# STATE OF COLORADO


## Colorado Water Conservation Board
### Department of Natural Resources
1313 Sherman Street, Room 721
Denver, Colorado 80203
Phone: (303) 866-3441
Fax: (303) 866-4474
www.cwcb.state.co.us




TO: Colorado Water Conservation Board Members

FROM: Linda J. Bassi, Chief
Kaylea White
Stream and Lake Protection Section

DATE: January 20, 2009

SUBJECT: **Agenda Item 14, January 27-28, 2009 Board Meeting**
**Stream and Lake Protection Section – Injury with Mitigation – Case No. 4-05CW264; Application of Ranch Properties, LLC**

**Introduction**

This agenda item addresses a proposed pretrial resolution under ISF Rule 8i. (3) (Injury Accepted with Mitigation). Rule 8i.(3) requires the Board to consider an injury with mitigation proposal using a two meeting process. This is the first meeting of the process. This proposal is to mitigate impacts of pond evaporation that cannot be replaced under the applicant's augmentation plan. The ponds were built as part of a 2 mile stream restoration and habitat improvement project along the mainstem of Ohio Creek.

The proposal would allow some injury to the Ohio Creek instream flow ("ISF") water right, but it appears that the extensive stream restoration and habitat improvement work on Ohio Creek will provide ample mitigation necessary to enable the CWCB to continue to preserve the natural environment to a reasonable degree on Ohio Creek. Applicant Ranch Properties' formal request to the Board for approval of this proposal is attached to this memo as Exhibit 1.

**Staff Recommendation**

Staff recommends that the Board:

1) Make a preliminary determination that the natural environment of Ohio Creek could be preserved to a reasonable degree with the proposed injury if Ranch Properties provides the proposed mitigation, and

2) Provide comments to Staff on the proposal and identify any issues that the Applicant and Staff should address before bringing the proposal to the Board for final approval.

**Background**

Applicant Ranch Properties has requested groundwater rights for ponds that are tributary to Ohio Creek, which is tributary to the Gunnison River. Ranch Properties seeks approval of absolute

water rights and an approval of a plan for augmentation and implicit exchange[1] to replace out-of-priority depletions associated with groundwater evaporation of 10.378 acre-feet per year. Under its augmentation plan, Applicant will fully replace the 10.378 acre-feet per year; however, 2.51 acre-feet per year will not be replaced at the point of depletion, but rather at a point downstream of the CWCB's ISF water rights. The implicit exchange reach is from the confluence of Ohio Creek and the Gunnison River up to points of depletions from pond evaporation on Ohio Creek.

In November 2008, the Board approved an intervention and filing of a statement of opposition to this application[2] because the Applicant claimed that it was not required to replace depletions from pond evaporation. The Division Engineer disagreed with the Applicant and brought this case to the attention of the CWCB staff. Based upon discussions with the Applicant's Counsel and engineer, CWCB became a party in this case with the intent of negotiating terms and conditions to fully protect the Board's ISF water rights. Staff has been unable to secure full protection, and is therefore recommending this injury with mitigation proposal to include in a stipulation and final decree. The exercise of the proposed rights could adversely impact the Board's ISF water rights listed below.

| CWCB Case No. | Stream/Lake | Amount (cfs) | Approp. Date | Watershed | County |
|---|---|---|---|---|---|
| 4-80CW112A | Ohio Creek | 10 | 3/17/80 | Upper Gunnison | Gunnison |
| 4-80CW112B | Ohio Creek | 12 | 3/17/80 | Upper Gunnison | Gunnison |

(See map attached to this memo). The 10 cfs Ohio Creek ISF water right extends through Ranch Properties' Castleton Ranch, approximately 10 miles north of Gunnison, Colorado. Depletions associated with pond evaporation will occur directly within the 10 cfs ISF reach, and will equally affect the 12 cfs ISF reach downstream. Ranch Properties has agreed to protect Ohio Creek by maintaining the habitat and stream restoration structures, described more fully below.

**Mitigation Improvements to Ohio Creek**

As stated in Ranch Properties' proposal for injury with mitigation,

> "Historically, this reach of Ohio Creek was characterized by a channel with a high width/depth ratio (wide and shallow) that resulted in high water temperatures, a lack of deeper water for "rearing" habitat and for in-stream "holding cover", all detrimental to a sustainable fishery. There was also significant evidence of severe and progressive bank erosion on short-radius bends in the river, which at higher flows contributed to significant sediment loading in the Ohio Creek – Gunnison River system and an on-going loss of riparian habitat. Because of this severe erosion, the alignment of the channel had lost the natural sinuosity associated with a stable channel."

The restoration project includes channel modifications to restore a natural sinuosity, installation of rock structures for bank stabilization, excavation of oxbow stream channels, and improvement of existing riparian ponds. These features are described in the attached proposal at Exhibit 1.

[1] "Implicit exchange," refers to a reach of stream that the augmentation plan does not fully replace, which is not explicitly claimed or identified in the Applicant's application or proposed decree as an exchange.

[2] Staff originally had not filed a SOP because the water right claimed was a storage right, junior to the ISF. However, during construction the ponds intercepted groundwater and therefore are now considered ground water rights referred to as "pond wells," for which the evaporation must now be augmented.

Ranch Properties has coordinated with Colorado Division of Wildlife (CDOW) staff on the stream habitat improvement project. The structures were installed in three phases from September 2004 - September 2007. Applicant will maintain the structures and will allow the CWCB and CDOW a reasonable right of access to the area for the purpose of inspecting the river restoration and stream habitat improvement structures.

It is anticipated that these restoration efforts will improve the hydraulic conditions of the stream and increase the ability of Ohio Creek to sustain aquatic biota and the natural environment with lower flows.

**Extent of proposed injury**

Applicant has constructed 3 off-channel ponds that intersect groundwater and 10 on-channel ponds. Total surface area of all ponds is 5.37 acres, with an estimated total annual evaporation loss of 10.378 acre-feet per year. On a monthly basis, local dry-up credits will replace 7.97 acre-feet per year of the evaporation, leaving 2.51 acre-feet per year of stream depletions that are not directly replaced. The 2.51 acre-feet per year of depletions will be replaced downstream using Upper Gunnison River Water Conservancy Credits from Blue Mesa Reservoir. Total injury to the instream flow reach is expected to be 2.51 acre-feet per year, distributed monthly as follows:

| | |
|---|---|
| April | 0.83 |
| May | 0.45 |
| September | 0.42 |
| October | 0.51 |
| November | 0.28 |
| December | 0.02 |
| Total | 2.51 |

---

**Benefits of mitigation**

At the Board meeting, Mr. George M. Fosha, Applicant's Consulting Water Resources Engineer, will provide comments on the (1) potential injury to the Ohio Creek ISF water rights resulting from Ranch Properties' plan for augmentation, and (2) benefits to the natural environment resulting from Ranch Properties' stream restoration and habitat improvement project.

The CDOW reviewed the design plan for this restoration project in 2005 and found that projects like this "have a long-term overall benefit to the aquatic environment…and are stable under a range of hydrologic conditions." CDOW further stated that the project design techniques "are very appropriate for this particular section of Ohio Creek." CDOW supports the enhancement of off-channel habitats for recruitment and rearing of sub-adult fish, such as proposed here. See CDOW recommendation letter, dated July 10, 2005, included in the Applicant's proposal attached as Exhibit 1. Based in part upon this evaluation and the 404 permit granted by U.S. Army Corps of Engineers, Ranch Properties proceeded with the project to restore two miles of the Ohio Creek bed and banks for channel stability and habitat improvement.

The project includes channel modifications that have resulted in a reduced width/depth ratio that lowers the ambient water temperatures and creates deeper holding water for the fishery. Reducing the width/depth ratio has also resulted in significantly less stream surface area and accordingly less evaporation loss. Scour pools, glides, low velocity zones, and random rock cover for habitat have been created from installation of approximately 120 rock and log structures. Oxbow channels were reconnected and deepened to create additional refuge and cover for fish during winter months and periods of low flow. The channel was realigned to restore the natural sinuosity of the river. The realignment along with the new rock and log

structures have stabilized the banks and significantly reduced bank erosion, resulting in a lower sediment load in Ohio Creek and the Gunnison River.

**Alternatives**

Ranch Properties has explored the following alternatives to the injury with mitigation proposal described herein:

1. Ranch Properties considered whether one of the riparian ponds (Ranch Pond No. 1, Entry Pond or Bridge Pond) might be equipped with some type of outlet structure through which small releases of augmentation water could be delivered back to Ohio Creek to offset the impact. However, these ponds are not lined and are excavated into the underlying alluvial soils. Any release of water from the ponds would subsequently be replaced by groundwater flowing into the pond, resulting in no net accretion to the stream. In addition, the DWR does not consider ponds that intercept ground water as storage vessels from which augmentation (replacement) water may be released.

2. Ranch Properties considered the feasibility of constructing a new off-channel reservoir that could be used to store water during periods of high flow in Ohio Creek (or to store excess consumptive use credits derived from the dry-up of 10 acres under the Acme Ditch or augmentation water by exchange), and then subsequently release water during the non-irrigation season as necessary to offset the impacts to the ISF water rights. This option is not a feasible alternative for two reasons: (1) There is a considerable expense in constructing a new off-channel reservoir and the appurtenant facilities (ditches/pipelines) that would be required to deliver water into and out of the reservoir; and (2) The releases required to offset the impact to the ISF water rights are very small (2 gpm to 6 gpm). Given the extreme cold temperatures that are typical in the fall, winter and early spring months in this basin, it is questionable whether such small releases could be made without freezing problems and whether the releases would actually make it back to the stream (which might be ice-covered itself). Because neither of these alternatives is practical, the Applicant has submitted this injury with mitigation proposal.

**Colorado Division of Wildlife Evaluation of Proposal**

CWCB and Colorado Division of Wildlife ("CDOW") staff members have met with Ranch Properties' representatives to discuss this proposal. The CDOW staff's analysis and recommendation is pending.

**Terms and Conditions**

Staff, the Attorney General's Office and representatives of Ranch Properties have discussed proposed terms and conditions related to the injury with mitigation proposal. Some terms and conditions are yet to be negotiated, but injury with mitigation terms and conditions in the final decree should include the following:

1. Maintenance. Ranch Properties will commit to maintain the structures and improvements in Ohio Creek that provide the mitigation benefits.

2. Inspection access. Ranch Properties will allow and agrees to facilitate access for CWCB and CDOW staff to inspect the mitigation structures and perform biological stream monitoring if necessary, subject to reasonable limits and provisions for advance notice.

3. Measuring Devices. Ranch Properties will install and pay operation and maintenance costs of (or commit to pay operation and maintenance costs if the CWCB installs) any measuring device deemed necessary by the Division Engineer to administer terms of the stipulation and decree implementing the injury with mitigation.

4. Retained jurisdiction. Ranch Properties will include in any final decree a retained jurisdiction provision allowing the water court to enforce the provisions of the injury with mitigation stipulation as a water matter.

Staff anticipates that the parties will work to refine the above-listed terms and conditions and incorporate them into a stipulation and the resulting water court decree, along with standard protective terms and conditions.

Based upon a review of the report prepared by George M. Fosha, and upon staff's and CDOW's discussions with Ranch Properties' representatives, it appears that Ranch Properties' river restoration and habitat improvement project on Ohio Creek support the conclusion that the natural environment of Ohio Creek can continue to be preserved to a reasonable degree under the conditions described herein as a result of the mitigation provided by Ranch Properties. Staff and the Attorney General's Office have consulted with the Division Engineer on this proposal. The Division Engineer has concluded that this proposal is administrable specifically because, in this particular case, the stipulation will not result in a selective call or subordination on the subject reach of Ohio Creek.

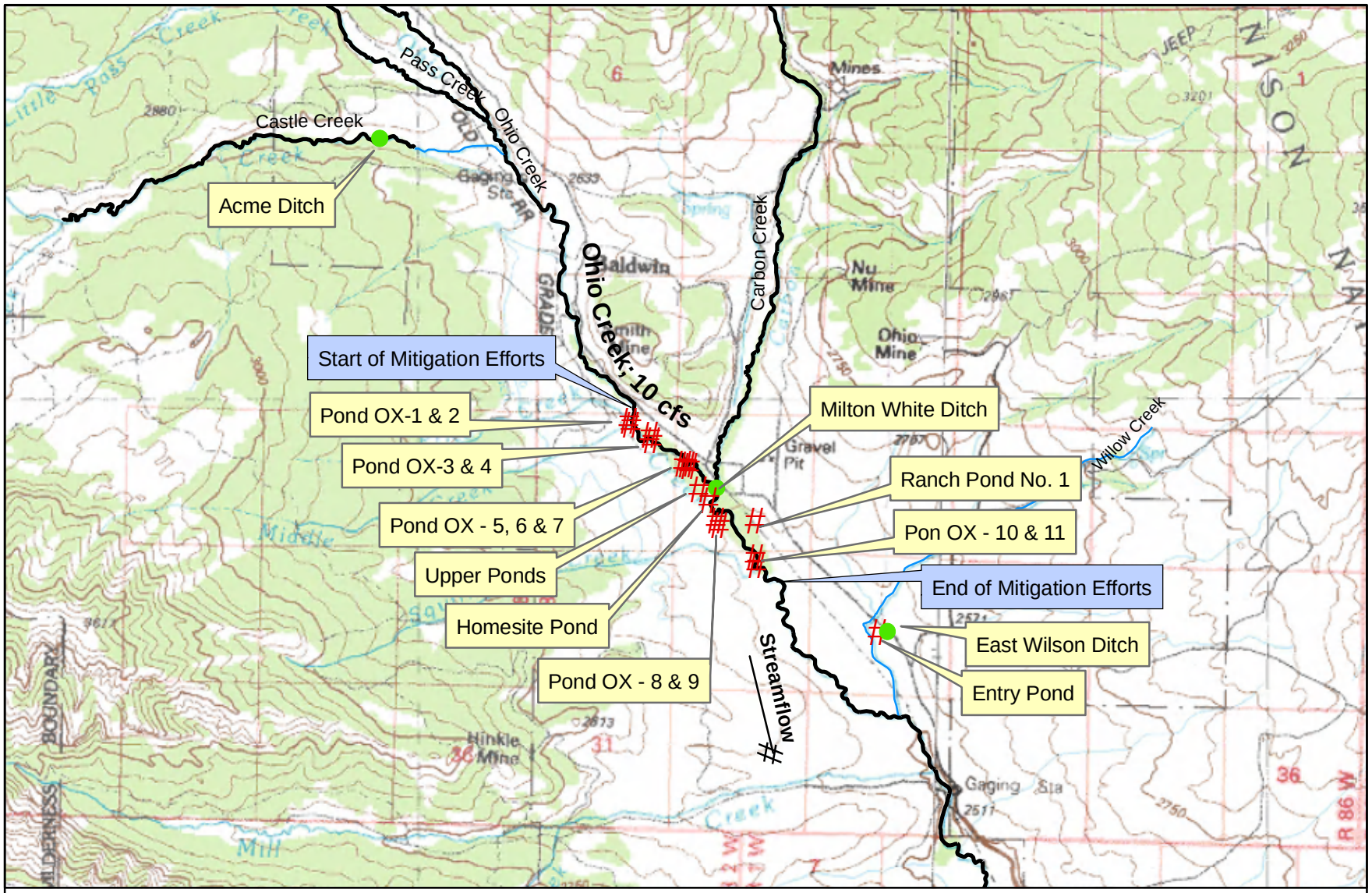
**Staff Recommendation**

As stated above, injury with mitigation is a two-meeting process. At the first meeting, the Board may "conduct a preliminary review of the pretrial resolution during any regularly scheduled meeting to determine whether the natural environment could be preserved to a reasonable degree with the proposed injury or interference if applicant provided mitigation." At a subsequent meeting, the Board may "take final action to ratify, refuse to ratify or ratify with additional conditions."

Staff recommends that the Board:

1. Make the preliminary determination that the natural environment of Ohio Creek could be preserved to a reasonable degree with the proposed injury if Ranch Properties provides the proposed mitigation; and
2. Provide comments to Staff on the proposal and identify any issues that Ranch Properties and Staff should address before bringing the proposal to the Board for final approval.

Attachments




January 27-28, 2009 Board Meeting
Agenda Item 14; Injury with Mitigation
Case No. 4-05CW264; Ranch Properties LLC

# EXHIBIT 1

# *GEORGE M. FOSHA*

**Consulting Water Resources Engineer**

**P. O. Box 136**

**Calhan, Colorado 80808**

Tel. (719) 347-3132


December 9, 2008

Colorado Water Conservation Board
Instream Flow Protection Program
1313 Sherman Street
Room 721
Denver, Colorado 80203

Attention: Kaylea White
Bahman Hatami

Re: CAS-14 Castleton Ranch
Request for Approval of Injury With Mitigation
Case No. 05CW264

Dear Members of the Board:

On behalf of Ranch Properties, LLC, the owner of the Castleton Ranch (Castleton), we respectfully request consideration by the CWCB Board of an *Injury with Mitigation* (IWM) plan pursuant to ISF Rule 8.i.3 as resolution of Case No. 05CW264 in the Division 4 Water Court. The IWM plan involves extensive river restoration and habitat improvement activities on Ohio Creek that have already been constructed by Castleton and which we believe provides mitigation necessary for the CWCB to continue to "preserve the environment to a reasonable degree" on Ohio Creek

## Background

Castleton Ranch is located in the Ohio Creek valley about 14 miles north of Gunnison Colorado. The primary water feature on the ranch is Ohio Creek, a tributary of the Gunnison River, which runs nearly the length of the ranch in a northwest to southeast direction. The general location of the Castleton Ranch is shown on the attached Figure 1.

Although the ranch continues to be operated for the historic use of cattle and hay production, the owner is placing a much greater emphasis on the development of recreational uses and the enhancement of wildlife and fishery habitat. As part of the fishery habitat improvements, Castleton has performed extensive modification and restoration of Ohio Creek along its course through the ranch. The project was implemented in three separate work phases from 2004 through 2007. The project work was completed pursuant to three separate permits issued by the Corps of Engineers under Section 404 of the Clean Water Act (File Nos. 200475401, 200575382 and 200575713).

As described in the following section, the project consisted of modifications and restoration of approximately 10,850 feet (2.05 miles) of the Ohio Creek channel. The work also included the installation of approximately 120 rock and log structures and the hydraulic re-connection of several of "oxbow" stream meanders.

## Description of Restoration Project

Historically, this reach of Ohio Creek was characterized by a channel with a high width/depth ratio (wide and shallow) that resulted in high water temperatures, a lack of deeper water for "rearing"

habitat and for in-stream "holding cover", all detrimental to a sustainable fishery. There was also significant evidence of severe and progressive bank erosion on short-radius bends in the river, which at higher flows contributed to significant sediment loading in the Ohio Creek – Gunnison River system and an on-going loss of riparian habitat. Because of this severe erosion, the alignment of the channel had lost the natural sinuosity associated with a stable channel.

***Channel Modifications***. The restoration of Ohio Creek was designed by Dave Rosgen of Wildland Hydrology. The bases for stream classification and stable channel design are presented in his well-known publication: "***Applied River Morphology***" (1996). The proposed improvements are designed to create a stable stream channel that will be able to transport the flows and sediment from the tributary watershed in such a manner that the stream will maintain its natural patterns, dimensions and profile, without aggradation (deposition of sediments) and/or degradation (bank erosion). In conjunction with achieving channel stability, the modifications have created habitat diversity and natural habitat features that allow for a self-sustaining fish population. This was accomplished by reducing the *width/depth ratio* of the channel which in turn will lower the average ambient water temperatures and create deeper "holding water" for the fishery. It was also necessary to re-align portions of the channel to re-store the natural sinuosity of the channel and reduce the shear stresses on the stream banks. This re-alignment, installation of bank protection features (rock vanes, root wads, etc.) and re-establishment of vegetative cover significantly reduced the erosional stresses on the banks and at the same time, provide shade and over-head cover for the fishery. The modified channel is designed to increase the mean and maximum water depths and decrease the water surface slope, resulting in velocities capable of transporting sediments at low flows while still being suitable for fishing, particularly along the stream banks. Analysis of the channel shear stress and bed material entrainment indicates that the modified channel will maintain its sediment transport capability and that the scour holes and glides will not fill with sediment. Typical channel modifications are shown on Figure A-1 in Appendix A.

The channel restoration work was based on analyses of river cross-sections, channel grades, bed materials and erosion potential in accordance with the Rosgen design principles. Using field surveys of the river profiles and cross-sections, the following parameters for a stable channel design were calculated.

| | **Existing** | **Proposed** |
|---|---|---|
| Channel Width (Bankfull) | 57.6 ft. | 41 ft. |
| Mean Depth (Riffle) | 1.8 ft. | 2.5 ft. |
| Width/Depth Ratio | 32 | 16.4 |
| Area | 125 $ft^2$ | 103 $ft^2$ |
| Mean Velocity | 4.4 fps | 5.3 fps |
| Meander Wave Length | 200 – 300 ft. | 450 – 500 ft. |
| Radius (Meander) | 50 – 80 ft. | 120 – 160 ft. |
| Slope | 0.009 | 0.008 |

***Rock Structures***. The restoration work included the installation of approximately 14 "cross vane" structures to provide grade control across the channel. These cross vanes will increase the stage of the river to provide a flatter gradient and decrease the surface velocities. The cross vanes were constructed using large rock boulders with an average diameter of 3.5 to 6.0 feet. The bottom course of the rock placement was excavated into the channel bed, providing a "footer" for the placement of the top courses of rock. Typical details of a cross vane are shown on Figure A-2 in Appendix A.

The work also included the installation of approximately 23 "J-hook" vanes, 28 modified J-hook vanes, 22 combination rock/log vanes and 26 rock vortex vanes. These types of control structures are designed to provide bank stabilization along the base of highly eroding stream banks, including those at the outside banks of river bends. In addition to bank stabilization, the "J" hook and combination vanes will provide lower velocities ("quiet" water) on the upstream side of the vane and small eddy pools on the downstream side, both providing enhanced habitat diversity, including dry-fly fishing. Typical details of a "J" hook vane are shown on Figure A-3 in Appendix A. The combination log vane is shown on Figures A-4 and A-5.

***"Oxbow Stream Channels"***. In certain areas where the river channel was re-aligned, materials were excavated from the former channel meanders ("oxbows") to create a natural, spring-fed creek/pond environment, hydraulically connected to the main channel of Ohio Creek. The design is intended to provide a more diverse recreational fishery, with deeper water and slower velocities for fish refuge at times when the flows in the main channel of Ohio Creek are too high and very turbid. The deeper water also provides refuge and holding capacity for fish during periods of low stream flow, including winter months. The work included construction of natural rock *cross-vanes* in the main channel that serve to re-connect these "oxbows" to the main channel.

Materials were excavated from the channel bed and sides of the old oxbow meanders to provide the additional depth needed. The oxbow areas were excavated to depths ranging from 5 to 12 feet, with an average depth being about 9 feet. The oxbows were also widened and shaped to simulate the natural appearance of a series of beaver ponds. Typically, the oxbow ponds average between 120 feet and 150 feet in length and will vary in width from about 15 feet to about 70 feet.

Ten small oxbow ponds were completed as part of the river restoration work. The total water surface area of all ten ponds is about 1.29 acres.

***Riparian Ponds***. As part of the restoration work, improvements were made to two existing ponds located in the riparian areas of the flood plain adjacent to Ohio Creek and a new pond was constructed in the hay meadow lying between Ohio Creek and County Road 730.

*"Ranch Pond No. 1"* was an existing pond that historically (and currently) served as a regulating structure for irrigation water supplies diverted through the Milton White Ditch. In 2004, this pond was excavated to provide deeper water for fishery habitat. The surface area of the pond was also increased from about 0.71 acre to 2.17 acres.

The *"Bridge Pond"* was an existing pond (circa 1977), constructed to provide fishery habitat on the west side and immediately adjacent to the Ohio Creek channel. In 2007, the pond was excavated to remove sediments that had been deposited in the pond and to provide deeper water to enhance the fishery habitat. The surface area of the pond (0.37 acre) was not changed.

The "*Entry Pond"* is a new pond constructed in 2004 to provide additional fishery and wildlife habitat and for aesthetic purposes near the main entry to the ranch. The water surface area of this new pond is 1.54 acres.

## Effects on River Flows (Stream Depletions)

The majority of the work involved in the river restoration and pond development work at Castleton Ranch, including the channel re-alignment, bed modifications, bank stabilization and the placement of rock structures was completed within the existing (and/or re-aligned) channel of the river

and typically below the normal water surface elevations ("bank-full width"). This construction, in itself, will not result in an increased depletion of the stream flow in Ohio Creek or the Gunnison River. In fact, because a major emphasis of the channel restoration is to generally reduce the width/depth ratio, there will be less water surface area, lower water temperatures, and accordingly, less evaporation loss. This reduction in stream evaporation loss could be substantial but is difficult to quantify because of the variable surface areas of the stream channel under different flow ranges.

Flow through the re-connected oxbow ponds returns directly back to Ohio Creek and is essentially non-consumptive by nature. However, construction to re-connect the old oxbow channels to the main stem of Ohio Creek has resulted in an increased exposed water surface area in comparison to historic conditions. Accordingly, there is a slight increase in the evaporation losses and depletion to the flows of the Ohio Creek/Gunnison River system. The enlargement of the existing *Ranch Pond No. 1*, the construction of the *Entry Pond* and the cleaning of the existing *Bridge Pond* also resulted in additional water surface areas being exposed to the atmosphere and accordingly more evaporation loss. The total water surface area is estimated to be about **5.37 acres**, as described in the previous section and as summarized in Table 1.

For the oxbow and riparian ponds, the unit evaporation loss was estimated using procedures recommended by the Colorado Division of Water Resources (DWR). The monthly calculations are summarized in Table 2. For this analysis, the average annual free water surface evaporation was estimated to be about 35 inches (From NOAA Technical Report NWS 33) which was then distributed on a monthly basis in accordance with the DWR guidelines for sites above Elevation 6,500 feet.

The in-channel oxbow ponds have been constructed in riparian areas that were historically dominated by wetland vegetation (rushes, sedges, willows, etc.). In itself, this vegetation would have consumed nearly as much water through "*evapo-transpiration*" as would be consumed by evaporation from the water surface of the oxbow ponds. Castleton Ranch, in its pending augmentation plan (Case No. 05CW264), **is not** claiming credit for the historic "consumptive use" of water by this vegetation. However, it is reasonable to reduce the gross evaporation (35 inches per year) by a portion of the natural precipitation that falls on the oxbow channels (and which will continue to do so). The DWR agrees that the gross evaporation can be reduced by an "effective" precipitation equal to about 70 percent of the total precipitation. For this analysis, we have used the average of the historic precipitation data as measured at the weather station near Gunnison Colorado (Gunnison 1N Sta. No. 053662) and at the Crested Butte station (Sta. No. 051959). The monthly average precipitation values for these stations are summarized in Column 5 of Table 2. 70 percent of these values are summarized in Column 6 of the table.

After adjusting for the effective precipitation, the net evaporation loss is estimated to be about 24.73 inches per year (2.06 acre-feet per acre) as shown in Columns 7 and 8 of the table. Finally, it is expected that the surface of the oxbow ponds typically will be ice-covered from November through March, with essentially no evaporation. With this adjustment, the annual net evaporation would be about 23.19 inches (1.932 acre-feet per acre). This "net" evaporation would apply to all "in-channel" ponds (i.e. oxbow ponds).

The "off-channel" ponds (Ranch Pond No. 1, Entry Pond and Bridge Pond) intercept and expose groundwater and are considered by the DWR as "pit wells". It is DWR policy that pit wells can take credit for effective precipitation, as discussed above. Accordingly, for these ponds, the net evaporation rate (after adjustment for the ice-covered months) would also be 23.19 inches (1.932 ft.).

The annual evaporation loss in the in-channel oxbow ponds and the off-channel riparian ponds would therefore be about **10.378 acre-feet** (5.37 acres x 1.932 ft.). The monthly values for all ponds are shown in Table 3.

As requested by the DWR, the evaporation losses from the "off-channel" ponds were "lagged" back to the main stem of Ohio Creek using the Glover procedure and the following parameters: The 'lagged" impacts to the stream from all ponds is shown in Table 3.

| Pond | Glover's "L" | Permeability |
|---|---|---|
| Ranch Pond No. 1 | 1,000 ft. | 2,500 gpd/ft$^2$ |
| Entry Pond | 700 ft. | 2,500 gpd/ft$^2$ |
| Bridge Pond | 150 ft. | 2,500 gpd/ft$^2$ |

In spite of the obvious offset that could be attributed to the historic, naturally occurring evapo-transpiration by native vegetation, Castleton has proposed a plan for augmentation (Case No. 05CW264) that will replace the entire net evaporation loss (10.378 acre-feet) on an annual basis.

## Proposed Augmentation Replacement Supply

As part of the proposed plan, it is Castleton's intention to replace (augment) the stream depletions attributable to the net evaporation loss occurring from the water surface areas of the proposed oxbow stream channels. The source of augmentation water will be "credits" made available by permanently removing from production a portion of the land historically irrigated by the ***Acme Ditch***, the majority of which is owned by Castleton. A detailed engineering analysis of the historic use of the Acme Ditch was completed and is attached as Appendix B to this proposal.

Based on these engineering studies, a ten acre parcel of land under the Acme Ditch was identified that could readily be removed from irrigation. The average historic consumptive use on the 10 acres was determined to be about **12.7 acre-feet** per year.

Table 4 summarizes the operation of the proposed augmentation plan. The first portion of the table summarizes the estimated project depletions attributable to the "lagged" evaporation losses (Column 4). The second portion is a summary of the historic stream depletions associated with the dry-up of 10 acres under the Acme Ditch (Column 6). The third portion (Columns 7 through 12) is the basic operation of the "replacement plan". In this operation, Acme Ditch "credits" are first used directly to offset the evaporation depletions. To the extent that the dry-up credits are insufficient to directly satisfy the replacement obligation, there will be a remaining impact to the Gunnison River stream system (expressed as acre-foot/month in Column 9 and as mean monthly cfs in Column 10).

As shown in Column 9 of Table 4, the annual impact to Ohio Creek / Gunnison River, after direct use of the Acme Ditch dry-up credits is about 2.51 acre-feet. In order to offset this impact, it will be necessary to provide an additional replacement supply. From discussions with State water officials, it is our understanding that the "river call" in the Gunnison River basin during the non-irrigation season would typically be either the Aspinall Storage Project on the main stem of the Gunnison River or the Redlands Canal, near Grand Junction. Because of the downstream location of these non-irrigation season calls, Castleton proposes to enter into a long-term lease-contract with the *Upper Gunnison Water Conservancy District (UGWCD)* for augmentation water stored in the Aspinall project reservoirs. This contract water, projected to be about three to five acre-feet annually, can then be released as necessary to satisfy the winter replacement requirements, as shown in Column 11.

Note also that under the proposed operation, there will be excess water delivered to Ohio Creek in the amount of 4.93 acre-feet during the months of June, July and August because the available dry-up credits are greater than the amount needed to offset the evaporation. This is also reflected as a net benefit to the total stream system in Column 12 of the table.

## CWCB Instream Flow Right (ISF)

The Colorado Water Conservation Board (CWCB) holds an "in-stream" flow right on Ohio Creek through the reach that was the subject of the restoration work. This ISF right is decreed for 10.0 cfs, year round and carries a 1980 priority date. Under the operation of the proposed augmentation plan as described above, there is still potential injury to the ISF during certain months of the year (Columns 9 and 10 of Table 11), because the UGWCD's Aspinall contract water cannot be exchanged up Ohio Creek.

Castleton believes that these small monthly impacts, ranging from only two to six gallons per minute (gpm), may not represent a "material" or legally cognizable injury to the ISF water right. However, in recognition of the positive stream benefits that derive from the extensive restoration work on Ohio Creek, Castleton Ranch herein proposes to offset the potential injury to the ISF by providing mitigation as provided for in Rule 8i.3 of the CWCB In-Stream Flow Rules & Regulations (Injury with Mitigation).

The primary bases for this IWM proposal are the significant stream and fishery benefits that have resulted from the Ohio Creek restoration work that has already been completed, at considerable expense, by Castleton. The benefits to the stream environment include:

1. Channel modifications that have resulted in a reduced width/depth ratio. This in turn has the effect of lowering the ambient water temperatures and creating deeper "holding water" for the fishery, particularly during the critical periods of low stream flow.

2. Reducing the width/depth ratio of the channel has resulted in significantly less exposed water surface area and accordingly less evaporation loss. As stated in this proposal, Castleton has not quantified this net benefit, nor has it claimed this benefit as a credit against the evaporation losses from the new oxbow and riparian ponds. However, it should be noted that reducing the width of the stream channel by 10 to 16 feet, over the reach of the restoration project (10,850 feet), translates to a potential reduction in water surface area of 2.5 to 4.0 acres. This would lessen the magnitude of the stream depletion caused by construction of the ponds.

3. Installation of approximately 120 rock and log structures (cross vanes, J-Hook vanes, vortex vanes, etc.) has improved the diversity of the fishery habitat by creating scour pools and glides, and by lowering the velocity along the stream banks. Additional rocks were placed to create random rock cover for habitat between structures.

4. Re-alignment of the channel to restore the natural sinuosity of the river, together with the installation of rock/log structure (vanes) on the outside bends have improved the stability of the stream banks and significantly reduced bank erosion, resulting in a lower sediment load in Ohio Creek and the Gunnison River. This too, is a considerable benefit to the stream environment.

5. Excavation to deepen the re-connected oxbow channels has created additional refuge and cover for fish during winter months and periods of low stream flow.

6. It is also noted that the Colorado Division of Wildlife and the Corps of Engineers concur with respect to the overall benefits to the fishery, resulting from the restoration work completed by Castleton Ranch. Attached is a copy of a July 10, 2005 letter from the DOW that expresses agreement with the overall improvement to the fishery habitat that will result from the restoration work.

Another basis for this IWM proposal relates to the magnitude of the potential impact to the ISF.

7. As shown in column 10 of Table 4, the impact to the ISF (after the augmentation credits from the dry-up of 10 acres under the Acme Ditch) is very small, ranging from only 0.005 cfs (2 gpm) to 0.014 cfs (6 gpm).

8. At a flow rate of about 0.014 cfs (6 gpm), the maximum impact to the ISF represents only about **0.14 percent** of the decreed ISF water right (10 cfs). This would clearly fall into the category of "de minimis" impact as defined in Rule 8e of the CWCB's ISF regulations (1.0 percent) and would not constitute material injury.

9. For the years 1958 through 1970, the USGS operated a stream gage on Ohio Creek immediately upstream of the Castleton Ranch (*Gage ID 09113300 – Ohio Creek at Baldwin*). Table 5 is a summary of the mean monthly flows (cfs) during this study period. Table 5-A was developed from the daily stream flow measurements for this period and summarizes the calculated 50$^{th}$ percentile (median) of all of the daily flows. This table shows that during the months of April and May, the median flow in Ohio Creek is well in excess of the ISF rate of 10 cfs and the Castleton depletion of 0.007 cfs to 0.014 cfs (Table 11) would not injure the ISF.

   Similarly, during the fall months of September, October and November, the median flows are still greater than the ISF and the Castleton depletion of 0.005 cfs to 0.008 cfs would not injure the ISF.

   It is also noted that the recorded flows at the old Baldwin gage do not include additional inflows to Ohio Creek from tributaries such as Carbon Creek, Price Creek and Squirrel Creek, all of which would tend to further offset the potential impact to the ISF.

## Alternatives

Castleton has considered the following alternatives to this *Injury with Mitigation* proposal that would offset the impact to the ISF.

a. We considered whether one of the riparian ponds (Ranch Pond No. 1, Entry Pond or Bridge Pond) might be equipped with some type of outlet structure through which small releases of augmentation water could be delivered back to Ohio Creek to offset the impact. However, these ponds are not lined and are excavated into the underlying alluvial soils. Any release of water from the ponds would subsequently be replaced by groundwater flowing into the pond, resulting in no net accretion to the stream. In addition, the new outlet structures (valves and pipelines) would create an additional expense for Castleton.

b. We considered the feasibility of constructing a new off-channel reservoir that could be used to store water during periods of high flow in Ohio Creek (or to store excess credits derived from the dry-up of 10 acres under the Acme Ditch) and then subsequently release water during the

non-irrigation season as necessary to offset the impact to the ISF. This option is not a feasible alternative for two reasons: (1) There is a considerable expense in constructing a new off-channel reservoir and the appurtenant facilities (ditches/pipelines) that would be required to deliver water into and out of the reservoir; (2) The releases required to offset the impact to the ISF are very small ( 2 gpm to 6 gpm). Given the extreme cold temperatures that are typical in the fall, winter and early spring months in this basin, it is questionable whether such small releases could be made without freezing problems and whether the releases would actually make it back to the stream (which might be ice-covered itself).

c. Neither of these alternatives are practical and neither provides more direct benefit to the stream environment and the affected ISF than the *Injury with Mitigation* reflected in this proposal.

**Additional Terms and Conditions**

With reference to the Memorandum dated May 5, 2006, from the CWCB staff regarding recommendations on implementing ISF Rule 8.i.3, Castleton is amenable to inclusion of the following terms and conditions as part of settlement of an Injury with Mitigation negotiation.

1. Maintenance: Castleton Ranch will commit to maintaining the structures and improvements made to the Ohio Creek channel as part of the river restoration project as summarized in this proposal.

2. Inspection Access: Castleton Ranch will allow access for CWCB and/or DOW staff to inspect the structures and improvements, subject to reasonable limits with respect to the privacy of the owners of the Castleton Ranch and provisions for advance notice.

3. Retained Jurisdiction: Castleton Ranch will include in any final decree in Case No. 05CW264 a retained jurisdiction provision that would allow the Water Court to enforce the *Injury with Mitigation* stipulation as a water matter.

4. Measuring Devices: Castleton Ranch has considered the merits of installing a new stream gage to measure and monitor the impacts to the ISF as described in this proposal. Given the extremely small impact to the ISF (2 gpm to 6 gpm), we believe that it is both impractical and infeasible to accurately measure this inconsequential flow in a natural stream channel that flows from 5 cfs to over 300 cfs, particularly during the fall and early spring months when the channel is often iced up.

**Conclusions**

The major stream restoration and habitat improvements made by Castleton Ranch on Ohio Creek, in themselves, provide the mitigation necessary for the CWCB to continue to "preserve the environment to a reasonable degree" and is more than sufficient to offset the very small impact to the ISF that could occur as a result of new evaporation losses from the oxbow ponds and riparian ponds recently constructed. Furthermore, the restoration work has enhanced and improved the stream environment considerably in comparison to the pre-restoration conditions.

Thank you for considering this proposed plan for Injury with Mitigation. Please feel free to call the undersigned if you have question or comments or if you need additional information related to the proposal.

Very truly yours,

George M. Fosha, P. E.

Encl.
Appendix A - Sketches
Appendix B - Engineering Report

CC: Brenda Ames
Lowell Inman
John Hill

STATE OF COLORADO

Bill Owens, Governor
DEPARTMENT OF NATURAL RESOURCES
**DIVISION OF WILDLIFE**
AN EQUAL OPPORTUNITY EMPLOYER

Bruce McCloskey, Director
6060 Broadway
Denver, Colorado 80216
Telephone: (303) 297-1192

*For Wildlife-*
*For People*

10 July 2005

Mr. George M. Fosha, P.E.
P.O. Box 136
Calhan, Colorado 80808

Subj: Castleton Ranch Fishery Enhancement Project (Phase II) – Ohio Creek

Dear George:

Thanks for the opportunity to review and comment upon your plan and design to improve aquatic habitat, control excessive bank erosion and enhance sediment transport in Ohio Creek on the Castleton Ranch property in Gunnison County. I have reviewed the design report and have consulted with a number of my colleagues here at the Division of Wildlife and all have concurred with your assessment of the current conditions on the property. Your assessment of the existing conditions, specifically the stream's high width/depth ratio, the overall lack of deep water cover habitat for fish, and the low level of instream cover for fish is correct. In light of these facts, we agree that the proposed construction project will result in an overall improvement of the fish habitat in Ohio Creek.

The DOW has long believed that stream restoration projects designed and constructed in this manner have a long-term overall benefit to the aquatic environment. Our experience has been that these projects meet their stated objectives (improvement of fish habitat, reduction of excessive bank erosion rates, reduction of width-depth ratios, enhanced natural reproduction and recruitment of fish, and they provide for a diversity of angling opportunities) and are self-maintaining and stable under a range of hydrologic conditions. We believe that the techniques incorporated into Phase II of the Castleton Ranch project (as designed) are complementary of the Phase I construction, and they are very appropriate for this particular section of Ohio Creek. We also support the enhancement of off-channel habitats for recruitment and rearing of sub-adult fish such as what you have proposed for the oxbow lake complexes. We, therefore, have no reason to believe that this project, as envisioned and designed, will not improve the situation on the Castleton Ranch property. We also believe that it is extremely beneficial (from an overall aquatic health standpoint) that this project will reduce sediment supplies and improve or enhance the stream's capacity to transport the sediment produced by its watershed.

Please feel free to provide this letter to the Corps of Engineers in your application for a Nationwide 27 404 Permit. They can consider this a letter of support for the project and documentation that the Division of Wildlife has reviewed the proposed design. If you or Corps of Engineers personnel have any questions or comments regarding this matter, please feel free to contact me at 303-291-7260.

Thanks again for taking the time to consult with me on the phone and for the opportunity to review the project proposal and design plans. I would very much like to visit the property both before and after construction, if that is possible. Please let me know.

Sincerely,

Jay W. Skinner
Water Resources Unit Supervisor

cc: Paul Jones, Sherman Hebein, Dan Brauch, AWM, DWM

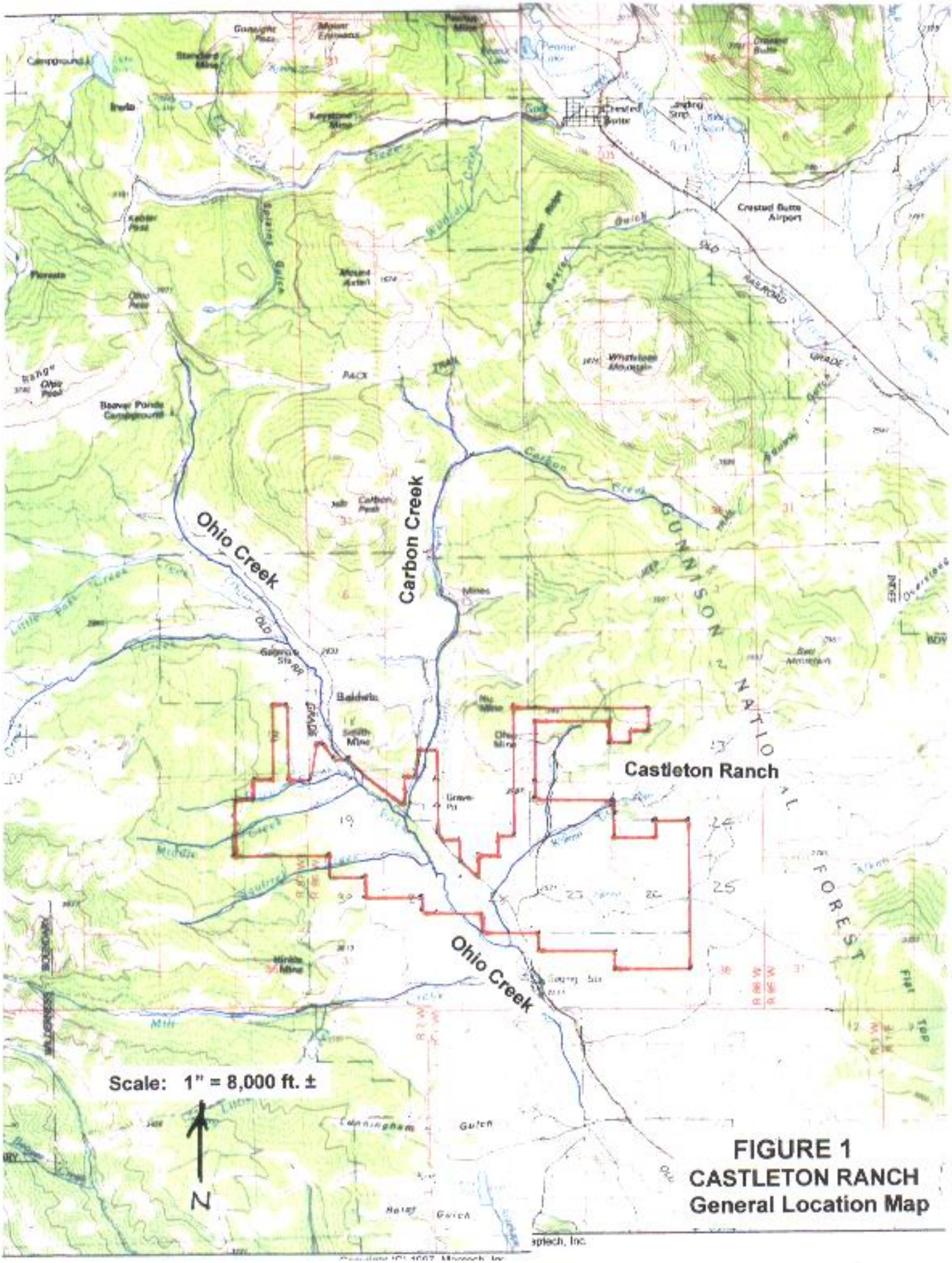



**FIGURE 1**
**CASTLETON RANCH**
**General Location Map**

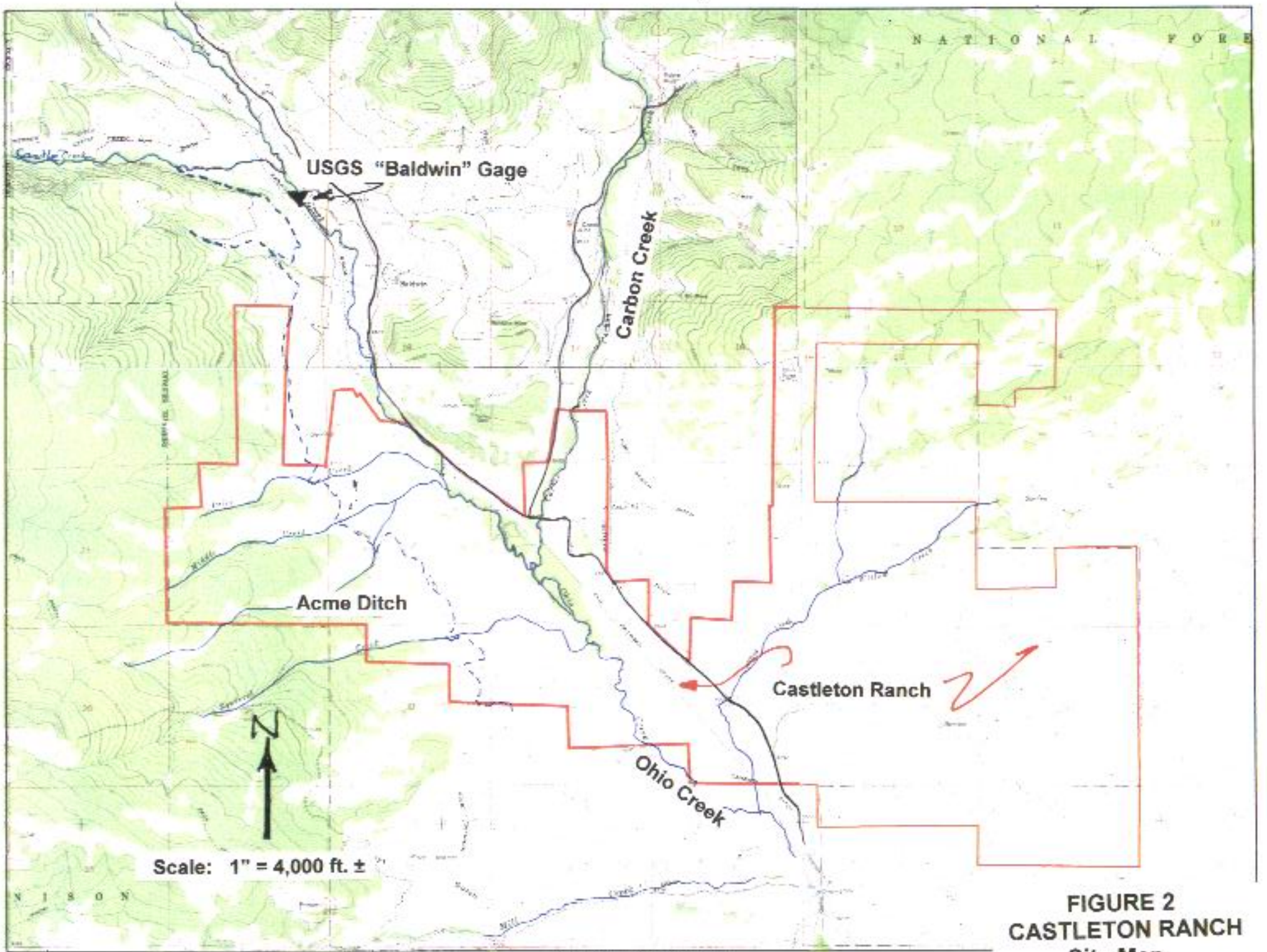





**FIGURE 2**
**CASTLETON RANCH**
**Site Map**

**Table 1**

**Castleton Ranch - Ohio Creek Restoration and Pond Development (2004-07)**

# SUMMARY OF POND CONSTRUCTION

| Oxbow No. | Location ('River Stations) | Water Surface Area (Sq. Ft.) | Water Surface Area (Acre) | Legal Description at Center of Pond: Quarter/Quarter | Section | Distance from Section Lines: North / South | Distance from Section Lines: East / West |
|---|---|---|---|---|---|---|---|
| OX-1 | 29+25 | 3,957 | 0.09 | NW,NE | 19 | 500 ft. from N. | 1,790 ft. from E. |
| OX-2 | 30+00 | 4,878 | 0.11 | NW,NE | 19 | 550 ft. from N. | 1,700 ft. from E. |
| OX-3 | Not Constructed | | | | | | |
| 0X-4 | Not Constructed | | | | | | |
| OX-5 | Not Constructed | | | | | | |
| OX-6 | Not Constructed | | | | | | |
| OX-7 | Not Constructed | | | | | | |
| Upper Ponds (3) | 77+00 | 11,385 | 0.26 | NW,SW | 20 | 2,300 ft. from S. | 1,000 ft. from W. |
| Homesite Ponds (3) | 83+00 | 8,137 | 0.19 | NE,SW | 20 | 1,890 ft. from S. | 1,410 ft. from W. |
| OX-8 | 94+00 | 12,160 | 0.28 | SE,SW | 20 | 1,110 ft. from S. | 1,680 ft. from W. |
| OX-9 | 95+50 | 15,554 | 0.36 | SE,SW | 20 | 990 ft. from S. | 1,810 ft. from W. |
| OX-10 | Not Constructed | | | | | | |
| OX-11 | Not Constructed | | | | | | |
| | *SUBTOTALS* | 56,071 | 1.29 | | | | |
| **Off-Channel Ponds** | | | | | | | |
| Ranch Pond No. 1 | N/A | 94,680 | 2.17 | NW,SE and SW,SE | 20 | 1,180 ft. from S. | 2,200 ft. from E. |
| Entry Pond | N/A | 66,886 | 1.54 | NE,SW and NW,SE | 20 | 3,120 ft. from N. | 2,600 ft. from W. |
| Bridge Pond | N/A | 16,125 | 0.37 | SE,SW | 20 | 300 ft. from S. | 2,620 ft. from W. |
| | | 177,691 | 4.08 | | | | |
| | **TOTALS** | 233,762 | 5.37 | | | | |

Note: All structures are located in Township 15 South, Range 86 West (6th PM)

April 10, 2008

# TABLE 2

# RESERVOIR EVAPORATION

## Basic Data:

| | | | | |
|---|---|---|---|---|
| 1 | Location: | Castleton Ranch<br>Gunnison, Colorado<br>Average of Gunnison 1N and Crested Butte (1975-2002) | | |
| 2 | Average Annual Evaporation from NOAA Technical Report NWS 33<br>(Enter Pan or FWS Evaporation) | | 35 | inches |
| 3 | Pan Coefficient:<br>(If (2) is FWS evaporation, enter a value of 1.00) | | 1 | |
| 4 | Percentage Precipitation is Effective: | | 70.0% | |
| 5 | Enter Option Number for Monthly Evaporation Distribution ( 1 for elevations below 6,500 feet or 2 for elevations above 6,500 feet) | | 2 | |

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|
| | Monthly Evaporation Distribution Options (Percent) | | Gross | Average Monthly | Effective | Net | |
| Month | < 6,500 feet | > 6,500 feet | Evaporation (Inches) | Precipitation (Inches) | Precipitation (Inches) | Evaporation (Inches) | (feet) |
| Jan | 3.0% | 1.0% | 0.35 | 1.59 | 1.11 | 0.00 | 0.000 |
| Feb | 3.5% | 3.0% | 1.05 | 1.52 | 1.06 | 0.00 | 0.000 |
| Mar | 5.5% | 6.0% | 2.1 | 1.42 | 0.99 | 1.11 | 0.092 |
| Apr | 9.0% | 9.0% | 3.15 | 1.14 | 0.80 | 2.35 | 0.196 |
| May | 12.0% | 12.5% | 4.375 | 1.2 | 0.84 | 3.54 | 0.295 |
| Jun | 14.5% | 15.5% | 5.425 | 0.87 | 0.61 | 4.82 | 0.401 |
| Jul | 15.0% | 16.0% | 5.6 | 1.52 | 1.06 | 4.54 | 0.378 |
| Aug | 13.5% | 13.0% | 4.55 | 1.75 | 1.23 | 3.33 | 0.277 |
| Sep | 10.0% | 11.0% | 3.85 | 1.49 | 1.04 | 2.81 | 0.234 |
| Oct | 7.0% | 7.5% | 2.625 | 1.18 | 0.83 | 1.80 | 0.150 |
| Nov | 4.0% | 4.0% | 1.4 | 1.39 | 0.97 | 0.43 | 0.036 |
| Dec | 3.0% | 1.5% | 0.525 | 1.3 | 0.91 | 0.00 | 0.000 |
| Totals | | | 35.00 | 16.37 | 11.46 | 24.73 | 2.06 |

Net Evaporation adjusted for winter ice cover (November - March) 23.19 '( 1.93 Feet)

April 10, 2008

**TABLE 3**
**Castleton Ranch**
**"Lagged" Evaporation From "As-Constructed" Ponds**

| Month | Unit Evaporation | | Water surface Evaporation | | | | | "Lagged" Impacts to Stream | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | In-Channel | Off-Channel | | | | | Off-Channel | | | |
| | Total (inches) | Net (inches) | Oxbows (ac-ft) | "Bridge" (ac-ft) | Ranch Pond (ac-ft) | Entry Pond (ac-ft) | In-Channel (ac-ft) | "Bridge" (ac-ft) | Ranch Pond (ac-ft) | Entry Pond (ac-ft) | Total (ac-ft) |
| Jan | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | 0 |
| Feb | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | 0 |
| Mar | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | 0 |
| Apr | 3.15 | 2.35 | 0.253 | 0.07 | 0.42 | 0.30 | 0.253 | 0.072 | 0.267 | 0.238 | 0.830 |
| May | 4.375 | 3.54 | 0.381 | 0.11 | 0.64 | 0.45 | 0.381 | 0.109 | 0.537 | 0.421 | 1.447 |
| Jun | 5.425 | 4.82 | 0.518 | 0.15 | 0.87 | 0.62 | 0.518 | 0.148 | 0.770 | 0.583 | 2.020 |
| Jul | 5.6 | 4.54 | 0.488 | 0.14 | 0.82 | 0.58 | 0.488 | 0.140 | 0.825 | 0.589 | 2.042 |
| Aug | 4.55 | 3.33 | 0.358 | 0.10 | 0.60 | 0.43 | 0.358 | 0.103 | 0.684 | 0.460 | 1.605 |
| Sep | 3.85 | 2.81 | 0.302 | 0.09 | 0.51 | 0.36 | 0.302 | 0.087 | 0.555 | 0.375 | 1.320 |
| Oct | 2.625 | 1.8 | 0.194 | 0.06 | 0.33 | 0.23 | 0.194 | 0.056 | 0.401 | 0.258 | 0.908 |
| Nov | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.001 | 0.132 | 0.049 | 0.182 |
| Dec | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | | | 0.020 | 0.001 | 0.021 |
| Jan | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | | | 0.003 | 0.000 | 0.003 |
| Feb | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | |
| | 29.58 | 23.19 | 2.493 | 0.715 | 4.194 | 2.976 | 2.493 | 0.715 | 4.193 | 2.976 | 10.377 |

| | | | Glover Lag Patterns | | |
|---|---|---|---|---|---|
| | | | Lag 1 | Lag2 | Lag3 |
| "In-channel Pond Surface Area: | 1.29 | Acres | | | |
| "Off-Channel Pond Areas: | | | 0.9902 | 0.6285 | 0.7903 |
| Bridge Pond | 0.37 | Acres | 0.0098 | 0.3159 | 0.2052 |
| Ranch Pond No. 1 | 2.17 | Acres | 0 | 0.0472 | 0.0043 |
| Ranch Entry Pond | 1.54 | Acres | 0 | 0.0072 | 0.0001 |
| | | | 0 | 0.0011 | 0 |
| | | | 0 | 0.0002 | 0 |

Surface acreages reflect ponds constructed under Phase 1, Phase 2 and Phase 3 + Existing "Bridge" Pond.

May 9, 2008

## TABLE 4

### Castleton Ranch
**Summary of Proposed Augmentation Plan**
**Acme Ditch "Dry-up + Aspinall Aug. Supply**

| 1 | 2 | 3 | 4 | | 5 | 6 | | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PROJECT DEPLETIONS | | | | ACME DITCH HISTORIC USE | | | | | | | | |
| Month | In-Channel Evaporation (Ac-Ft) | Out of Channel Evaporation (Ac-Ft) | "Lagged" Impacts (Ac-Ft) | | Historic Diversions (Ac-Ft) | Prorated CU "Credit" (Ac-Ft) | | Credit Used Direct | Excess Acme Credit | Remaining Impact (Ac-Ft) | (cfs) | UGRWCD Credit (Ac-Ft) | Net Impact Basin (Ac-Ft) |
| April, 2008 | 0.253 | 0.799 | 0.830 | | 0.1 | 0.00 | | 0.00 | 0.00 | 0.83 | 0.014 | 0.83 | 0.00 |
| May | 0.381 | 1.204 | 1.447 | | 3.9 | 1.00 | | 1.00 | 0.00 | 0.45 | 0.007 | 0.45 | 0.00 |
| June | 0.518 | 1.639 | 2.020 | | 16.1 | 4.70 | | 2.02 | 2.68 | 0.00 | 0.000 | 0.00 | 2.68 |
| July | 0.488 | 1.544 | 2.042 | | 20.0 | 4.20 | | 2.04 | 2.16 | 0.00 | 0.000 | 0.00 | 2.16 |
| August | 0.358 | 1.132 | 1.605 | | 9.1 | 1.70 | | 1.61 | 0.10 | 0.00 | 0.000 | 0.00 | 0.10 |
| September | 0.302 | 0.955 | 1.320 | | 4.2 | 0.90 | | 0.90 | 0.00 | 0.42 | 0.007 | 0.42 | 0.00 |
| October | 0.194 | 0.612 | 0.908 | | 2.8 | 0.40 | | 0.40 | 0.00 | 0.51 | 0.008 | 0.51 | 0.00 |
| November | 0.00 | 0.00 | 0.182 | | 0.0 | -0.10 | | 0.00 | 0.00 | 0.28 | 0.005 | 0.28 | 0.00 |
| December | 0.00 | 0.00 | 0.021 | | 0.0 | 0.00 | | 0.00 | 0.00 | 0.02 | 0.000 | 0.02 | 0.00 |
| January , 2009 | 0.00 | 0.00 | 0.003 | | | 0.00 | | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.00 |
| February | 0.00 | 0.00 | 0.000 | | | 0.00 | | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.00 |
| March | 0.00 | 0.00 | 0.000 | | | 0.00 | | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.00 |
| TOTALS | 2.494 | 7.885 | 10.378 | | 56.2 | 12.80 | | 7.97 | 4.93 | 2.51 | | 2.51 | 4.93 |

**Column Descriptons:**

1. Typical Monthly Operation
2. In-Channel Pond Area: 1.29 acres (From Table 4)
3. Out of Channel Pond Area: 4.08 acres (From Table 4)
4. Evaporation Loss "Lagged" to Stream
5. Historic Diversions to 10-Acre Parcel (Pro rated).
   Total Historic Irrigated Acreage: 10.00 acres
   Acreage "Dried Up"; 10.00 acres
6. Historic Depletions from Dry-Up of 10 acres. (Negative Value = Accretion to Stream (Delayed Return Flow))
7. Lesser Value of Col. 4 or Col. 6
8. Acme Dry-Up Credit Available but Not Used (Col. 6 - Col. 7)
9. Col. 4 - Col. 7
10. Remaining Impact in Mean Monthly cfs.
11. Leased Contract Water from Upper Gunnison River Water Conservancy District (= Col. 8).
12. Net Impact to Gunnison River after Release of UGRWCD "Aspinall" Water (Col. 8 - Col. 10)

May 9, 2008

# Table 5
# Castleton Ranch

### Historic Streamflow - Ohio Creek at Baldwin (Gage ID 09113300)
**(Values in Mean Monthly CFS)**

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1958** | | | | | | | | | | 11.5 | 10.6 | 12 |
| **1959** | 11 | 10 | 8.94 | 23.6 | 140 | 143 | 31.4 | 20 | 8.07 | 19.6 | 18.9 | 11 |
| **1960** | 10 | 9 | 9.13 | 75.8 | 116 | 160 | 34.4 | 15.2 | 8.18 | 12.3 | 10.4 | 10 |
| **1961** | 10 | 8.54 | 9.45 | 30.7 | 151 | 113 | 18.4 | 16.8 | 27.4 | 24.3 | 16.6 | 12 |
| **1962** | 11 | 12 | 14 | 91.7 | 264 | 243 | 102 | 30 | 10.4 | 9.66 | 7.5 | 5.5 |
| **1963** | 5 | 5.54 | 9.87 | 37.2 | 100 | 38.1 | 7.55 | 15.7 | 12 | 8.25 | 10.5 | 8.5 |
| **1964** | 8.5 | 7.5 | 7 | 13.2 | 162 | 141 | 38.9 | 25 | 10.1 | 9.74 | 8 | 9 |
| **1965** | 9 | 10 | 9.84 | 41 | 230 | 317 | 204 | 53.1 | 40.9 | 26.3 | 15.4 | 14 |
| **1966** | 12 | 11 | 11.8 | 82.8 | 139 | 86.2 | 21.3 | 16.1 | 7.34 | 11.7 | 11.1 | 11.2 |
| **1967** | 7.82 | 8.54 | 22.8 | 58.5 | 127 | 154 | 38.7 | 24.8 | 25.2 | 10.3 | 8.98 | 8.11 |
| **1968** | 8.4 | 8.09 | 9.47 | 22.4 | 192 | 291 | 59.4 | 57.5 | 18.4 | 11.2 | 13 | 9.54 |
| **1969** | 7.26 | 7.06 | 7.3 | 93.7 | 257 | 144 | 69 | 26.6 | 23.5 | 23.2 | 17.5 | 11.3 |
| **1970** | 10.2 | 9.25 | 10.3 | 19.7 | 287 | 202 | 62.4 | 25.8 | 45.3 | | | |
| **Average** | 9.18 | 8.88 | 10.83 | 49.19 | 180.42 | 169.36 | 57.29 | 27.22 | 19.73 | 14.84 | 12.37 | 10.18 |
| **Minimum** | 5 | 5.54 | 7 | 13.2 | 100 | 38.1 | 7.55 | 15.2 | 7.34 | 8.25 | 7.5 | 5.5 |

**Values in Acre-Feet**

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1958** | | | | | | | | | | 707 | 631 | 738 | |
| **1959** | 676 | 555 | 550 | 1,404 | 8,608 | 8,509 | 1,931 | 1,230 | 480 | 1,205 | 1,125 | 676 | 26,950 |
| **1960** | 615 | 500 | 561 | 4,510 | 7,133 | 9,521 | 2,115 | 935 | 487 | 756 | 619 | 615 | 28,367 |
| **1961** | 615 | 474 | 581 | 1,827 | 9,285 | 6,724 | 1,131 | 1,033 | 1,630 | 1,494 | 988 | 738 | 26,521 |
| **1962** | 676 | 666 | 861 | 5,457 | 16,233 | 14,460 | 6,272 | 1,845 | 619 | 594 | 446 | 338 | 48,467 |
| **1963** | 307 | 308 | 607 | 2,214 | 6,149 | 2,267 | 464 | 965 | 714 | 507 | 625 | 523 | 15,650 |
| **1964** | 523 | 417 | 430 | 785 | 9,961 | 8,390 | 2,392 | 1,537 | 601 | 599 | 476 | 553 | 26,665 |
| **1965** | 553 | 555 | 605 | 2,440 | 14,142 | 18,863 | 12,544 | 3,265 | 2,434 | 1,617 | 916 | 861 | 58,796 |
| **1966** | 738 | 611 | 726 | 4,927 | 8,547 | 5,129 | 1,310 | 990 | 437 | 719 | 661 | 689 | 25,483 |
| **1967** | 481 | 474 | 1,402 | 3,481 | 7,809 | 9,164 | 2,380 | 1,525 | 1,500 | 633 | 534 | 499 | 29,881 |
| **1968** | 517 | 449 | 582 | 1,333 | 11,806 | 17,316 | 3,652 | 3,536 | 1,095 | 689 | 774 | 587 | 42,334 |
| **1969** | 446 | 392 | 449 | 5,576 | 15,803 | 8,569 | 4,243 | 1,636 | 1,398 | 1,427 | 1,041 | 695 | 41,674 |
| **1970** | 627 | 514 | 633 | 1,172 | 17,647 | 12,020 | 3,837 | 1,586 | 2,696 | | | | |
| **Average** | 565 | 493 | 666 | 2,927 | 11,094 | 10,078 | 3,523 | 1,674 | 1,174 | 912 | 736 | 626 | 34,466 |
| | | | | | | | | | | | | | 730 |

Sum of Monthly Averages

Ac-Ft / sq. mi.

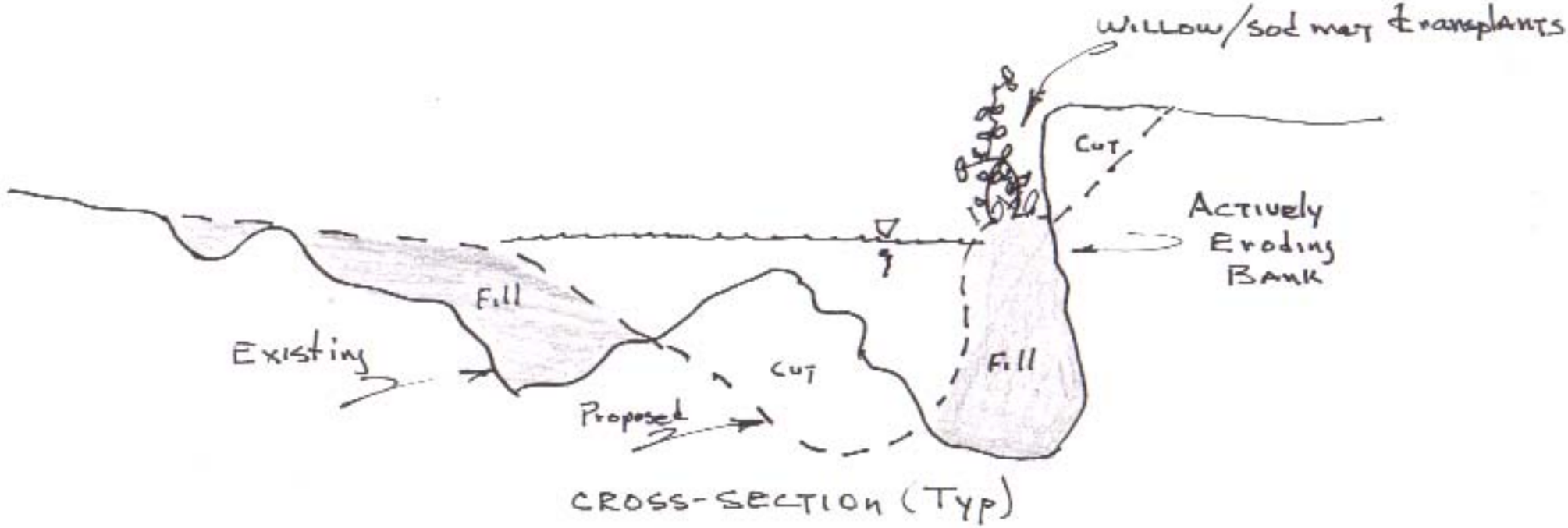
April 10, 2008

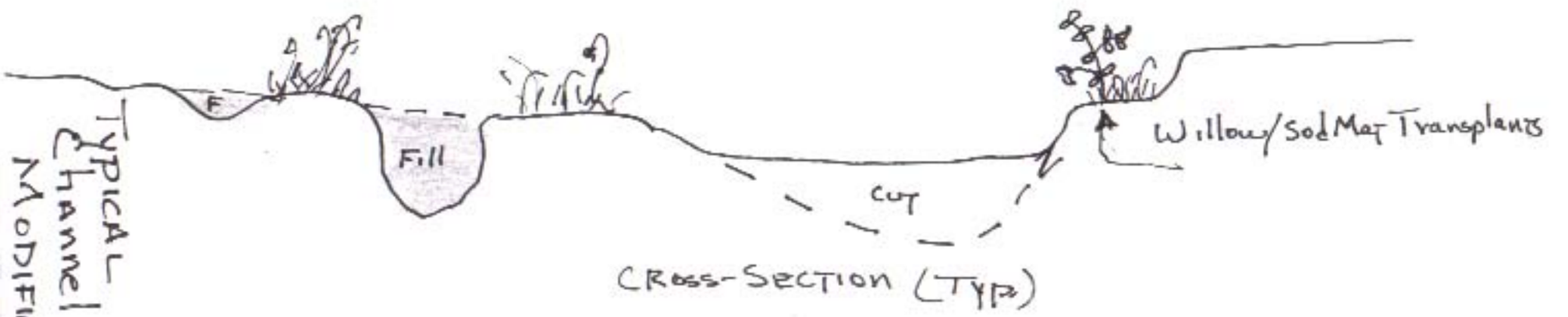
**Table 5-A**
**Castle Creek at Baldwin (USGS Gage No. 09113300)**
**50th Percentile (Median) of Daily Mean Flows (1958 - 1970**
**(Values in cfs)**

| Day of Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9.3 | 9.0 | 9.3 | 12.0 | 77 | 173 | 85 | 24 | 14 | 12 | 12 | 10 |
| 2 | 9.5 | 8.8 | 9.3 | 12 | 90 | 181 | 75 | 24 | 13 | 12 | 12 | 10 |
| 3 | 9.5 | 8.8 | 9.3 | 14 | 106 | 167 | 72 | 20 | 14 | 11 | 12 | 11 |
| 4 | 9.5 | 9.0 | 9.3 | 17 | 116 | 184 | 67 | 22 | 14 | 12 | 12 | 11 |
| 5 | 9.5 | 9.0 | 9.0 | 18 | 120 | 187 | 65 | 26 | 15 | 12 | 12 | 11 |
| 6 | 9.5 | 9.0 | 9.0 | 23 | 129 | 196 | 58 | 26 | 20 | 12 | 12 | 10 |
| 7 | 9.5 | 9.0 | 9.3 | 27 | 112 | 193 | 54 | 29 | 18 | 12 | 11 | 10 |
| 8 | 9.5 | 9.0 | 9.3 | 22 | 121 | 215 | 47 | 27 | 17 | 11 | 11 | 10 |
| 9 | 9.5 | 9.0 | 9.3 | 20 | 133 | 200 | 42 | 28 | 17 | 11 | 11 | 10 |
| 10 | 9.5 | 9.0 | 9.3 | 19 | 132 | 175 | 42 | 24 | 15 | 12 | 11 | 10 |
| 11 | 9.5 | 9.0 | 8.8 | 19 | 138 | 172 | 52 | 22 | 15 | 12 | 12 | 10 |
| 12 | 9.5 | 9.0 | 8.6 | 20 | 153 | 157 | 48 | 21 | 14 | 13 | 12 | 10 |
| 13 | 9.5 | 9.0 | 9.0 | 21 | 160 | 144 | 41 | 27 | 14 | 12 | 12 | 10 |
| 14 | 9.5 | 9.0 | 9.0 | 25 | 149 | 143 | 38 | 25 | 16 | 12 | 11 | 9.9 |
| 15 | 9.5 | 9.0 | 8.8 | 35 | 158 | 160 | 33 | 26 | 14 | 13 | 12 | 9.9 |
| 16 | 10 | 8.8 | 8.6 | 33 | 170 | 150 | 36 | 24 | 15 | 13 | 12 | 10 |
| 17 | 10 | 8.8 | 8.9 | 32 | 175 | 160 | 43 | 23 | 15 | 14 | 11 | 9.9 |
| 18 | 9.7 | 8.8 | 9.5 | 30 | 176 | 143 | 35 | 21 | 14 | 12 | 10 | 9.5 |
| 19 | 9.5 | 8.5 | 9.4 | 34 | 186 | 155 | 29 | 23 | 14 | 13 | 10 | 9.5 |
| 20 | 9.5 | 8.5 | 9.1 | 41 | 189 | 165 | 28 | 23 | 14 | 14 | 10 | 9.8 |
| 21 | 9.5 | 8.8 | 9.0 | 52 | 202 | 139 | 26 | 21 | 15 | 12 | 11 | 9.5 |
| 22 | 9.5 | 8.8 | 8.9 | 51 | 203 | 122 | 24 | 20 | 14 | 12 | 12 | 9.5 |
| 23 | 9.3 | 8.5 | 9.0 | 57 | 224 | 107 | 34 | 18 | 14 | 12 | 11 | 9.5 |
| 24 | 9.0 | 8.5 | 9.5 | 47 | 209 | 127 | 37 | 16 | 12 | 12 | 12 | 9.5 |
| 25 | 8.8 | 8.8 | 10 | 51 | 203 | 114 | 33 | 17 | 12 | 11 | 12 | 9.5 |
| 26 | 8.8 | 9.0 | 11 | 59 | 213 | 119 | 25 | 15 | 11 | 12 | 11 | 9.5 |
| 27 | 8.8 | 9.0 | 10 | 68 | 191 | 112 | 23 | 18 | 14 | 12 | 10 | 9.5 |
| 28 | 8.8 | 9.0 | 11 | 67 | 201 | 107 | 23 | 16 | 12 | 11 | 10 | 9.5 |
| 29 | 8.8 | 8.5 | 12 | 66 | 181 | 97 | 20 | 14 | 12 | 12 | 10 | 9.5 |
| 30 | 9.0 |  | 11 | 79 | 168 | 93 | 20 | 14 | 12 | 11 | 10 | 9.3 |
| 31 | 9.5 |  | 12 |  | 168 |  | 24 | 14 |  | 12 |  | 9.3 |

# APPENDIX A

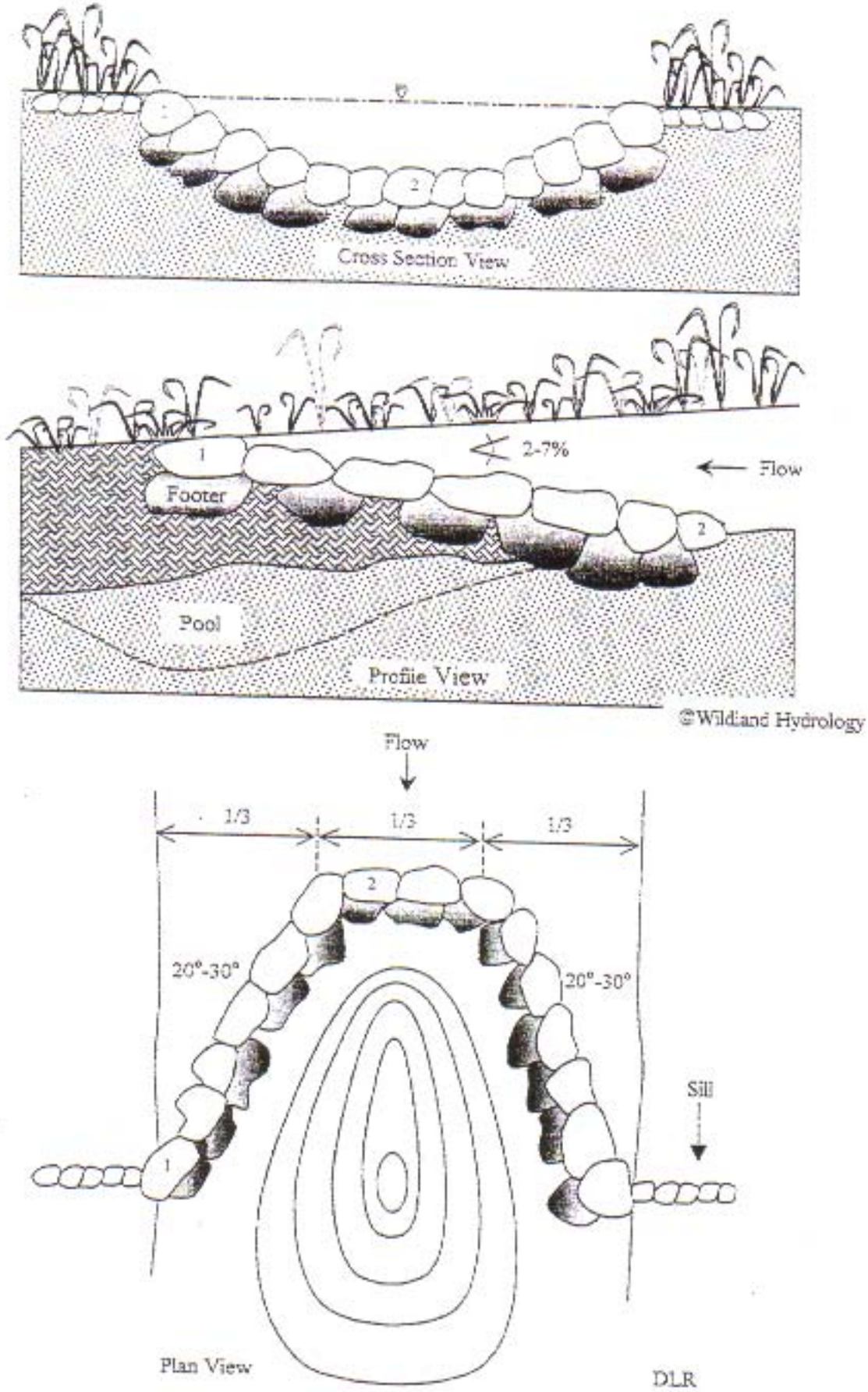
## Details of Proposed River Improvements




TYPICAL Channel MODIFICATIONS

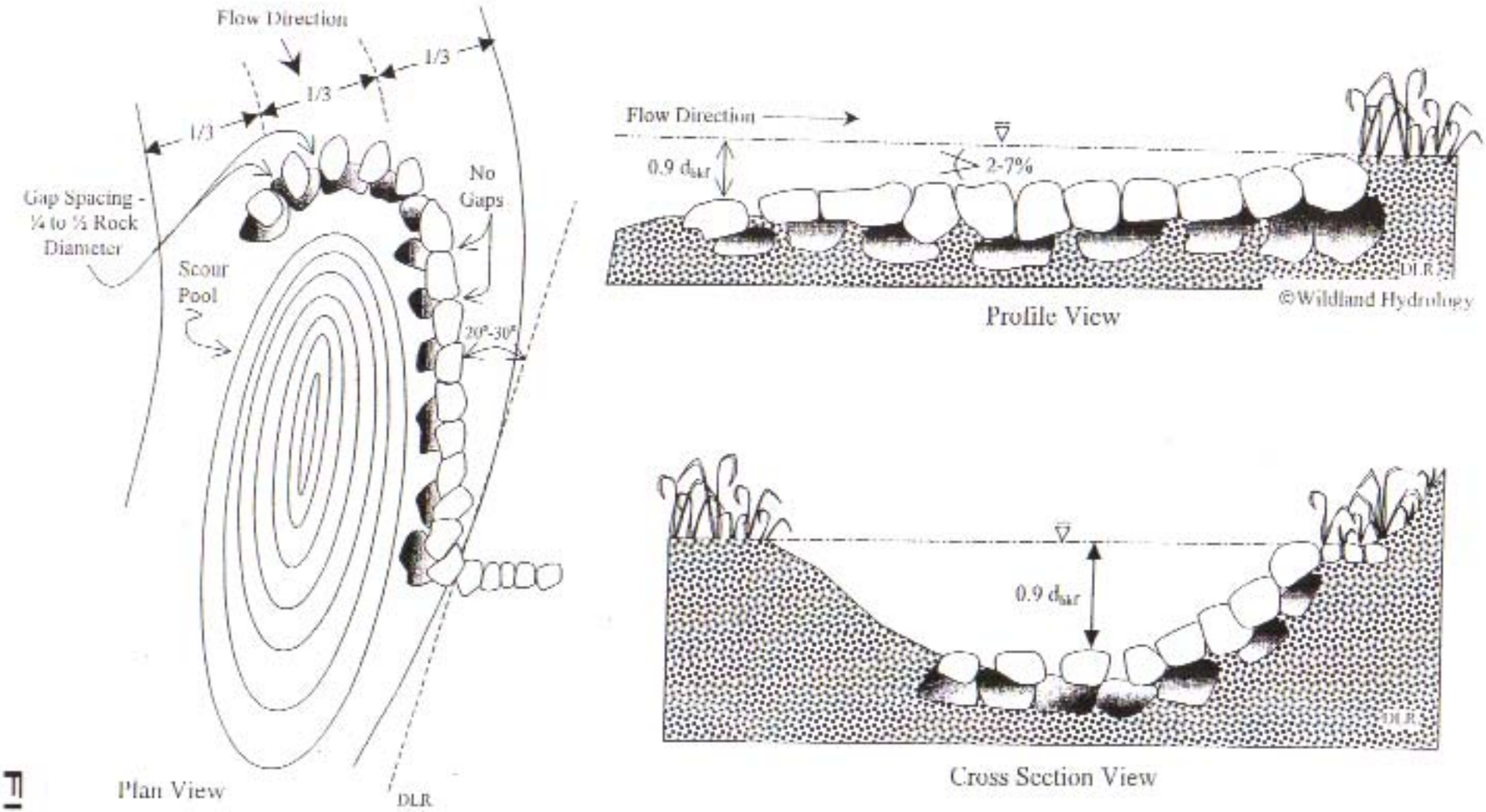
FIGURE A1




*Cross section, profile and plan view of a cross vane*


\\Mother\mother's c\Design documents\CaseManual\SectionF\crosssection2.doc

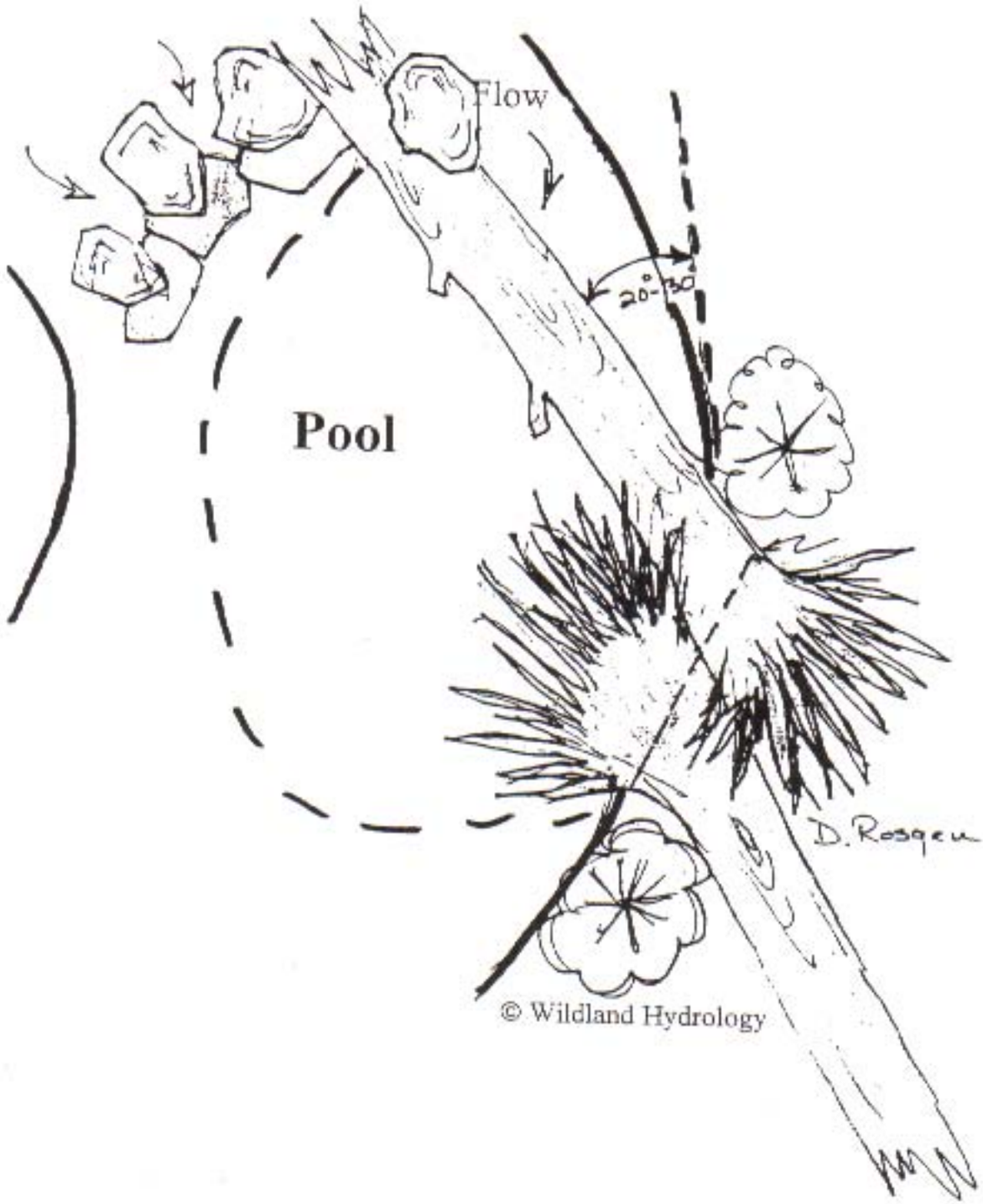
FIGURE A2




*Plan, profile, and section view of the J-Hook vane*

FIGURE A3


\\Mother\mother's_c_S\Design documents\ClassManual\SectionF\planprofile2.doc




*Log Vane/J-Hook Combo with Root Wad*