and stream habitat. Riparian vegetation is degraded, banks are eroding and stream habitat is simplified.

Upland contribution to degradation

Highway impacts and home development on the left bank uplands contributes to stream degradation by increasing impervious surfaces, decreasing infiltration, increasing runoff, and increasing sediment and other pollutants in that runoff.

Vegetation considerations

Riparian Zone: Riparian habitat on the upper 40% of the reach on each bank is characterized by montane riparian forest dominated by Colorado blue spruce, narrowleaf cottonwood, thinleaf alder and coyote willow. Community composition is naturally diverse with an even distribution of age-classes of trees and shrubs conveying the potential for recruitment, recovery and habitat maintenance.

On the upper 40% of the reach, the riparian zone on each bank is 15-20 m wide and is mostly unimpacted by recent human activity. Tree cover here totals 20% on each bank and is comprised of three layers, each dominated by narrowleaf cottonwood, Colorado blue spruce and box elder. Shrub cover on each bank totals 30% and is comprised of three layers that are dominated by thinleaf alder, coyote willow, spruce and cottonwood seedlings and saplings and Wood's rose. Herbaceous species and cover are typical for this habitat type; on each bank cover totals 40% and dominant native plants include sedge, rush, equisetum, aster and senecio species.

On the lower 60% of the reach right bank riparian habitat is characterized by wet meadows dominated by sedges, rushes and grasses. Numerous open water ponds are scattered throughout the meadows where bulrush dominates along the banks. Riparian zone width is 20-100 m and largely unimpacted by recent human activity. Plant species diversity and vegetation structure is appropriate for the habitat type.

Left bank riparian habitat on the lower 60% of the reach is altered by home development, degraded by the highway road cut and by a network of trails that access a hot springs. A naturally narrow riparian zone has been further reduced by human activities from a potential width of 6 m to typically <2 m. Plant species community composition has been altered and is dominated by disturbance-tolerant species with a simplified habitat structure.

Tree cover on the lower 60% of the reach, compared to the upper part of the reach, is reduced on each bank to 10% and is comprised of two layers. On the left bank this reduction in cover is due to human impacts while on the right bank the reduction is mostly natural and due to high soil moisture. Dominant trees on the left bank include box elder and narrowleaf cottonwood and on the right bank blue spruce and narrowleaf cottonwood. Like tree cover, shrub cover is also reduced and for similar reasons. Shrub cover on each bank totals 15% and is comprised of two layers: dominant shrubs on the left bank include Gambel oak, Rocky Mountain juniper, coyote willow and three-leaf sumac; dominant shrubs on the right bank include spruce saplings and seedlings, thinleaf alder, and coyote willow. Herbaceous cover on the left bank is 40% and dominated by disturbance-tolerant species such as virgin's bower, pasture grasses and noxious weeds. Herbaceous cover on the right bank totals 75% and dominated by moisture-loving plants such as sedges, rushes, and bulrush but also by pasture grasses that have invaded (or are left over from historic agricultural development) throughout the reach.

Sufficient kinds of riparian plant species are present on both banks to stabilize stream banks and hold onto water. However, on the left bank the distribution and abundance of stabilizing plants is insufficient to prevent erosion and drying soils; <55% of the riparian cover has a stability rating >6. On the right bank both stabilizing and water holding functions are adequate with >85% of the riparian canopy cover having a stability rating >6.



Above: natural habitat on the right bank provides critical habitat for bighorn and elk. Warm, mineral rich, ground water discharge provides nutrients for abundant algal growth.

Stream bank Stability: The left bank is only moderately stable; 30% of the reach, mostly along the bottom half of the reach, has areas of erosion and another 10% is armored with boulders to prevent further erosion. The right bank is stable; only 10% of the reach has areas of erosion and this occurs primarily in conjunction with home development and associated vegetation alteration.

Floodplain characteristics: The floodplain on the upper 40% of the reach on the left bank has adequate habitat characteristics, such as dense vegetation and large woody debris, to dissipate flood energy and trap sediment. Habitat characteristics on the lower 60% of the left bank provide very little sediment trapping or energy dissipation function. Throughout the reach on the right bank dense riparian vegetation and numerous overflow channels provide important flood energy dissipation and sediment trapping functions.

Weedy and undesirable species: Noxious weeds occur on 10% (abundant) of the riparian zone on the left bank and up to 5% (a few are present) on the right bank. Weedy species include Canada thistle, bull thistle, cheatgrass, oxeye daisy, reed canarygrass, and yellow sweetclover. Undesirable plants occur on 5-10% of each bank and include poison ivy and pasture grasses such as timothy, red top and smooth brome.

Wildlife considerations

Instream: An adequate amount of habitat is available to aquatic wildlife year-round. However, stream substrate and available cover for fish and invertebrates is less than adequate on >60% of the reach. Woody debris, overhanging vegetation and undercut banks are rare. Deep pools and backwater pools are also rare and although riffles are frequent, the variety of instream habitat is generally diminished on all but the top 20% of the reach. Gravel and cobble are frequent but are 25% embedded by fine sediment.

Riparian: The right bank provides important and critical habitat for numerous native wildlife species including bighorn sheep, mule deer, elk, numerous songbird species and raptors. The landscape provides opportunity for year-round wildlife use with an uninterrupted connection to the river. This area is important bighorn lambing and elk calving habitat as well as critical winter habitat for both species. Additionally, golden eagles hunt the meadows in the summer, bald eagles forage along the river in the winter and songbirds nest throughout riparian and upland habitat in the spring and summer.

Intact habitat connections between upland and riparian habitat provide a rare opportunity for wildlife to migrate between two critical habitats, undisturbed and unthreatened by human intrusion. Consequently, right bank riparian and upland habitat provides excellent wildlife potential. Although ungulates are numerous, browse is light due to an abundance of high quality vegetation.

On the left bank, limitations to wildlife potential results from habitat fragmentation and habitat loss. On the left side of the river, Highway 133 divides upland and riparian habitat creating a lethal barrier to daily and seasonal animal migration. Left bank habitat is also disturbed by development and by road cut impacts.

Management Recommendations:

- Protect and conserve river and upland habitat connectivity on the right bank.
- Maintain a “human-free” right bank environment.
- On the left side of the river construct wildlife passageways to enable safe movement across the highway between uplands and the river.
- Revegetate the left bank where the road cut and development have degraded riparian vegetation.
- Prevent road gravel and road-based pollutants from moving into the stream.
- Designate and harden access to the hot springs to prevent ongoing vegetation trampling and bank erosion.
- Increase the variety of instream habitat by installing large woody debris and root wads, and, where possible, re-enable natural meandering.



High quality vegetation at Filoha Meadows provides important elk calving and bighorn lambing habitat. In the fall, elk bugling is commonplace, and in the winter, the area serves as critical winter range for bighorn.

General Characteristics

Location CR2-5: N39 13.146/W107 13.562; 39 13.919/107 13.635. **Elevation:** 6955'. **Life Zone:** Montane.

Eccosystem: sedge-rush wet meadow/cottonwood-blue spruce riparian forest/open water beaver ponds.

Watershed Features: predominant surrounding land use – Forest and Residential; local watershed NPS pollution – some potential sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Narrowleaf cottonwood, blue spruce, thinleaf alder, coyote willow, sedge spp., rush spp. Upland – LB Douglas fir forest/shrublands, RB Ponderosa pine/shrublands.

Instream Features: stream width – 23 m; stream depth – 0.6 m; canopy cover – 10%; high water mark – 0.85 m; stream morphology types – riffles 28%, pools 12%, runs 60%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: periphyton/filamentous algae: estimated abundance – 2 (common).

Water Quality: water odors – sulfur from hot springs; water surface oils – none; turbidity – slightly turbid.

Sediment/Substrate: odors – sulfur; oils – absent; deposits – sand; undersides of unembedded stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 25; cobble 40; gravel 10; sand 15; silt 10; clay 0.

Organic Substrate Components %: detritus (CPOM) <10; muck-mud (FPOM) 0; marl 0.

Assessment Data

EPA Habitat Assessment Score: 140/200.

NRCS Habitat Assessment Score: left bank – 38/61; right bank – 53/61.

Weedy species: LB Canada thistle, cheatgrass, yellow sweetclover, oxeye daisy; RB Canada thistle, bull thistle, cheatgrass, reed canarygrass.

Disturbance-caused undesirable plants: Timothy, red top and smooth brome grasses, poison ivy.

Dominant Native Riparian Vegetative Species:

Trees: narrowleaf cottonwood, Colorado blue spruce, box elder, Rocky Mountain juniper.

Shrubs: coyote willow, thinleaf alder, Gambel oak, 3-leaf sumac, Wood's rose.

Grasses and Forbs: sedge and rush spp., slender equisetum, virgin's bower, scirpus, senecio spp., solidago spp., aster spp., milkweed spp., broad-leaved cattail, wild hop-vine, wood rush, northern gentian.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - L; Roads - M; leach fields - L.

Recreational: Hot springs - L.

Agricultural: Livestock use - L; water withdrawal - M

Stream management: Angling - L;

Channelization - historic H, current - L.

Other Human Influences:

Nutrient enrichment: fairly clear or slightly greenish, moderate algal growth on stream substrates.

Barriers to fish movement: none.

Manure presence: none.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

Beaver sign – common; flow modification – historic - major, current - minor.

Dominant Land Use – historic - agriculture, current - forest; forest age class – 25-75.

Functional Rating: at risk.

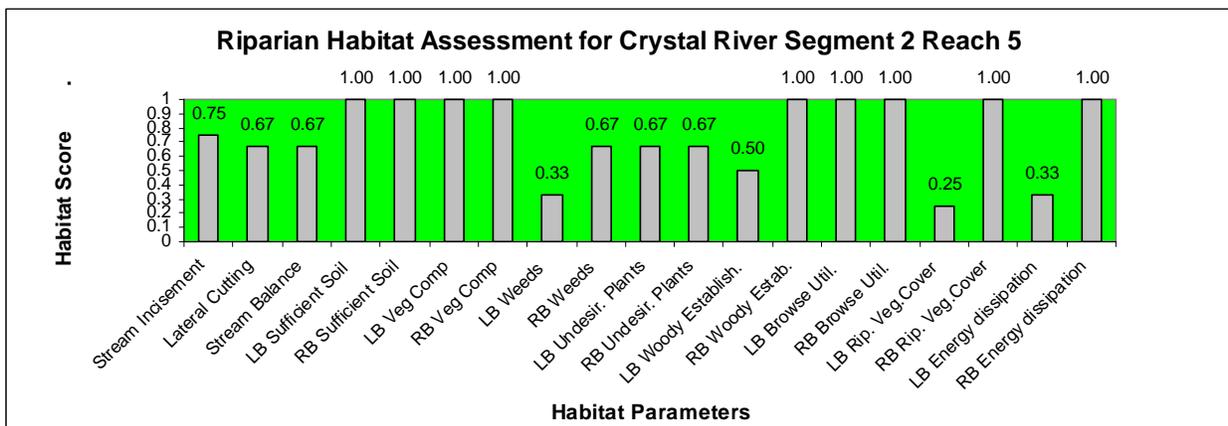
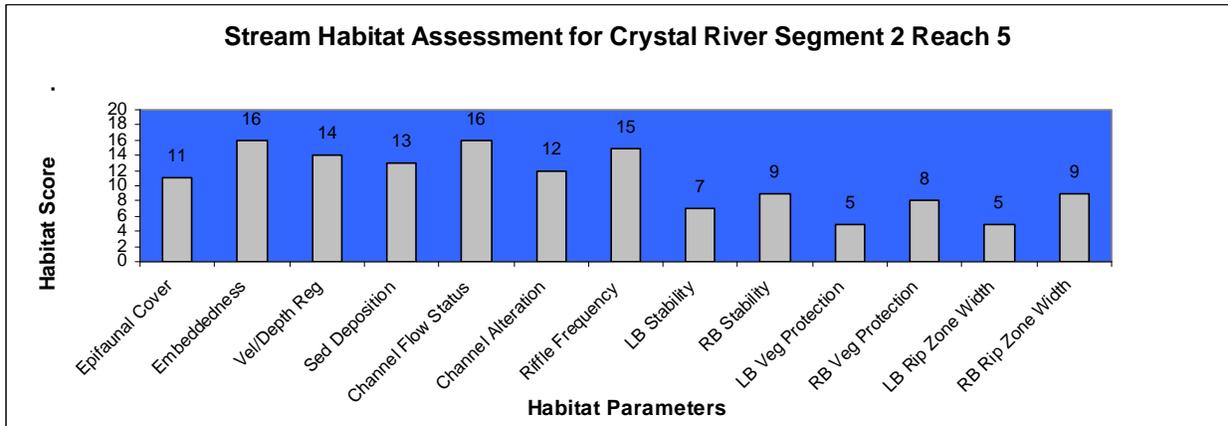
Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 17/34/0 indicating potentially impaired water quality.



At the top of the reach, large meanders still occur, increasing stream habitat variety. However, historic agricultural development that destroyed riparian vegetation continues to impact the stream system.

- Two American dippers were observed at the top of the reach indicating sufficient breeding and foraging resources; no dippers were observed on the lower 60% of the reach likely due to a lack of suitable nest sites.
- A survey of the breeding bird community recorded 53 individuals in 31 species for a biodiversity score of 3.323 and an evenness score of 0.837. The survey was conducted at the top of the reach on the right bank in a habitat mosaic of willow and cottonwood forest. Breeding bird richness and abundance indicates good quality habitat. Additional surveys should be conducted lower on the reach in wet meadow habitat.
- Estimated abundance of both periphyton and filamentous algae was “2” (common) potentially indicating excessive nutrient enrichment. However, at this site, natural sources may be supplying excess nutrients.



Crystal River Segment 2, Reach 6.

Habitat Condition: Stream – heavily modified; LB/RB Riparian – moderately modified/moderately modified.
Stream Class (Rosgen) – B2. **Stream Order** – 4th. **Reach Length** – 3.01km.

Summary

Hydrologic considerations

Channel Condition: Channelization is extensive; boulder or marble riprap is present on both banks, riparian vegetation has been altered and stream flows have been diverted. Channelization impacts the entire reach and has resulted in a straighter and steeper channel. However, over time on the lower half of the reach, point bars and mid-channel islands have re-developed increasing sinuosity and resulting in decreased gradient.

On the left bank, Highway 133 channelizes the upper 47% the reach; banks are armored with boulders and the channel is straightened. On the lower half of the reach, banks are revegetating and meanders are reestablishing with the development of well-vegetated riparian benches. On the right bank, an abandoned railroad grade channelizes the upper 30% of the reach and home development channelizes the lower 35%; the middle 35% of the right bank is recovering from historic channelization impacts – development of well vegetated riparian benches and mid-channel islands is helping to restore a more natural channel shape.

Instream heterogeneity: Structurally, the channel is characterized by a series of rapids with cascades and runs. Instream habitat variety has been diminished by channelizing activities that have straightened the channel but, in those areas where recent channelization has not occurred, habitat variety is increasing. In these recovering areas, over time, “self-restoration” has resulted in the re-development of point bars and mid-channel islands. Consequently on the lower half of the reach, sinuosity has increased to 1.13, from 1.02 on the upper half where ongoing channelizing activities occur.

Channelizing activities have also resulted in the reach being dominated by run habitat with relatively few riffles or pools. Thus, although all four velocity/depth regimes are present, representation is uneven; a fast-deep regime occurs on 64% of the reach, fast-shallow on 18%, slow-deep on 10% and slow-shallow on 10%.

Hydrologic Alteration: The width/depth ratio is within the normal range for this stream class and landscape but gradient has been increased by channelization-induced stream straightening. Bank-full flows occur regularly but the flood plain is inundated only in those areas where the banks are not riprapped and where riparian benches have re-developed; thus overbanking occurs on 53% of the left and 35% of the right bank.

Evidence of abundant historic beaver activity exists but signs of recent activity were not in evidence. The return of beaver activity to this reach would benefit the stream by helping to slow flooding flows, increasing water storage and enhancing riparian habitat.

Stream balance / Erosion – deposition: Excess sediment initiates primarily from two sources, eroding banks and road-based sand and gravel. Although no active downcutting is occurring, old downcutting is apparent but a new stable riparian area has formed within the incised channel. However, a moderate amount of human-induced lateral bank erosion is occurring at road cuts and developed areas including homes, pastures, ponds and wherever lawns replace riparian vegetation.



Above: At the top of the reach the highway on the left bank and railroad grade on the right bank severely channelize the stream.

Below: On the lower part of the reach well-vegetated riparian habitat traps sediment and slows flood energy.

The stream is not in balance due to the excess sediment that initiates from eroding banks and from offsite sources, especially highway-source gravel and sand that is carried into the stream with precipitation and snowmelt and makes a significant contribution to excess sedimentation. Impacts to this reach from excess sedimentation include pools filling with sediment, 30% of the stream bottom affected by sediment and cobble and gravel that are slightly embedded.

Upland contribution to degradation

Intermittent home development occurs throughout the reach and results in direct habitat loss, increased impermeable surfaces, decreased infiltration and increased runoff that is laden with excess sediment and pollutants. Highway 133 contributes road-based pollutants directly to the stream via culverts that drain the road and discharge directly into the stream and indirectly with dispersed road runoff. Ancillary highway impacts include snow removal storage areas that direct runoff into the river over steep eroding banks, exacerbating erosion but also directing pollutants and sediment into the stream.

Vegetation considerations

Riparian Zone: Vegetated riparian zone width varies with condition of the banks. On riprapped banks (47% of the left and 65% of the right bank) vegetated width is typically 0-2 m, while in those areas of the reach where recent channelization does not occur (53% of the left bank and 35% of the right bank) and where riparian benches have developed, the riparian zone is typically 10-12 m wide and occasionally 20-30 m wide. In addition, well-vegetated mid-channel islands frequently occur in the lower part of the reach.

The plant community on riparian benches and mid-channel islands is characterized by a cottonwood-spruce-dogwood riparian forest. Box elder, a drought-tolerant species, is becoming co-dominant with narrowleaf cottonwood and indicates drying soils. On riparian benches and islands, native plant cover, species diversity and structural complexity are high and an even distribution of all age-classes of trees and shrubs is present. However, on areas that have been recently channelized or are constantly disturbed, natural habitat characteristics have been altered. Here, the plant community is dominated by noxious weeds or disturbance-tolerant plant species with little cover and diminished structural complexity.

Tree species on both banks are similar but cover percentage differs between banks. Tree cover is comprised of three layers on each bank and totals 20% on the left bank and 40% on the right bank. The upper layer contributes 5% cover on the left and 20% cover on the right bank and is dominated by Colorado blue spruce, narrow leaf cottonwood, and Douglas fir. The middle tree layer contributes 10% cover on the left and 10% cover on the right bank and is dominated on each bank by box elder. The lower layer contributes 5% cover on the left and 10% cover on the right bank and is dominated on each bank by box elder, thinleaf alder, and river birch.

Shrub species on both banks are similar but cover percentage differs between banks. Shrub cover is comprised of three layers on each bank and totals 25% on the left and 40% on the right bank. The upper shrub layer contributes 5% cover on the left and 15% cover on the right bank and is dominated by river birch, thinleaf alder and Rocky Mountain maple. The middle shrub layer contributes 10% cover on the left and 15% cover on the right bank and is dominated by red-osier dogwood, coyote willow and mountain spray. The lower shrub layer contributes 10% cover on each bank and is dominated by Wood's rose and snowberry.

Compared to the left bank, tree and shrub cover on the right bank indicates ongoing recovery from historic disturbance, whereas



Below: On the right bank, natural recovery is occurring.

Above: On the upper part of the reach, road cut and maintenance activities continue to degrade the stream bank plant community resulting in bank instability.

vegetation conditions on the left bank indicate ongoing disturbance. In addition, the conspicuous presence of plant species such as box elder, coyote willow and snowberry in the riparian zone indicates drying soils.

Overall, 50% of the left and 60% of the right stream banks and immediate riparian zone are protected by native vegetation; patches of bare soil are common and disruption is obvious. Thus, although sufficient kinds of plant species are present to stabilize banks and hold onto water, abundance and distribution is insufficient to accomplish these functions; only 55-65% of riparian cover has a stability rating >6.

Stream bank Stability: 40-50% of the banks in the reach have areas of erosion. Banks are however re-stabilizing on 50-60% of the reach wherever bank disturbance or channelizing activities have not recently occurred.

Floodplain characteristics: On the lower half of the reach important energy dissipation and sediment trapping habitat characteristics, such as overflow channels, woody debris and dense riparian vegetation and mid-channel islands, are common. On the upper half of the reach these characteristics are absent or reduced. Consequently, on the upper half of the reach stream bank erosion is common and sediment capture is minimal.

Weedy and undesirable species: Noxious weeds are present on over 10% of the left bank up to 10% of the right bank riparian area. Weedy species include Canada thistle, common burdock, cheatgrass, houndstongue, common tansy and oxeye daisy. Extensive coverage of oxeye daisy and tansy excludes native plant species and reduces habitat sustainability.

Undesirable plant species occur on 10-15% of each bank. Species include Kentucky bluegrass, pasture grasses, and non-native grasses that are likely from the Highway departments' roadside revegetation seed mix.

Wildlife considerations

Instream: Flows are sufficient throughout the year to provide an adequate amount of aquatic wildlife habitat. Throughout the reach stable, abundant boulders and cobbles and frequent riffles provide good epifaunal substrate. However, conditions on the upper half of the reach are wildlife limiting due to channelization impacts that have degraded fish habitat and eliminated cover and resting habitat.

Habitat conditions for wildlife improve on the lower half of the reach due to the development of well-vegetated mid-channel islands and riparian benches. Abundant protective cover and resting habitat occurs with the presence of overhanging vegetation, undercut banks, and overflow channels. Natural, irregularly shaped stream banks and an abundance of large woody debris have created numerous deep, slow-water pools that are important fish habitat.

Riparian: The upper half of the reach provides little opportunity for wildlife. However, where recovery has occurred on the lower part of the reach and riparian benches and mid-channel islands have developed, wildlife potential has greatly improved. These riparian benches and mid-channel islands provide protected nursery sites for elk calves, a diversity of high quality forage attracts an abundance of mule deer and the structurally complex plant community provides nesting habitat for a diverse assemblage of riparian songbirds. Although deer and elk were abundant here, due to the profusion of forage, browse was light and does not negatively impact plant vigor.

Management Recommendations

The historic railroad grade on the right bank is a site being discussed for a new, paved recreational trail. Over time the right bank has undergone considerable "self restoration" and currently provides good wildlife potential. The presence of a recreational trail will degrade the habitat for wildlife by introducing disturbance that sensitive wildlife species cannot tolerate.



Above: Mid-channel islands slow flood energy and providing wildlife habitat.

Middle: A sinuous channel shape has redeveloped towards the middle of the reach, increasing stream diversity and function.

Below: Snow removal storage areas direct sediment- and pollutant-laden snowmelt into the stream.

- To enable continued restoration and improved wildlife potential on the right bank, manage the area for wildlife only; maintain the present condition as free of human recreational disturbance.
- Weed eradication is essential to restore ecological integrity to this reach; eradicate noxious weeds and revegetate roadsides with native plant seed mixes.
- Revegetate stream banks with appropriate native vegetation – especially where the highway is adjacent to the stream with little or no intervening vegetation to act as a pollution/sediment filter.
- Install sediment traps to prevent road gravel/sand and pollutants from being carried into the stream.
- Sweep up road sand from winter sanding operations to prevent sand from being washed into the stream.

General Characteristics

Location CR2-6: N39 13.919/W107 13.635; 39 15.299/107 14.028.

Elevation: 6920'. **Life Zone:** Montane. **Ecosystem:** Cottonwood-spruce-dogwood riparian forest.

Watershed Features: predominant surrounding land use – Forest and Residential; local watershed NPS pollution – obvious sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Narrowleaf cottonwood, Colorado blue spruce, box elder, thinleaf alder, river birch, willow spp., red-osier dogwood. Upland – Douglas fir-aspens-oak shrubland mosaic.

Instream Features: stream width – 18 m; stream depth – 1.3 m; canopy cover – 10%; high water mark – 0.5 m; stream morphology types – riffles 25%, pools 12%, runs 63%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: kind – periphyton and filamentous algae; estimated abundance – 2 (common).

Water Quality: water odors – sulfur from ground water discharge; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – road-based gravel & sand; undersides of unembedded stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 40; cobble 20; gravel 20; sand 10; silt 10; clay 0.

Organic Substrate Components %: detritus (CPOM) <10; muck-mud (FPOM) 0; marl 0.

Assessment Data

EPA Habitat Assessment Score: 126/200.

NRCS Habitat Assessment Score: left bank – 43/61; right bank – 43/61.

Weedy species: Canada thistle, burdock, oxeye daisy, cheatgrass, houndstongue, reed canarygrass.

Disturbance-caused undesirable plants: Kentucky bluegrass, smooth brome, orchard grass.

Dominant Native Riparian Vegetative Species:

Trees: narrowleaf cottonwood, Colorado blue spruce, box elder, ponderosa pine, Douglas fir, Rocky Mountain juniper.

Shrubs: River birch, thinleaf alder, Rocky Mountain maple, red-osier dogwood, coyote willow, mountain spray, Wood's rose, snowberry.



Above: Near the confluence of Avalanche Creek riparian habitat has recovered and is in good condition providing good wildlife potential for large mammals such as elk and also for smaller critters such as songbirds.

Below: The highway road cut degrades bank vegetation and the road is a source of stream pollution via indirect runoff and also directly via culverts that direct polluted runoff into the stream.

Grasses and Forbs: equisetum spp., sedge spp., rush spp., broad-leaved cattail, scirpus, bracken fern, aster spp., false solomonseal.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - L; Maint. Lawns - L; Bridges/Culverts - L.

Recreational: none.

Agricultural: Pasture - L; Livestock use - L; Water withdrawal - L.

Stream management: Liming (natural) - M; Angling - L; Channelization - H.

Other Human Influences:

Nutrient enrichment: fairly clear or slightly greenish, moderate algal growth on stream substrates.

Barriers to fish movement: none.

Manure presence: evidence of livestock access to riparian zone.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

Beaver: beaver sign – rare; flow modification – none.

Dominant Land Use – forest & rural; forest age class – 25-75.

Functional Rating: at risk, trend depends on management of stream bank and riparian habitat.

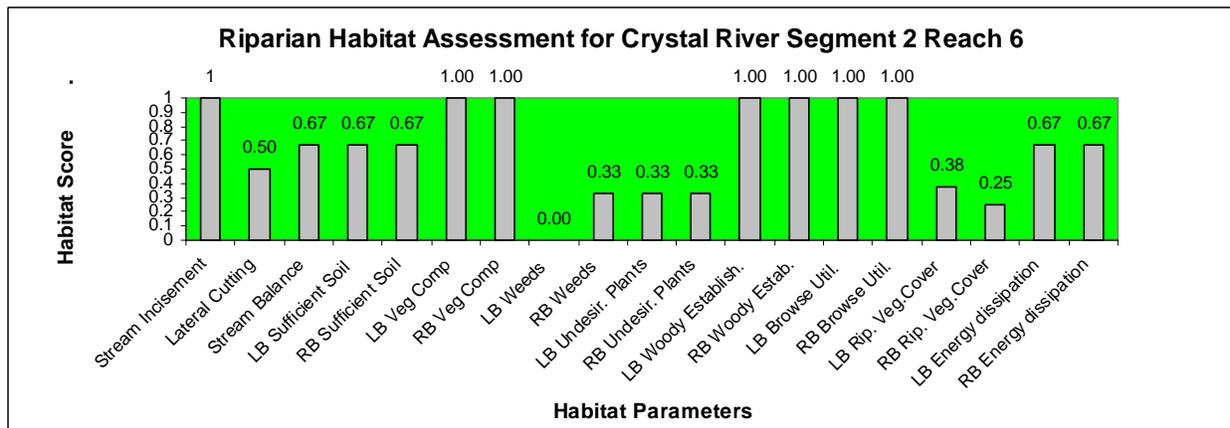
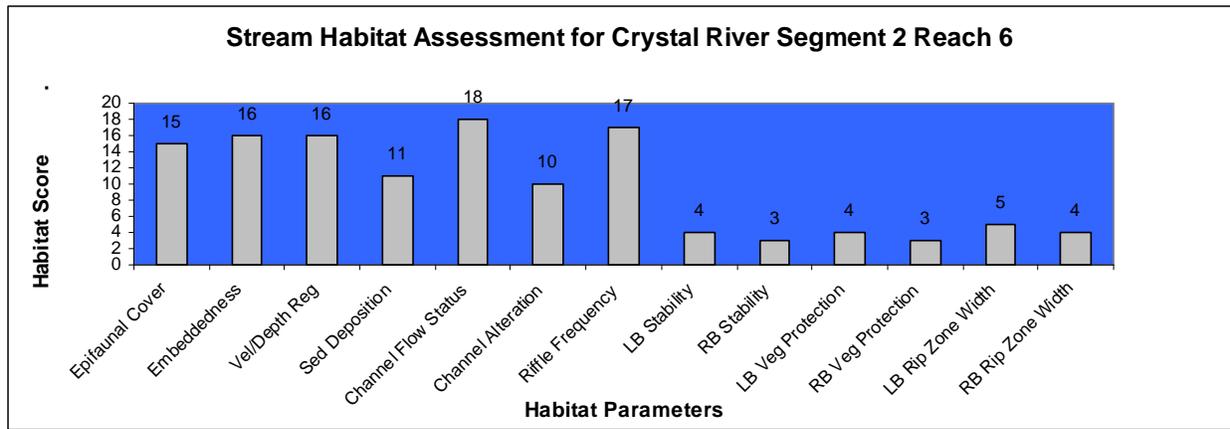
Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 27/52/0 indicating potential water quality impairment.
- Three American dippers were observed in the survey area, which was located toward the bottom of the reach indicating sufficient food and nesting resources. No dippers were observed in the upper part of the reach.
- A survey of the breeding bird community recorded 52 individuals in 15 species for a biodiversity score of 2.367 and an evenness score of 0.599. Both abundance and richness are somewhat low when compared to other similar habitats, likely because only about 50% of this reach provides suitable habitat – as the amount of appropriate habitat increases we would expect an increase in diversity. Of note was the presence of two common yellowthroats (one male and one female) at a cattail-bulrush pond on the right bank that was created by ground water discharge. They were seen later in the season (August) and so were not included in the bird survey scores. Also of note was the presence of four brown-headed cowbirds, located in a horse pasture.
- Estimated abundance of both periphyton and filamentous algae was “2” (common) indicating potentially excessive nutrient enrichment. Potential sources of excess nutrients include pastures and constructed ponds.

A natural process of revegetation on the right bank below the railroad grade has resulted in recovery of much of the right bank riparian habitat. At the bottom of the bank, warm ground water discharge has created a limestone precipitate outcrop.



Warm ground water discharge fills this pond on the right bank. Two common yellowthroats, a male and a female, were observed foraging at this pond.



Crystal River Segment 2, Reach 7.

Habitat Condition: Stream – severely degraded; LB/RB Riparian – severely degraded/severely degraded.
Stream Class (Rosgen) – F3. **Stream Order** – 4th. **Reach Length** – 2.42 km.

Summary

Hydrologic considerations

Channel Condition: Impacts from the development of the historic Town of Janeway and current highway and home building have altered channel characteristics. On the upper 40% of this reach, highway channelization on the left bank and historic Town and railroad grade-induced channelization on the right side of the stream have resulted in the straightening of a once sinuous stream. Impacts include downcut and eroding stream banks and isolation of the stream from the historic floodplain. Consequently, riparian soils have dried and support only drought-tolerant upland plant species such as potato cactus, mountain mahogany, and ponderosa pine. These native upland plant species have a reduced capacity to stabilize stream bank soils thus channel-altering erosion continues unabated.

Where the highway moves away from the left bank of the stream so that the stream is no longer confined, the channel widens and stream energy is rapidly dissipated, which has resulted in the abrupt deposition of bedload to create large unstable cobble deposits. Further downstream the channel becomes more stable and narrow and begins to regain a more natural meandering shape. On this lower 60% of the reach, where the highway moves away from the stream, the floodplain is intermittently developed with homes, lawns and pastures to the edge of the stream. Downcutting occurs in conjunction with vegetation alteration in these developed locations. In places where development does not occur banks are stable, and a functional riparian zone has developed.

On the right bank, just below Janeway, good quality cottonwood-riparian woodland occurs for approximately 0.7 km (30% of the reach). Here stream banks are stable, sinuosity increases and stream morphology is more complex. Below this area, the old railroad grade has channelized the reach and, in combination with housing development, has resulted in eroding banks, channel straightening and riparian degradation.

Instream heterogeneity: On the upper 40% of the reach, sinuosity (1.04) is decreased below what is appropriate for the landscape and stream class (sinuosity = >1.2), but on the lower part of the reach, the stream is regaining a more natural meandering shape (sinuosity = 1.12) that is appropriate to the landscape. Riffle and run morphology dominate throughout with only a few pools present and those only occur in the mid-section of the reach. Thus, although all four velocity-depth regimes are present, slow-water regimes are underrepresented; a fast-deep regime occurs on 40% of the reach, fast-shallow on 40%, slow-deep on 10% and slow-shallow on 10%.

Hydrologic Alteration: The width/depth ratio is inappropriately high (59/1) due to erosion-induced channel widening. Bank-full flows occur regularly with spring runoff but due to downcutting, overbanking occurs only on <50% of the reach where banks are not downcut. Abundant historic sign of beaver is present throughout the reach but there is no evidence of recent activity.

Stream balance / Erosion – deposition: This reach is not in balance. Human-induced downcutting and lateral cutting are excessive. Consequently the width/depth ratio exceeds what is appropriate for the stream class, un-vegetated mid-channel bars are common, point bars are enlarged by gravel with abundant sand and silt, and pool frequency is low. Additionally, excess sediment from eroding banks affects 40% of the stream bottom and is filling pools.



Above: Channelization and consequent hydrologic alteration has severely altered both instream and riparian habitat.

Below: Excessive bedload in combination with channel widening has resulted in large unstable cobble deposits.

Upland contribution to degradation

Home and road development have increased impermeable surfaces and runoff. Runoff from these sources is frequently laden with road-based pollutants and fertilizers and pesticides from lawns and pastures.

Vegetation considerations

Riparian Zone: Riparian habitat is vastly different on the upper compared to the lower part of the reach where hydrologic alteration has impacted floodplain habitat characteristics. Only a remnant of the riparian plant community remains at the Janeway townsite, which is now characterized by a narrow strip of drought-tolerant ponderosa-juniper forest with an understory dominated by bitterbrush, mountain mahogany and sage. Below Janeway, riparian habitat is characterized by cottonwood-blue spruce forest with an understory dominated by alder, river birch and red-osier dogwood. Plant community characteristics on the lower portion of the reach that is undisturbed by development provide an indication of community potential on the upper portion, if a natural hydrologic regime could be restored.

Age-class distribution of trees and shrubs provides a good indication of ecosystem health and resilience. Age-class distribution of woody riparian plant species on the upper part of the reach provides little or no potential for plant community recovery – only a few decadent cottonwood trees and a sparse representation of riparian shrubs remain. However, on the lower part of the reach, all age-classes classes of desirable trees and shrubs are present providing good potential for regeneration and habitat sustainability. When the reach is considered as a whole, even though all age-classes of desirable woody riparian species are present, given the current hydrologic condition there is no potential for recovery on the upper part of the reach.

Highway- and railroad grade-induced channelization on the upper 40% of the reach has resulted in a reduction of canopy cover as well as a reduction of riparian zone width to <1m from a historic width of >30 m. Tree cover on each bank consists of two layers with a total canopy cover of 10% and is dominated by ponderosa pine, Rocky Mountain juniper, pinon pine and decadent narrowleaf cottonwood. Shrub cover on each bank consists of two layers with a total cover of 20% and is dominated by bitterbrush, 3-leaf sumac, mountain mahogany, snowberry, Wood's rose and coyote willow. Herbaceous cover on each bank has a total cover of 20% and is dominated by noxious weeds including especially cheatgrass, common burdock, common tansy and bastard toadflax and drought-tolerant native plants such as potato cactus, Indian ricegrass, needle and thread, gilia, dusty maiden and fringed sage.

On the lower 60% of the reach, undeveloped riparian areas alternate with developed areas. Good quality riparian vegetation is present on approximately 30% of both banks where the highway and home development is moved away from the stream. On these undeveloped areas, the riparian zone is widening and well-vegetated riparian benches and mid-channel islands are developing. Riparian zone width on the left bank averages 10-12 m in undeveloped areas and <6 m on developed areas; riparian zone width on the right bank is >12 m on undeveloped areas and <6 m on developed areas.

The cottonwood-spruce forest that occurs on this lower 60% of the reach is characterized by a natural diversity of trees and shrubs with a good distribution of all age-classes. Consequently, in undeveloped areas, species diversity and habitat structural complexity are adequate to enable a functional, sustainable riparian ecosystem. On each bank, tree cover consists of three layers with a total cover of 20% on the left and 40% on the right bank; dominant tree species include narrowleaf cottonwood,



Above: At the Janeway townsite the floodplain has dried out and supports drought-tolerant plant species.

Below: On the lower part of the reach where soil moisture is high, riparian plant species thrive.

Colorado blue spruce, ponderosa pine, Douglas fir, and box elder. Shrub cover on each bank consists of three layers with a total cover of 30% on the left and 50% on the right bank; dominant shrub species include river birch, thinleaf alder, coyote willow, 3-leaf sumac, silverberry, red-osier dogwood, and river hawthorn. Herbaceous cover totals 40% on the left and 50% on the right bank; dominant herbaceous species include sedges and rushes, star solomonplume, senecio sera, aster spp. and equisetum spp.

When the reach is considered as a whole, <50% of the stream bank surfaces are protected by native vegetation, patches of bare soil and closely cropped vegetation are common and disruption of stream bank vegetation is very high.

Although sufficient kinds of plant species are present to stabilize bank soils and hold onto water, abundance and distribution is inadequate to accomplish these functions; only 55-65% of the riparian canopy has a stability rating >6. Consequently, throughout the reach, due to a variety of channel-altering activities, stream bank soil has been lost to erosion and soil condition has been degraded; <65% of the reach has sufficient soil to hold onto water and act as a rooting medium.

Stream bank Stability: Both stream banks are moderately unstable; 40% of the left and 50% of the right bank has areas of erosion. Vegetation removal or alteration on each bank has necessitated bank armoring to prevent further erosion, without which, the percentage of eroding banks would be greater.

Floodplain characteristics: An inadequate amount of large rock, large woody debris, and riparian vegetation is available to accomplish energy dissipation and sediment capture. Consequently, there is little evidence of sediment capture, stream bank erosion occurs due to human disturbance, and head cuts occur where overland flow returns to the main channel.

Weedy and undesirable species: Noxious weeds occur on over 10% of the riparian area. Weedy species include cheatgrass, bastard toadflax, Canada thistle, common burdock, common tansy and oxeye daisy. Undesirable plant species occur on over 15% of the riparian area and include pasture grasses and Kentucky bluegrass.

Wildlife considerations

Instream: Unnaturally low base flows reduce the amount of habitat available to aquatic wildlife. At base flow, water fills only 60% of the channel and riffle substrates are frequently exposed. Epifaunal substrate and fish cover is suboptimal and limits aquatic wildlife potential; snags or submerged logs are few, undercut banks and deep pools are rare and in many areas the cobble substrate is frequently disturbed. Thus, although riffles are frequent, habitat variety is decreased and provides limited potential for fish and invertebrates.

Riparian: Habitat degradation by hydrologic alteration at the historic townsite of Janeway limits wildlife potential by reducing the quality, abundance and variety of available resources. Vegetation is dominated by drought tolerant upland species and noxious weeds – potato cactus thickets are ubiquitous across the 300 m wide floodplain, and habitat structure is greatly simplified. However, the lack of human disturbance is apparently a benefit that outweighs the degraded condition of the habitat; elk and mule deer frequent the area throughout the year, bighorn use this area for critical winter range, coyote and fox sign was abundant and breeding bird richness was much greater than expected, although abundances were low.

The mid-section of the reach, where healthy riparian forest thrives, provides wildlife with a diversity of high-quality resources and relative lack of human disturbance. Conversely, developed areas have eliminated resources and introduced disturbance, both factors that reduce wildlife potential.



**Above: Downcutting and erosion occur where riparian vegetation has been removed.
Below: Corrals on the stream bank are a source of nutrient and sediment pollution.**

Management Recommendations:

- Restore the USFS property at the top of the reach (historic Janeway townsite) to a functional stream ecosystem; although this area is severely degraded by hydrologic alteration, the area has the potential to provide important habitat for native wildlife, especially in its current human-disturbance-free condition.
 - Enable overbanking flows
 - Remove the old railroad grade to enable floodplain inundation
 - Restore meanders
 - Increase the variety of instream habitat with large woody debris such as root wads
 - Revegetate stream banks and the riparian zone with appropriate native plant species
 - Maintain the area free of recreational trails and human disturbance
 - Reintroduce beaver
- Stabilize eroding banks with appropriate native vegetation.
- Revegetate ripped banks.
- Weed eradication is essential to restore stability to this reach.



Cottonwood forest thrive on the lower part of the reach on the right bank where overbanking flows recharge soil moisture.

General Characteristics

Location CR2-7: N39 15.299/W107 14.028; 39 16.362/107 13.517. **Elevation:** 6767'. **Life Zone:** Upper Sonoran.

Ecosystem: Upper – Ponderosa- Rocky Mountain juniper forest/mountain mahogany-bitterbrush shrubland.

Lower – Cottonwood-spruce forest.

Watershed Features: predominant surrounding land use – Forest and Residential; local watershed NPS pollution – obvious sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Narrowleaf cottonwood, ponderosa pine, blue spruce, river birch, coyote willow, red-osier dogwood. Upland – Douglas fir forest/pinon-juniper woodland/oak shrubland mosaic.

Instream Features: stream width – 47 m; stream depth – 0.80 m; canopy cover – 10%; high water mark – 0.40 m; stream morphology types – riffles 40%, pools 15%, runs 45%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: periphyton: estimated abundance – 2 (common).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – none & normal; oils – absent; deposits – silt; undersides of stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 15; cobble 50; gravel 15; sand 10; silt 10; clay 0.

Organic Substrate Components %: detritus (CPOM) <5; muck-mud (FPOM) 0; marl 0.

Assessment Data

EPA Habitat Assessment Score: 105/200.

NRCS Habitat Assessment Score: left bank – 27/61; right bank – 27/61.

Weedy species: cheatgrass, bastard toadflax, Canada thistle, common burdock, common tansy, oxeye daisy.

Disturbance-caused undesirable plants: Kentucky bluegrass, pasture grasses including smooth brome, squirreltail, potato cactus.

Dominant Native Riparian Vegetative Species:

Trees: narrowleaf cottonwood, ponderosa pine, Colorado blue spruce, box elder, Douglas fir, Rocky Mountain juniper, pinyon pine.

Shrubs: river birch, thinleaf alder, Rocky Mountain maple, red-osier dogwood, coyote willow, dusky willow, silverberry, river hawthorne, bitterbrush, mountain mahogany, sagebrush, 3-leaf sumac, Wood's rose, snowberry.

Grasses and Forbs: indian ricegrass, needle & thread, fringed sage, snakeweed, star solomonplume, aster spp., senecio sera, wild strawberry, whiplash erigeron, blue-eyed mary, gilia, flax, dusty maiden, yarrow.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - L; Maint. Lawns - L; Roads
M; Bridges/Culverts - L.

Recreational: Hiking trails - L

Agricultural: Livestock use - L; Pature - L; Water
withdrawal - L.

Stream management: Angling - L; Channelization - H;
Water fluctuation - H.

Other Human Influences:

Nutrient enrichment: fairly clear or slightly greenish, moderate algal growth on substrate.

Barriers to fish movement: none.

Manure presence: evidence of livestock access to riparian zone.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

Beaver: beaver sign – historic - common, current - absent; flow modification – none.

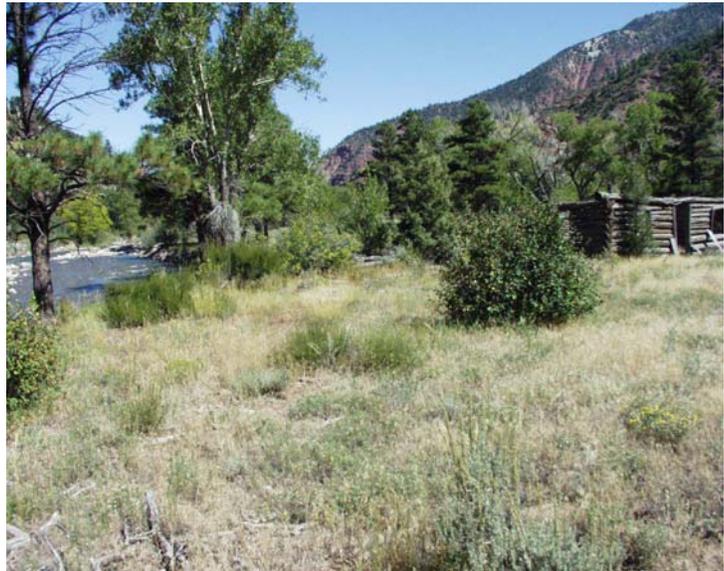
Dominant Land Use – forest; forest age class 25-75 years.

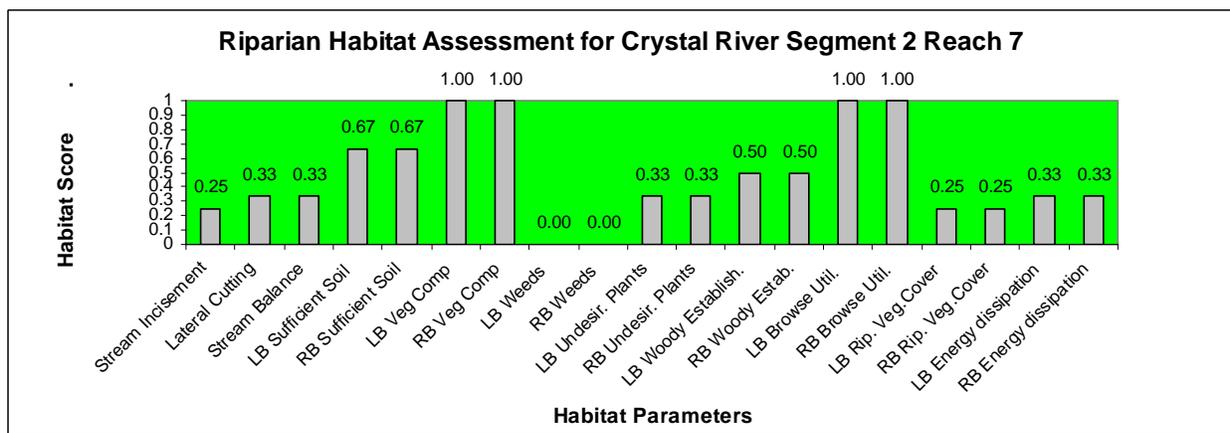
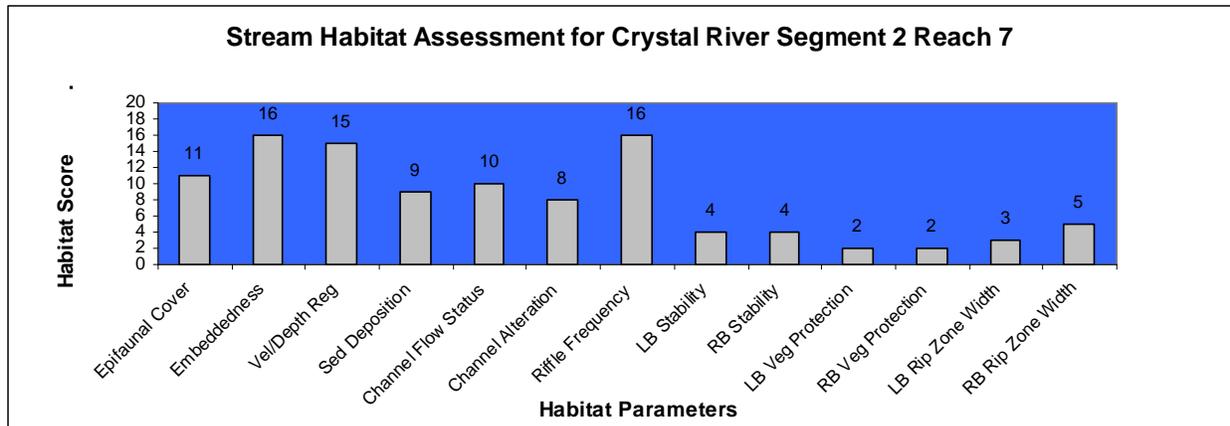
Functional Rating: not sustainable, but recovery is possible with hydrologic restoration.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 12/31/0 indicating potential water quality impairment.
- One American dipper was observed in the survey area indicating insufficient resources.
- A survey of the breeding bird community recorded 37 individuals in 25 species for a biodiversity score of 3.147 and an evenness score of 0.872. Included were riparian species such as MacGillivray's warbler as well as upland species such as Townsend's solitaire, sensitive species such as Lewis's woodpecker and non-native invaders such as European starlings. Relatively high species richness in combination with somewhat low abundance and the disparate nature of the bird community indicate a disturbed habitat that has the potential to become an important wildlife refuge if hydrologic restoration were to occur.
- Estimated abundance of periphyton was "2" (common) indicating appropriate levels of nutrient enrichment. However, isolated algal blooms were observed downstream of nutrient sources such as corrals indicating nutrient enrichment.

At the Janeway townsite, lack of overbanking flows has resulted in drying soils with a consequent change in the plant community to one that is characterized by drought-tolerant species such as bitterbrush, mountain mahogany and sage.





Crystal River Segment 2, Reach 8.

Habitat Condition: Stream – heavily modified; LB/RB Riparian – heavily modified/heavily modified.
Stream Class (Rosgen) – B2. Stream Order – 4th. Reach Length – 5.73km.

Summary

Hydrologic considerations

Channel Condition: Highway 133 on the left bank and a railroad grade and home development on the right bank channelize the entire reach. Additional channelizing alterations include water diversions, 4 bridges, numerous culverts, and severely altered stream bank and riparian vegetation. Channelization is consequently extensive; both banks are riprapped with boulders along 65% of the left bank and 46% of the right bank with commensurate vegetation degradation along these riprapped sections as well as up- and downstream of riprapped areas. Channelization impacts include channel straightening, reduced variety of instream habitat, increased gradient, increased entrenchment with consequent isolation of the floodplain from its connection with the stream.

Instream heterogeneity: Stream habitat heterogeneity is decreased as a result of channel alterations. Sinuosity (1.03) is less than appropriate for the stream class and landscape. Stream morphology is dominated by runs that are interspersed with short but frequent riffles. Pools are rare. Thus although all four velocity/depth regimes occur, representation is uneven; a fast-deep regime occurs on 50% of the reach, fast-shallow on 30%, slow-deep on 10% and slow-shallow on 10%.

Hydrologic Alteration: Instream diversions contribute to dewatering and somewhat reduced base flows. But, because the channel is confined and entrenched, width/depth ratio (20/1) is only slightly excessive and water fills 85% of the channel. Bank-full flows occur regularly with snowmelt. However, due to highway and railroad grade-induced entrenchment, overbanking occurs on <50% of the reach and inundation of the entire floodplain probably never occurs.

Vegetated width of the riparian zone is reduced compared to the historical width over the entire length of the reach, thereby reducing water storage potential that would otherwise help sustain late season base flows. Recent beaver sign was absent but historic sign was common.

Stream balance / Erosion – deposition: Excessive stream bank erosion has resulted in excess sedimentation over the entire reach. Old downcutting is evident but has begun stabilizing as evidenced by riparian vegetation that is establishing at the base of failing banks and within the incised channel. However, a moderate amount of active human-induced lateral bank erosion currently occurs. Consequently bedload is excessive with regard to the amount of water in the channel resulting in stream imbalance. Impacts include deposition of fine sediment on point bars, point bar enlargement and moderate deposition and filling of pools.

Upland contribution to degradation

On the right bank pastures and housing development with related roads and lawns result in decreased precipitation infiltration and excessive runoff that is laden with pollutants and fertilizers. The highway fragments upland and riparian habitat, interrupts ground water discharge, contributes road-based pollutants to the stream and is a lethal barrier to wildlife attempting to migrate between upland and stream ecosystems.

Vegetation considerations

Riparian Zone: Native riparian habitat on this reach is characterized by narrowleaf cottonwood-blue spruce forest with point bars and mid-channel islands dominated by coyote willow, alder and birch. Functional riparian zone width has been reduced by the highway on the left bank and by the railroad grade on the right bank, which also



Above: The highway grade on the left and railroad grade on the right bank channelize and simplify >50% of the reach.

Below: Unchannelized sections of the stream have a good variety of velocity/depth regimes that create runs, riffles and pools.

intermittently dissects the floodplain. Left bank zone width is <3 m on 70% of the reach but >12 m on 30%; right bank zone width is <3 m on 60% and >12 m on 40% of the reach.

Although both a diverse age-class distribution and a diverse composition of riparian vegetation are present, abundance is reduced and distribution is sporadic, which then limits ecosystem functions. Patches of healthy and functional riparian habitat is interspersed with severely degraded habitat, with the majority of the reach being severely degraded. Healthy riparian habitat is present on 30% of the left and 40% of the right bank; degraded riparian habitat occurs on 70% of the left and 60% of the right bank. Additionally, where the floodplain is no longer directly connected to the river due to the railroad grade, soils are drying and vegetation composition is changing to a more drought tolerant community with species such as box elder replacing species such as narrowleaf cottonwood.

Overall tree cover totals 20% on each bank and is comprised of three layers. Dominant tree species include narrowleaf cottonwood, Colorado blue spruce, ponderosa pine and box elder. Shrub cover on each bank is comprised of three layers and totals 20% on the left bank and 25% on the right bank. Dominant shrub species in the upper shrub layers include river birch, thinleaf alder, silverberry, Rocky Mountain maple and cottonwood. Lower shrub layers are dominated by river hawthorn, coyote willow, dusky willow, red-osier dogwood, twinberry, 3-leaf sumac and Wood's rose. Herbaceous cover averages 20% on the left and 30% on the right bank. Low herbaceous cover is due to large areas of stream bank that are rippapped with boulders where little vegetation grows. Higher percent cover on the right bank is due to lawns that replace riparian vegetation and frequently accompany home development.

Overall, native vegetation covers <50% of stream bank surface with patches of bare soil and closely cropped vegetation common. Thus, although sufficient kinds of native plant species are present to stabilize soil and hold onto water, abundance and distribution is inadequate to accomplish these functions; only 55-65% of the riparian canopy cover has a stability rating >6.

Stream bank Stability: Vegetation stabilizes 30% of the left bank. The remaining 70% of the left bank has been altered by highway channelization and home development. Half of the altered area has been stabilized with riprap such as boulders or marble and is not eroding; devegetated areas that are not rippapped are eroding. Thus, the left bank is moderately stable with 30-35% of the banks eroding. Riprap does not effectively dissipate stream energy, so although rippapping stabilizes those banks where it is installed, downstream banks are negatively impacted by the increased stream energy that results from upstream rippapping and are eroding.

Approximately 40% of the right bank is well-vegetated with native riparian plant species and stable; 16% of the right bank is degraded by lawns and pastures that come to the stream edge; and 44% is downcut and eroding due to railroad grade impacts. Altogether >44% of the right stream bank is unstable and eroding with high erosion potential during flood events.

Floodplain characteristics: Floodplain area is limited and characteristics are inadequate to dissipate energy. Overflow channels are few and although large rock, woody debris and riparian vegetation are present, quantity and quality are insufficient to adequately dissipate energy or trap sediment.

Weedy and undesirable species: Noxious weeds are abundant and occur on up to 10% of the riparian area. Weedy species include common tansy, oxeye daisy, yellow sweetclover, houndstongue and Canada thistle. Undesirable species occur on 10% of the left bank and 15% of the right bank. Undesirable plant species include pasture grasses and Kentucky bluegrass.



Above: Along natural sections of the reach, riparian vegetation is species rich and structurally complex. Below: Marble riprap destroys stream bank habitat and increases stream energy in the downstream direction.

Wildlife considerations

Instream: Flows are adequate year around to provide a sufficient amount of habitat for aquatic wildlife. However, reduced variety of instream habitat limits aquatic wildlife potential. Characteristics that are essential to fish survival such as deep pools, overhanging vegetation, and backwater pools are rare. Characteristics that provide important substrate for macroinvertebrate colonization such as large and fine woody debris, submerged logs, leaf packs and undercut banks are also rare. Boulder, cobble and gravel are abundant, and only slightly to moderately embedded (20-25%) and so provide some macroinvertebrate habitat.

Riparian: Small, isolated pockets of good quality riparian habitat provide some opportunity for wildlife. However the level of human disturbance is high throughout the reach and the highway is a lethal barrier for both mammals and birds attempting to access the stream. Additionally, even those riparian areas that are owned and managed as Open Space by Pitkin County are degraded by hydrologic alteration with consequent changes in plant community composition. In many areas along this reach riparian vegetation is being replaced by drought tolerant upland vegetation.

Management Recommendations:

- Highway- and railroad grade-induced channelization fragment the historic floodplain; riparian habitat that is isolated from flooding flows is drying with resultant plant community alteration to domination by upland species; restore the hydrological connection between the river and the floodplain.
- Stream bank erosion and consequent excessive sedimentation impact the entire reach;
 - Revegetate stream banks along the highway and railroad grade.
 - Encourage homeowners to restore native riparian vegetation to stream bank habitat.
 - Enforce riparian vegetation and homebuilding setbacks
- Throughout this watershed good quality riparian habitat is in short supply;
 - Manage remaining good quality habitat for wildlife
 - Minimize human disturbance
- Highway 133 isolates upland from stream ecosystems and is a lethal barrier for wildlife;
 - Provide wildlife appropriate underpasses and or overpasses.
 - Enforce the speed limit.
 - Install “wildlife-crossing” warning lights.
- Weed management is essential to restore the integrity of the stream ecosystem.



Above: Small pockets of good quality riparian habitat provide some wildlife potential.
Below: Highway 133 degrades stream and riparian habitat and is a lethal barrier to wildlife attempting to access the stream.

General Characteristics

Location CR2-8: N39 16.362/W107 13.517; 39 19.066/107 12.613.

Elevation: 6650'. **Life Zone:** Upper Sonoran.

Ecosystem: Cottonwood-box elder-blue spruce riparian forest.

Watershed Features: predominant surrounding land use – Forest, Field/Pasture, Residential; local watershed NPS pollution – obvious sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Narrowleaf cottonwood, Colorado blue spruce, box elder, thinleaf alder, river birch, coyote willow, red-osier dogwood. Upland – Douglas fir/ oak shrubland /pinon-juniper mosaic.

Instream Features: stream width – 24 m; stream depth – 1.2 m; canopy cover – 0%; high water mark – 0.70 m; stream morphology types – riffles 30%, pools 10%, runs 60%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: periphyton: estimated abundance – 2 (common).

Water Quality: water odors – normal; water surface oils – none; turbidity – slightly turbid.

Sediment/Substrate: odors – normal; oils – absent; deposits – sand; undersides of unembedded stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 35; cobble 30; gravel 15; sand 10; silt 10; clay 0.

Organic Substrate Components %: detritus (CPOM) 0; muck-mud (FPOM) 0; marl 0.

Assessment Data

EPA Habitat Assessment Score: 121/200.

NRCS Habitat Assessment Score: left bank – 38/61; right bank – 37/61.

Weedy species: common tansy, oxeye daisy, yellow sweetclover, houndstongue, Canada thistle.

Disturbance-caused undesirable plants: pasture grasses, Kentucky bluegrass.

Dominant Native Riparian Vegetative Species:

Trees: narrowleaf cottonwood, Colorado blue spruce, ponderosa pine, box elder.

Shrubs: river birch, thinleaf alder, coyote willow, dusky willow, red-osier dogwood, twinberry honeysuckle, silverberry, river hawthorn, 3-leaf sumac, Wood's rose, common juniper,.

Grasses and Forbs: equisetum spp., sedge and rush spp., aster spp., solidago spp., star solomonplume, goldeneye, wild licorice, virgin's bower.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - M; Maint. Lawns - M; Bridges/Culverts M.

Recreational: Trails – M.

Agricultural: Pasture - M; Irrigation equipment - M; Water withdrawal - M.

Stream management: Angling - L; Channelization - H.

Other Human Influences:

Nutrient enrichment: fairly clear or slightly greenish, moderate algal growth on stream substrates.

Barriers to fish movement: none.

Manure presence: evidence of livestock access to riparian zone.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

Beaver: beaver sign – historic - common, current - absent; flow modification – none.

Dominant Land Use – rural; forest age class 25-75 years.

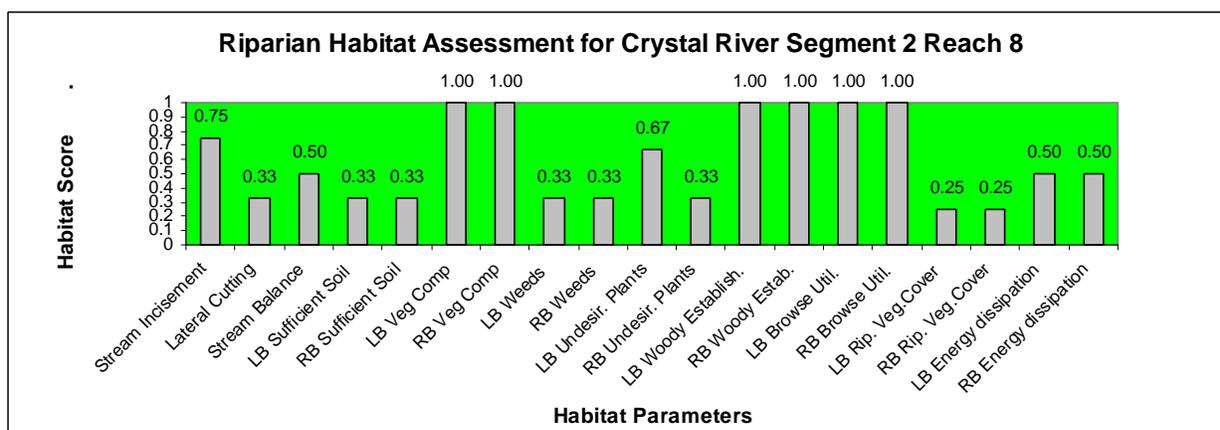
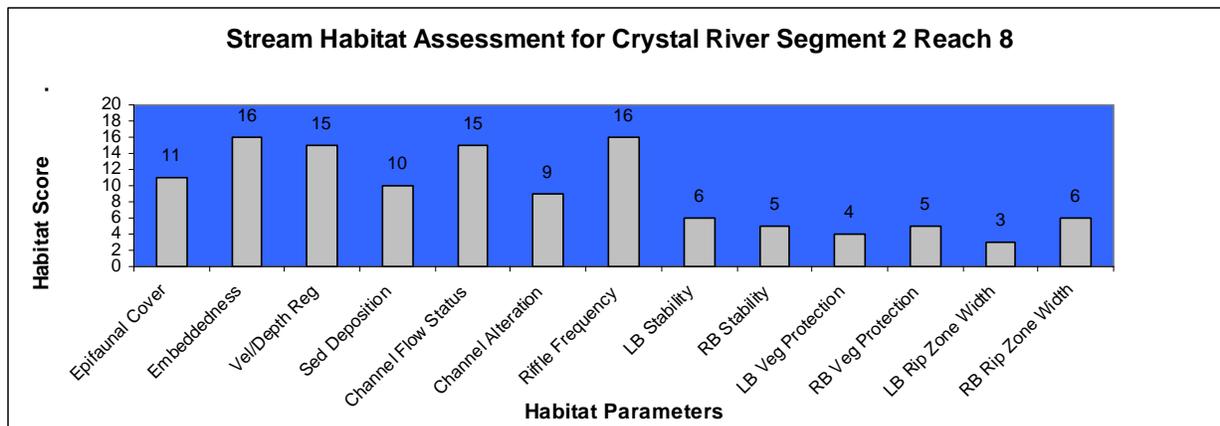
Functional Rating: at risk, trending downward without immediate management.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 28/41/0 indicating potential water quality impairment.
- 3 American dippers were observed in the survey area indicating the presence of sufficient resources. Active dipper nests were found built into banks that had been historically ripped with boulders but were revegetating and now protected by dense overhanging vegetation.
- A survey of the breeding bird community recorded 49 individuals in 17 species for a biodiversity score of 2.533 and an evenness score of 0.656. Relatively low abundance and richness scores in combination with community assemblage indicate habitat impairment.
- Estimated abundance of periphyton was “2” (common) and filamentous algae “1” (rare) indicating appropriate levels of nutrient enrichment.



A large diversion (bank-full width = 9m) contributes to dewatering and channelization.



Left: Channelizing impacts of the highway include simplification of stream habitat. Run habitat dominates the velocity/depth regime.

Right: Disturbed habitats that are common in this stream corridor select for wildlife species that are tolerant of disturbance and of human activity. Raccoon tracks were the most frequently observed mammal sign along this reach.

Crystal River Segment 2, Reach 9.

Habitat Condition: Stream – Severely degraded; LB/RB Riparian – severely degraded/severely degraded.
Stream Class (Rosgen) – C2. Stream Order – 4th. Reach Length – 7.43km.

Summary

Hydrologic considerations

Channel Condition: At the top of this reach the stream comes out of a narrow canyon to enter a wide valley. Historically, the stream meandered widely across the low-gradient floodplain. Now, due to historic and ongoing ranching and agricultural activities the stream is channelized, downcut and confined to a narrow corridor. Additional channelizing impacts result from numerous large and small irrigation diversions, housing and commercial development and highway development. Consequences to the channel from these activities include straightening, entrenchment, and structural simplification of instream habitat.

A few areas of the channel along this reach are unaltered and in good condition. These functional areas of the channel correspond to areas of intact riparian habitat. Channel condition is also improving along areas where new riparian benches are forming within the incised channel.

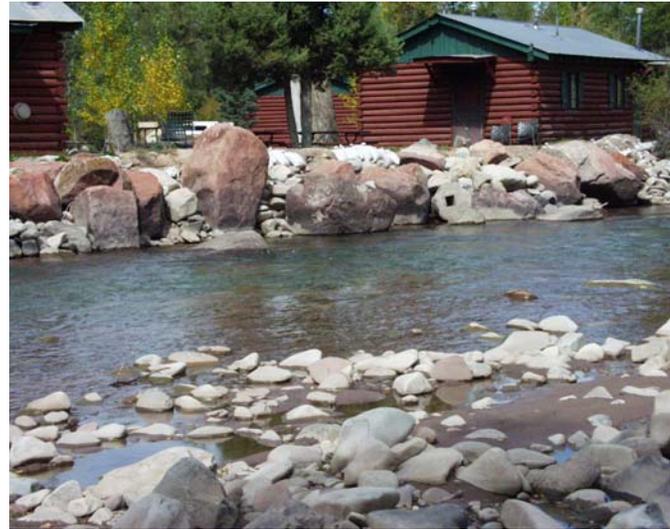
Instream heterogeneity: Channelization impacts have reduced the variety of instream habitat. Both horizontal sinuosity and vertical structural diversity has been reduced. Channel straightening occurs over the entire reach but is greatest on the lower 35% of the reach where sinuosity has been reduced to 1.03 while sinuosity on the upper 65% of the reach is 1.08; appropriate sinuosity for this landscape and stream class is >1.2. Vertical stream morphology is dominated by runs and riffles with very few pools. Consequently, although all four velocity/depth regimes are present, representation is uneven: a fast-deep regime occurs on 40% of the reach, fast-shallow on 50%, slow-deep on 5% and slow-shallow on 5%. Thus, although riffles are frequent habitat variety is diminished.

In contrast, the development of a few well-vegetated islands has increased the variety of instream habitat. Irregular shaped island edges contribute to the creation of pools and riffles. Deep pools have also developed in the lee of the islands and behind logs and snags that have been deposited on these island shores.

Hydrologic Alteration: Erosion-induced stream widening and irrigation-induced dewatering result in a width/depth ratio that is inappropriately high (44/1). Channel straightening has resulting in a steeper stream gradient. Although bank-full flows occur regularly with spring runoff, overbanking only occurs along 32% of the reach. Due to downcutting and riprapping, overbanking flows are prevented from accessing the floodplain on 68% of the reach.

Width of the riparian zone that is vegetated with native riparian plant species is reduced on 80% of the reach. Beaver activity, although historically abundant, is currently rare and does not contribute to flow modification. The combined effects of vegetation degradation, reduced overbanking and a lack of beaver activity have likely reduced ground water recharge. Because late season base flows are at least partly dependant on ground water discharge to maintain sustainable flows, alteration of these characteristics impacts base flow.

Stream balance / Erosion – deposition: Areas of old downcutting are stabilizing, as evidenced by the presence of vegetated riparian benches that are developing at the base of downcut banks. However, active



Top: A commercial campground has built into the riparian zone and onto the left bank necessitating riprapped stream banks to prevent flooding but channelizing the stream in the process.

Bottom: Agricultural alteration of riparian and bank vegetation has resulted in bank erosion, sedimentation, and channel straightening.

downcutting and lateral erosion continue to occur on this reach. Stream balance has been negatively affected by excess sediment that results from bank instability. In combination with dewatering due to diversions, stream widening and excess sedimentation result in stream imbalance. Consequences include deposition that affects 50% of the stream bottom and is filling pools with sediment.

Upland contribution to degradation

Upland pastures and agricultural activities contribute to excess stream nutrients and pollutants via contaminated ground water and runoff. Home development removes water from the system and contributes to excess runoff and reduced infiltration.

Vegetation considerations

Riparian Zone: Native habitat is characterized by cottonwood forests. However, a variety of human developments impact both the character and extent of the riparian habitat. Habitat altering impacts include agriculture and grazing, highway and roads, homes, and campgrounds. As a consequence of these activities width of the riparian zone that is vegetated with native plants is reduced over the entire reach resulting in habitat loss and decreased riparian function. Potential vegetated riparian zone width is >20 m and up to > 200 m. Actual vegetated width is 12-18 m on 17% of the left and 35% of the right bank; 6-12 m on 43% of the left and 32% of the right bank; and 0-6 m on 40% of the left and 33% of the right bank.

Although a diverse composition of native trees and shrubs is present, the age-class distribution of trees and shrubs is uneven with minimal cottonwood recruitment on >80% of the reach. The tree stand is comprised mainly of mature or decadent individuals with two age classes, seedlings and saplings, mostly missing on >80% of the reach. Narrowleaf cottonwood defines the ecosystem type and structures the riparian, stream bank and channel conditions. Without cottonwood recruitment, dying individuals are not replaced and the ecosystem undergoes alteration with changes to riparian-stream system functions sure to result. Plant community composition is changing to become dominated by facultative riparian species that do not require a natural flooding regime and to upland species that are tolerant of drying soils. Additionally, without a good distribution of age classes of varying heights, structural diversity is also decreased and riparian habitat is simplified.

Tree cover on each bank is comprised of two layers with a total cover 10% on the left and 15% on the right bank. Dominant tree species on each bank are similar. The upper tree layer contributes 5% cover on each bank and is dominated by narrowleaf cottonwood and Colorado blue spruce; the lower layer contributes 5% cover on the left and 10% cover on the right bank and is dominated by cottonwood and box elder.

Shrub cover is similar on each bank and is comprised of three layers with a total cover of 34%. Similar species dominate on each bank. The upper shrub layer contributes 8% cover and is dominated by river birch and thinleaf alder; the middle layer contributes 16% cover and is dominated by coyote willow, twinberry honeysuckle, river hawthorn and silverberry; the lower layer contributes 10% cover and is dominated by coyote willow, Wood's rose, 3-leaf sumac and red-osier dogwood. Herbaceous cover is high at 50%, and is variably dominated by either pasture grasses in agricultural areas or, in natural areas, by native herbs including horsetail species, and sedge and rush species.

Overall, native vegetation covers approximately 60% of stream bank surfaces on the left and 67% on the right bank. Although sufficient kinds of bank stabilizing vegetation occur on each bank to stabilize soil and hold



Above: In grazed pastures only a narrow riparian zone remains of a once likely hundreds meter wide riparian zone.

Bottom: Riparian vegetation is in good condition on the right bank where grazing does not occur. Fencing protects only a narrow strip of the left bank from overgrazing.

onto water, abundance and distribution are insufficient to accomplish these functions; only 55-65% of the riparian canopy cover has a stability rating >6.

Soil in areas where native riparian vegetation is absent or degraded has been lost to erosion. Road cuts, overgrazing and lawns that replace native vegetation have resulted in <65% but >35% of the reach with sufficient soil to hold water and act as a rooting medium.

Stream bank Stability: Banks are moderately unstable. Erosion occurs on 40-50% of banks in the reach with high erosion potential during flood events. Raw areas and patches of bare soil are frequent along straight sections and bends.

Floodplain characteristics: Channelizing alterations have reduced the areal extent of the floodplain and altered habitat characteristics so sediment trapping and energy dissipation functions are inadequate. Overflow channels are few, large rock, woody debris and riparian vegetation have been diminished and the irregular, scalloped-shaped stream banks that result from a sinuous channel and that help dissipate energy have been straightened.

Weedy and undesirable species: Noxious weeds are present on up to 5% of the reach and include plumeless thistle, houndstongue, oxeye daisy, and yellow sweetclover. Undesirable plants species are present on >15% of the reach and are primarily pasture grasses, alfalfa, and Kentucky bluegrass.

Wildlife considerations

Instream: Wildlife potential is limited by reduced base flows, habitat simplification, reduced canopy cover and degraded stream substrate. Base flows, and consequently aquatic habitat, is depleted by numerous large and small irrigation withdrawals so that water fills only 70% of the available channel. Fish cover is reduced due to the rarity of deep pools, woody debris, overhanging vegetation and undercut banks. Macroinvertebrate substrate is abundant but degraded by fine sediment that embeds cobble and gravel by up to 35%.

Riparian: Wildlife potential is limited by habitat loss and conversion to agriculture and housing development, highway-induced fragmentation and human disturbance. Hydrologic alteration has contributed to the degradation of the remaining patches of native riparian habitat and eliminated the likelihood of long-term sustainability or recovery. Cottonwood forests are dependent on a natural hydrologic regime for seedling establishment and regeneration. The current cottonwood stand is dominated by mature and decadent individuals with few recruits. Long-term cottonwood forest sustainability is dependent on recruitment. Thus the hydrologic regime must be restored to enable habitat maintenance.

Impacts of hydrologic alteration to riparian habitat-dependent wildlife include loss of bald eagle winter roosting habitat provided by large cottonwood trees. Long-term conservation of eagles, and other wildlife that depend on these cottonwood forests, depends on a natural hydrologic regime that enables cottonwood recruitment.

Grazing is excessive and has eliminated most palatable shrubs, including cottonwood and willow seedlings and saplings. Most of the remaining shrubs have a clubbed growth form or are "high-lined". To accomplish system restoration, sustainable riparian grazing management must occur in combination with reestablishment of a natural hydrologic regime and requires adequate grazing setbacks.

Management Recommendations:

- Restore a natural hydrologic regime including maintaining sustainable base flows.
- Revegetate stream banks and riparian areas with native vegetation.
- Use sustainable cattle grazing management practices to improve riparian habitat.



Top: Banks are sloughing where weeds dominate bank vegetation.

Bottom: Some forms of human development benefit wildlife such as bridges which make good nest sites for American dippers.

- Increase riparian grazing setbacks and enforce development setbacks.
- In those areas where cattle are not adequately fenced away from the stream, install an enclosure fence to keep cattle a minimum of 50 m away from the riparian zone and stream banks,
- Pastures on either side of the highway result in an especially lethal condition for wildlife that is attracted to the forage and the stream;
 - Install wildlife crossing warning lights that are activated when wildlife cross the highway,
 - Install appropriate underpasses in known wildlife crossing areas.

General Characteristics

Location CR2-9: N39 19.068/W107 12.613; 39 22.545/107 12.159.

Elevation: 6410'. **Life Zone:** Upper sonoran.

Ecosystem: Cottonwood-box elder riparian-blue spruce riparian forest.

Watershed Features: predominant surrounding land use – Field/Pasture, Residential; local watershed NPS pollution – obvious sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Narrowleaf cottonwood, Colorado blue spruce, box elder, river birch, willow, silverberry, hawthorn, red-osier dogwood. Upland – Douglas fir/ oak shrubland /pinon-juniper mosaic.

Instream Features: stream width – 31m; stream depth – 0.70 m; canopy cover – 0%; high water mark – 0.70 m; stream morphology types – riffles 50%, pools 10%, runs 40%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: periphyton and filamentous algae: estimated abundance – 3(abundant).

Water Quality: water odors – cattle; water surface oils – none; turbidity – slightly turbid.

Sediment/Substrate: odors – cattle; oils – absent; deposits – sand, silt; undersides of stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 20; cobble 50; gravel 10; sand 10; silt 10; clay 0.

Organic Substrate Components %: detritus (CPOM) >10; muck-mud (FPOM) 0; marl 0.



Bank vegetation is degraded and stream banks are destabilized by housing that is located too close to the stream.

Assessment Data

EPA Habitat Assessment Score: 115/200.

NRCS Habitat Assessment Score: left bank – 27/61; right bank – 27/61.

Weedy species: houndstongue, oxeye daisy, plumeless thistle.

Disturbance-caused undesirable plants: Kentucky bluegrass, clover, brome, orchard grass.

Dominant Native Riparian Vegetative Species:

Trees: narrowleaf cottonwood, Colorado blue spruce, box elder.

Shrubs: river birch, thinleaf alder, coyote willow, dusky willow, mountain willow, red-osier dogwood, twinberry honeysuckle, silverberry, river hawthorn, 3-leaf sumac, Wood's rose,.

Grasses and Forbs: equisetum spp., virgin's bower, dogbane, aster spp., star solomonplume, solidago spp., wild licorice, broad-leaf cattail, woodrush, sedge and rush spp., milkweed spp..

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - M; Roads - L; Bridges/Culverts - M.

Recreational: Campground - H; Trash - M

Agricultural: Pasture - H; Livestock use - H; Irrigation equipment - H; Water withdrawal - H.

Stream management: Angling - L; Channelization - H; Water fluctuation - H.

Other Human Influences:

Nutrient enrichment: greenish water, overabundance of macrophytes, abundant algal growth.

Barriers to fish movement: seasonal withdrawals inhibit movement; drop structures, culverts, diversions > 1 foot within reach.

Manure presence: evidence of livestock access to riparian zone, manure in stream.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

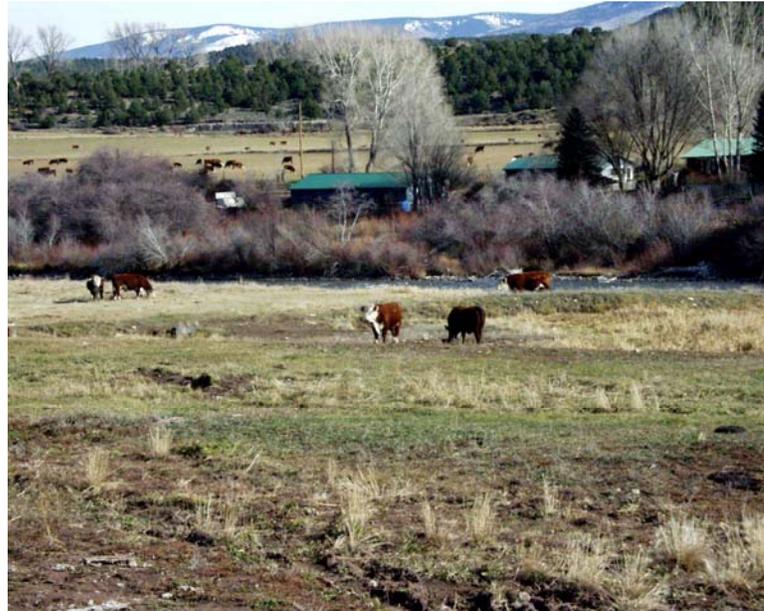
Beaver: beaver sign – historic - common, current - rare; flow modification – historic - major, current - minor.

Dominant Land Use – agriculture; forest age class >75 years.

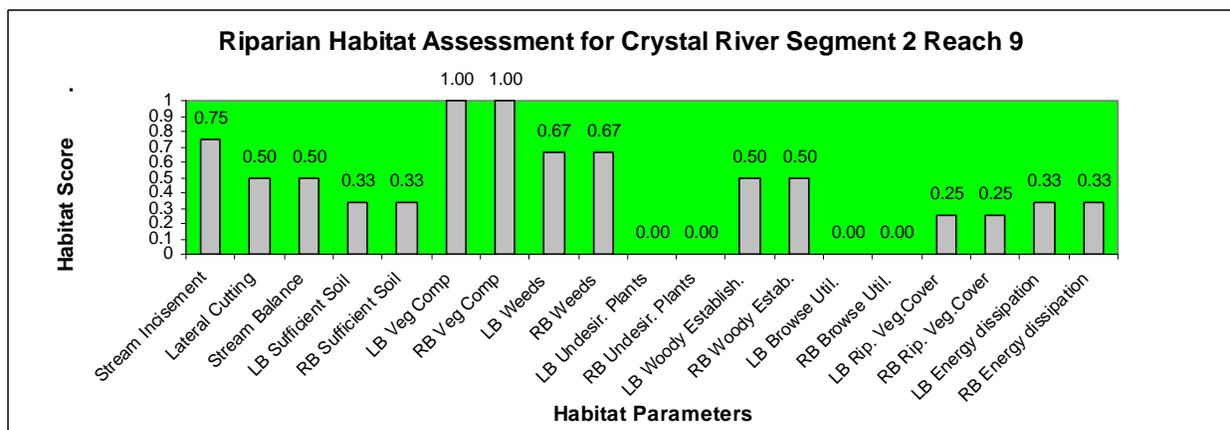
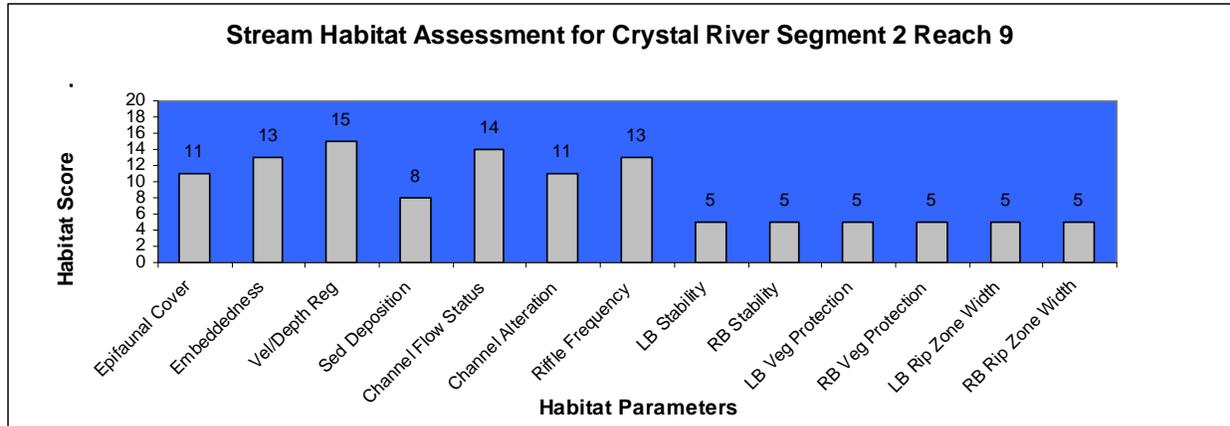
Functional Rating: not sustainable, trending downward.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 19/137/0 indicating potential water quality impairment.
- Two American dippers were observed in the survey area. Their nest was located under a bridge which provided one of the few possible nesting sites.
- A survey of the breeding bird community recorded 71 individuals in 27 species for a biodiversity score of 3.115 and an evenness score of 0.731. These scores indicate a fairly healthy riparian habitat. However, bird community assemblage reveals a disparate community composition that includes riparian-dependent species as well as habitat generalists, upland, and invasive species, thus indicating habitat disturbance.
- Estimated abundance of periphyton was “3” (abundant) and of filamentous algae was “2” (common) indicating excessive nutrient enrichment (at the bottom of the reach filamentous algae abundance increased to “3”).



Overgrazing in the riparian zone and grazing on stream banks has eliminated most riparian habitat functions and severely compromised stream water quality.



Left: The channel has been dredged to create a large irrigation diversion on the left. In the process, stream substrate has been disturbed and aquatic wildlife habitat destroyed.

Right: Riparian floodplain conversion to pasture has left only a narrow border of riparian vegetation. Little cottonwood recruitment occurs along this reach so these mature trees are not being replaced when they die.

Crystal River Segment 2, Reach 10.

Habitat Condition: Stream – Heavily modified; LB/RB Riparian – Heavily modified/heavily modified.
Stream Class (Rosgen) – F3. **Stream Order** – 4th. **Reach Length** – 6.34 km.

Summary

Hydrologic considerations

Channel Condition: Historically, this reach was dominated by cottonwood forests. Later, agriculture and ranching became commonplace and now a variety of development scenarios impact 72% of the reach with the remainder continuing to be managed as agricultural land. Consequently, a variety of impacts contribute to channel alteration. Agriculturally-induced riparian degradation has resulted in channel straightening, downcutting, lateral erosion and the floodplain drying. Some recent development activities have continued these trends while others have resulted in restoration. Generally, the cumulative impacts of historic and recent development have degraded channel condition by resulting in a straighter, wider, and incised channel. However, undisturbed portions of the reach are recovering with new riparian areas forming within the incised channel and with the development of well-vegetated mid-channel islands.

Numerous and large irrigation withdrawals severely dewater the stream and in so doing diminish stream structuring functions. Thus, the ability to redevelop meanders or pools is impaired. Although relatively minor in comparison, other channelizing alterations include bridges and culverts.

Instream heterogeneity: Habitat variety is diminished over the entire reach. Channelizing impacts include a reduction in sinuosity with a consequent reduction in structural heterogeneity. Dewatering has also contributed to a loss of habitat variety. Natural flows make an important contribution to structuring a diverse stream habitat by scouring out pools and redistributing stream substrate. Dewatering has resulted in flows that are inadequate to perform stream structuring functions. Consequently, stream morphology is dominated by riffles and runs. Although all four velocity/depth regimes occur, representation is uneven: a fast-deep regime occurs on 48% of the reach, fast-shallow on 27%, slow-shallow on 19% and slow-deep on 5%.

Hydrologic Alteration: Numerous large and small irrigation diversions on the Crystal and on its tributaries dewater the stream. Consequently width/depth ratio is excessively high (44/1). Bank-full flows occur regularly with spring runoff but the flood plain is only inundated where downcutting does not occur or where a new riparian area is forming within the incised channel. Width of the riparian zone that is vegetated with native plants and functional is reduced over the entire reach. Consequently, runoff is increased but infiltration and ground water recharge is decreased. These hydrologic changes result in reduced in ground water storage with a consequent reduction in late season base flows.

Irrigation diversions not only in deplete stream flows but also alter the timing and pulse of flows. These hydrologic alterations impede cottonwood seedling establishment that requires a natural flooding regime and sufficiently moist soils. Throughout the reach cottonwood seedlings and saplings are typically present only on mid-channel islands that are inundated with flooding flows. Reduced cottonwood recruitment, in riparian habitat that has evolved with cottonwood as the determinant of the ecosystem, has set in motion the decline of functional riparian habitat.



Above: Only a narrow, dysfunctional remnant of a once wide cottonwood forest remains.

Below: Golf courses now dominate much of the riparian habitat. Without riparian vegetation, pollutants such as fertilizers and pesticides move unfiltered into the stream.

Stream balance / Erosion – deposition: The stream is downcut throughout the reach. However, in areas where disturbance from grazing has ceased and where development is set back from the stream bank, old downcutting has begun stabilizing and a process of “self-restoration” is occurring. This restoration process is occurring along the banks of the golf course where a setback has been established and up- and downstream of where 108 Road crosses the Crystal River where degraded ranchland is no longer grazed.

Currently active lateral erosion occurs on 24% of the left and 40% of the right bank. Eroding areas are associated with ongoing development that encroaches onto stream banks and corrals that are located in the riparian zone and on stream banks.

Bank erosion together with dewatering has resulted in stream imbalance; the amount of water in the stream is insufficient to effectively move sediment through the channel. Results include large mid-channel deposits of cobble and gravel, a moderate amount of deposition on point bars, 30-50% of the stream bottom affected by sedimentation, and cobble substrate 20-30% embedded by fine sediment.

Upland contribution to degradation

With rare exception, uplands are either severely degraded ranchland, heavily developed with golf courses and large homes that are spread out and engulf the uplands with severely altered habitat, or dense housing developments with bluegrass lawns. All of these types of development create less pervious surfaces that result in decreased precipitation infiltration and increased runoff, which also carries a panoply of pasture, lawn and road pollutants into the stream.

Vegetation considerations

Riparian Zone: Vegetated width of the riparian zone is decreased over the entire reach. Potential riparian width is typically >30 m but downcutting and development has reduced the functional width of the zone. Throughout the reach, soils in the historic riparian zone are drying due to downcutting and consequent lack of overbanking flows. Vegetation in the historic floodplain has changed to drought-tolerant upland species and noxious weeds. However, along sections of the reach a new riparian zone is forming within the incised channel and here the width of the riparian zone that is vegetated with native riparian plants is increasing. 64% of the left and 27% of the right bank has a vegetated riparian zone width of 10-18 m – these areas are typically newly formed riparian benches; 12% of the left and 16% of the right bank has a zone width of 6-10 m; and 24% of the left and 56% of the right bank has a zone width of <2 m – these areas are downcut and without a functional riparian area.

The historic plant community was characterized by narrowleaf cottonwood-Colorado blue spruce forest. Currently only remnant cottonwood-spruce forests remain. An agricultural-urbanized landscape has replaced most of the native habitat. A natural diversity of native tree and shrub species may be present but the age-class distribution of those woody species is dominated by mature and decadent trees and shrubs with seedlings and saplings generally absent or greatly reduced over much of the reach.

Tree canopy cover is comprised of three layers with a total cover of 15%; the upper layer contributes 10% cover and is dominated by narrowleaf cottonwood and Colorado blue spruce; the middle layer contributes <3% cover and is dominated by cottonwood, blue spruce and box elder; and the lower layer contributes <3% cover and is dominated by river birch, Rocky Mountain juniper and apple trees. Shrub cover consists of three layers and totals 30%. Shrub community composition is a mixture of riparian and upland species indicating habitat alteration. The



Above: At a designated natural area adjacent to the golf course weeds inundate the riparian zone and degrade habitat potential.

Below: An exception to riparian degradation occurs upstream of 108 Road where a wide riparian zone with a natural diversity and composition of native vegetation protects and contributes to the development of healthy stream habitat.

upper shrub layer contributes 5% cover and is dominated by river birch, thinleaf alder, Gambel oak and Rocky Mountain juniper; the middle layer contributes 15% cover and is dominated by mountain and coyote willow, silverberry, hawthorn, and Gambel oak; the lower layer contributes 10% cover and is dominated by red-osier dogwood, twinberry honeysuckle, Wood's rose, 3-leaf sumac and mountain sage. Herbaceous cover totals 80% with >60% of the herbaceous cover comprised of pasture grasses, weeds or introduced ornamentals.

Approximately 75% of stream banks on the left and 40% on the right are protected from erosion by native riparian vegetation. Although sufficient kinds of plant species are present to stabilize bank soil and hold onto water their abundance and distribution is inadequate to accomplish reach sustainability; < 65% of the riparian canopy cover has a stability rating >6.

Stream bank Stability: Historic agricultural activities resulted in bank erosion throughout the reach. Recent development activities have variably affected stream bank stability; some development activities have resulted in improved bank stability while other activities have continued or exacerbated agriculturally-induced instability. Consequently, the left bank is moderately stable with about 24% of the banks having areas of erosion while the right bank is moderately unstable with approximately 40% of the banks having areas of erosion.

Floodplain characteristics: Although habitat characteristics that accomplish energy dissipation and sediment trapping are present, abundance and quality is below that required to accomplish these functions. Riparian vegetation structure is simplified and reduced in density and areal extent, large woody debris and large rocks are infrequent, and no overflow channels are present to help dissipate energy or remove sediment.

Weedy and undesirable species: Weeds and undesirable plant species are ubiquitous throughout the reach and dominate the herbaceous cover. Noxious weed species include common tansy, houndstongue, curly dock, plumeless thistle, reed canarygrass, common burdock, Canada thistle, deadly nightshade, common mullein, cheatgrass, bull thistle and Russian olive. Undesirable plant species include Kentucky bluegrass, smooth brome, Dutch clover, orchard grass and red top.

Wildlife considerations

Instream: Aquatic wildlife potential is limited by dewatering, which has reduced available habitat. Decreased canopy cover has increased water temperature, and habitat simplification has eliminated essential foraging, breeding, resting and protected habitat. Habitat characteristics that provide these wildlife resources such as deep pools, large woody debris, overhanging vegetation, undercut banks and side channels are rare or absent. Although cobble substrate is abundant and potentially provides good macroinvertebrate colonization sites, cobbles are 20-30% embedded with fine sediment that degrades the resource.

Riparian: Historically, this landscape almost certainly provided essential breeding habitat for a large diversity of bird species and critical winter habitat for raptors, large herbivores and carnivores. Currently the landscape is urbanized and provides little opportunity for a sustainable natural community of wildlife. Although the restoration of historic populations has been eliminated, with appropriate stream and riparian management, opportunity still exists for some wildlife species.

In those areas where development has been set back from the stream bank and disturbance minimized, point bars have redeveloped and native plants have revegetated those areas. Here the restoration of a natural diversity of native plant species is not only helping to stabilize the stream but is also creating habitat for wildlife. With the establishment of cottonwood seedlings and saplings and native shrubs on riparian benches there is a greater diversity of plant species and a



Above: Stream habitat has been simplified by channelizing impacts that have resulted in channel straightening and widening and stream shallowing.

Below: Weeds that dominate habitat at the top of the bank do not have the capacity to stabilize soils, and erosion results.

more complex habitat structure – both factors enhance wildlife potential by creating a greater variety of foraging resources, nesting habitat and protected cover.

Breeding bird surveys indicate that this habitat is potentially valuable breeding habitat for a fairly large diversity of bird species including songbirds, raptors, and wading birds. Although species abundances were typically low the variety of bird species was high indicating the presence of appropriate habitat albeit in short supply. One unfortunate consequence of agriculture and urbanization is the presence numerous non-native bird species including brown-headed cowbirds, European starlings, house sparrows, and rock doves (city pigeons).

Management Recommendations:

- Restore a natural hydrologic regime with sufficient base flows.
- Establish riparian setbacks sufficient to allow a functional floodplain.
- Revegetate eroding banks with appropriate native plants species.
- Control weeds.
- Control and reduce point and non-point source nutrient inputs.

General Characteristics

Location CR2-10: N39 22.545/W107 12.159; to confluence with the Roaring Fork River.

Elevation: 6225'. **Life Zone:** Upper sonoran. **Ecosystem:** Cottonwood-spruce-bx elder riparian forest/golf/lawn.

Watershed Features: predominant surrounding land use – Field/Pasture and Residential; local watershed NPS pollution – obvious sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Narrowleaf cottonwood, Colorado blue spruce, box elder, river birch, thinleaf alder, silverberry, hawthorn, willow, red-osier dogwood, 3-leaf sumac. Upland – Pinon-juniper woodland.

Instream Features: stream width – 31m; stream depth – 0.70 m; canopy cover – 0%; high water mark – 0.5 m; stream morphology types – riffles 46%, pools 6%, runs 48%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: periphyton/filamentous algae: estimated abundance – 4 (dominant).

Water Quality: water odors – normal; water surface oils – none; turbidity – slightly turbid.

Sediment/Substrate: odors – normal; oils – absent; deposits – sand, silt; undersides of stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 10; cobble 55; gravel 15; sand 10; silt 10; clay 0.

Organic Substrate Components %: detritus (CPOM) 10; muck-mud (FPOM) 10; marl 0.

Assessment Data

EPA Habitat Assessment Score: 129/200

NRCS Habitat Assessment Score: left bank – 37/61; right bank – 37/61.

Weedy species: common tansy, houndstongue, curly dock, plumeless thistle, reed canarygrass, bull thistle, Canada thistle, common burdock, common mullein, cheatgrass, bittersweet nightshade, Russian olive.

Disturbance-caused undesirable plants: Kentucky bluegrass, timothy, Dutch clover, yellow sweetclover,



Above: Removal of riparian vegetation has also removed wildlife resources and an essential part of the stream ecosystem thereby eliminating the potential for functional habitat.

Below: Upstream of 108 Road, riparian vegetation is recovering from ranching degradation and provides good wildlife habitat.

orchardgrass, red top.

Dominant Native Riparian Vegetative Species:

Trees: narrowleaf cottonwood, Colorado blue spruce, box elder, ponderosa pine, apple.

Shrubs: river birch, silverberry, thinleaf alder, river and willow hawthorn, twinberry honeysuckle, red-osier dogwood, willow spp including coyote, mountain, and beaked, 3-leaf sumac, Wood's rose, mountain sage,.

Grasses and Forbs: equisetum spp., sedge and rush spp., virgin's bower, solidago spp, willowherb spp., green bog orchid, wild licorice, horse mint, aster spp., wild asparagus, woodrush, veronica spp., broadleaf cattail.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - H; Maintained Lawns - H; Pipes, drains - H; Roads - H; Bridges/culverts - H.

Recreational: Hiking trails - L

Agricultural: Livestock use - M; Pasture - M; Water withdrawal - H

Stream management: Angling - M; Channelization - H; Water fluctuation - H; Fish stocking - H

Other Human Influences:

Nutrient enrichment: greenish water, overabundance of macrophytes, abundant algal growth.

Barriers to fish movement: seasonal withdrawals inhibit movement.

Manure presence: evidence of livestock access to riparian zone.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 2/2.

Beaver: beaver sign – historic - common, current - rare; flow modification – none.

Dominant Land Use – suburban/pasture; forest age class – NA.



Riparian zone vegetated width has been decreased and is insufficient to adequately prevent nutrients from horse and llama corrals from moving into and polluting the stream with excessive nutrients.

Functional Rating: at risk; trend depends on future management of riparian habitat and hydrologic regime.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 61/50/0 indicating potential water quality impairment.
- One American dipper was observed in the survey area. A lack of nest sites, due to bank instability, likely accounts for their low abundance.
- A survey of the breeding bird community recorded 64 individuals in 29 species for a biodiversity score of 3.060 and an evenness score of 0.736.
- Estimated abundance of periphyton was “4” (dominant) and of filamentous algae was “3” indicating excessive nutrient enrichment.

Algal blooms occur where nutrient-rich effluent from fish hatchery ponds discharges into the stream.

