# 2008 Fish and Environmental Monitoring Report

for the

Rio Grande Nature Center

Habitat Restoration Project

Bernalillo County, NEW MEXICO

Prepared by

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of Engineers®
Albuquerque District

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Introduction

The Rio Grande Nature Center Habitat Restoration Project (RGNCHRP) is a Middle Rio Grande Endangered Species Collaborative Program (MRGESCP) project. Construction of the project included restoration of the existing side channel by reconnecting it to the river in order to reestablish predominantly native habitat that benefits both the silvery minnows and flycatcher. Two embayments were constructed where the channel connects with the river. Another two embayments were constructed along the side of the channel. These additional embayments were inundated at higher flows and flows receded into the channel. The embayments varied from 1' to 3' in depth. Construction was completed by the U.S. Army Corps of Engineers Albuquerque District (Corps) in March 2008.

Per the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) on the effects of the action described in the Biological Assessment for the Rio Grande Nature Center Habitat Restoration Project for the Albuquerque Reach of the Rio Grande in Bernalillo County, New Mexico dated February 1, 2007 and the Final Environmental Assesment (EA) and Finding of No Signification Impact for the Rio Grande Nature Center Habitat Restoration Project dated November 27, 2006, monitoring of the project would occur. The following Terms and Conditions in the BO will be addressed in this monitoring report:

To implement RPM 1, the Corps shall:

1. In coordination with the Service, develop a protocol to monitor presence/absence of silvery minnows in the ephemeral channel following high flows, and to determine whether channel maintenance is warranted.
2. Report findings of injured or dead silvery minnows to the Service.
3. The final restoration monitoring report (outlining the results and effectiveness of the side channel restoration and embayment creation) shall be provided to the Service.

To implement RPM 2, the Corps shall:

1. Report to the Service, water quality measurements taken before, during and after construction activity.

Monitoring, Adaptive Management and Maintenance

Per the EA, the monitoring plan included monitoring for a number of habitat features, most specifically use by Rio Grande silvery minnow egg, larvae, and adults. The channel would be monitored for use and also to make sure that no fish (of any species) are stranded. Other environmental features, including vegetation and ground water, were monitored.

The channel was also monitored for accumulation of sediment which may require removal. Other maintenance may need to be required periodically and the channel would be monitored for this (such as treatment of re-sprouting of non-native vegetation). Part of this monitoring may provide information on design that may require changes. Depending on how high flows move through the channel and potential for maintenance items such as scouring and/or build up of sediment, adaptive management could be implemented for maintenance of habitat features.

Construction Monitoring

During construction of the opening of the north (which occurred March 17-18, 2008) and south (which occurred March 19-20, 2008) ends of the channel in connection with the river,, the following monitoring occurred: For RPM 2, #1, water quality was not recorded because construction occurred under completely dry conditions, though turbidity was observed during opening of the channel as described below.

During the removal of the berms at the downstream and upstream ends of the high flow channel (March 17-20, 2008), the Corps' Fishery Biologist was present. The downstream berm was removed first, allowing water to back up into the channel. The turbidity was slightly elevated during berm removal, but did not extend more than 5 m from the active construction. The upstream berm was removed the following day using techniques directed by the Corps fishery biologist. The excavator removed sediment down to the water line, and then raked the shelf to allow water to start pouring over the berm lip. The turbidity level was reduced and the extent within the upper embayment was less than 2 meters before it was imperceptible. For RPM 1, #2, no injured or dead fish of any species were observed.

2008 Monitoring

The flow during spring runoff in 2008 inundated the channel, including the constructed embayments. Monitoring focused on the determining the presence of silvery minnows and spawning.

Methods

*Water Temperature*

Locations for sampling the continuous water temperature (C) and water quality (F) sites were mapped prior to initiation of monitoring (Figure 1). Environmental data was collected by the Friends of the Rio Grande Nature Center (FRGNC) volunteers. Temperature (°C) and dissolved oxygen (ppm) data were recorded using a Hach LDO101 optical dissolved oxygen probe. Water quality data was recorded on a rotating schedule in the morning (7-11 AM), midday (11AM -3 PM), or afternoon (3-7 PM), two or more times a week. Waterproof data loggers were deployed at seven locations from May 8 to June 26 to collect continuous water temperature data on a diurnal basis.

*Fish Sampling*

A 3 or 7.5 m wide 3/16" mesh seine was used for fish sampling. The seine was drawn over selected areas in each of the constructed inlets. Kicknets and seines were used to sample for silvery minnow eggs. Fish collected by seining were identified to species. The locations of the fish sampling sites (C 02, 04, 05, 07) are shown in Figure 1. The numbers of individual fish by species were recorded by seine haul with an estimate of the area sampled. All fish were released alive following enumeration. Pedestrian surveys were conducted after the channel became intermittent to evaluate stranding of fish in pools along the channel

Geographic coordinates were recorded using a Trimble GeoXH handheld GPS unit and corrected prior to transfer into GIS. The spatial data was mapped using ArcGIS for describing potential habitat value for the silvery minnow at the Rio Grande Nature Center Project.

*Groundwater Monitoring*
As part of the construction of the project, groundwater monitoring wells were installed at 3 locations adjacent to the channel (Figure 3). Monitoring of these wells will help to evaluate the connection between the shallow groundwater and surface water of the channel (when it is flowing). It also aided in installation of native vegetation and where to place which species based on distance to groundwater. The wells were monitored for depth to groundwater on the following dates:

*Installation of USGS Stage Gage and Monitoring*
The objective of the installation of a stage gage is to collect intermittent streamflow data in the RGNCHRP over an extended duration. The crest-stage gage was installed near station 14+00 (Figure 2) in the channel bottom at the toe of the east bank in October 2008.

The streamflow site was equipped with an In-Situ Level Troll 500 pressure transducer (vented type). The transducer will record gage height data on 5-minute increments and the data will be transferred from the field to the USGS database approximately every month. The gaging site will be surveyed by USGS personnel and a theoretical stage vs. discharge rating will be computed using the Corps of Engineer's HEC-RAS software. USGS personnel will continue to calibrate and service the gage throughout the 2009 fiscal year and thereafter on an annual basis as the contract is renewed. An annual summary report including a brief summary of completed work items will be provided at least once during the fiscal year to the Corps. The summary for 2008 is provided in Appendix A.

Results
The area of habitat features (pool and bars) shown in Figure 1 are summarized in Table 1. The total area of the pools during inundation was 3073.8 $m^2$, while the sandbars that formed during runoff had an area of 1129.1 $m^2$.

A total of 1444 fish (Table 2) were collected and identified during seven sampling trips from pools at each of the four inlets (Figure 1; Table 2). The most numerous species were red shiners (*Cyprinella lutrensis*) and young of year common carp (*Cyprinus carpio*). The 268 silvery minnows (*Hybognathus amarus*) were all adults. No silvery minnow eggs were collected during sampling with seines or kicknets. There were few signs of avian predation at the pools before or after they became isolated from the main channel. The pools maintained suitable depth and water quality after becoming isolated by seepage through the sandbars. Fish remaining in the pools appeared to be in good condition. Pool 4 was connected to the channel at 2600 cfs (USGS Albuquerque Gage), and isolated when flow decreased to 2060 cfs. Pool 5 was connected at 2290 and was isolated at a flow of 1020 cfs.

Pedestrian surveys of the channel were conducted on 7/16, 7/30, and 8/11. Approximately 15 dead young of year carp were observed at pool 4 after complete drying on 8/11. Flow at the Albuquerque Gage on 8/6 and 8/9 were sufficient to rewet the channel with peak flow of 1930 cfs (USGS Albuquerque Gage) and 1890 cfs. These two events elevated flow above 1000 cfs from midnight to 6:00 AM. The survey on 8/11 did not observe any newly stranded fish of any

species, and few bird or mammal tracks were observed. Another rain event produced a peak flow of 1750 cfs on 9/1 with flow above 1000 cfs for 17 hours during the day.

Data from loggers deployed along the channel and pools (Figure 1; Table 3) recorded diurnal and longitudinal water temperature at the project. Figure 2 compares water temperature in the channel (C-03) with temperatures in two of the pools (C-04 &05). Figure 3 shows the elevated water temperature at one interior pool (C-04) with temperatures in the main river channel at C-01 and C-08. Water quality data collected by the FRGNC (Figure 1; Table 4) provides longitudinal comparisons of temperature (Table 5) and dissolved oxygen (Table 6). Temperatures in the pools were higher than the adjacent channel when the river flow was lower (2000-3000 cfs). Dissolved oxygen generally tracked between the river (F-01, 23), the channel, and the pools. Oxygen levels were higher in the pools later in the day.

Depth to groundwater results are shown in Table 6. There is currently not enough sampling data to show trends but the information has been utilized in order to plant native vegetation along the banks of the channel during the winter of 2008 and 2009.

Discussion

Monitoring of the project pools along the reconnected high flow channel validates one of the purposes of the project to provide habitat used by silvery minnow during spring runoff when flows are elevated. The silvery minnows collected were in good condition and a suitable size for spawning. The absence of silvery minnow eggs indicates that either no spawning occurred within 24 hours prior to fish sampling, or flow through the pools was sufficient to transport eggs into the high flow channel. Water temperature data collected by FRGNC and the Corps indicates water exchange between the channel and the pools, particularly at higher flows. Though silvery minnow eggs have been collected off un-vegetated substrate (Porter and Dean, 2007), inundated vegetation appears to be a preferred habitat feature. Subsequent studies at the site should increase sampling area and frequency for eggs to verify whether the features are functioning as spawning and nursery habitat.

The number of silvery minnows and red shiners in the pools 3-5 days prior to isolation suggests escapement occurred prior to the pools becoming disconnected from the channel. No increases in predator tracks were noted during visits prior to or after the pools became isolated. The presence of carp (*C. carpio*) and fathead minnows (*P. promelas*) in the isolated pools also indicates that silvery minnows emigrated from the pools rather than removal by predators. The differential emigration of silvery minnows and red shiners versus other fish (carp and fathead minnows) suggests an un-described mechanism for their exit behavior. Understanding this behavior may provide useful insights for how silvery minnows avoid pools during river drying. The three rain events during the summer reconnected the high flow channel with the river, but do not appear to have re-connected with the pools (C-04/05) along the channel. The brief time period (~6 hours) at night may not have been conducive for fish movement into the channel. The pedestrian surveys provide preliminary observations of temporary channel inundation with minimal stranding of small fish. Installation of the gage by the U.S. Geological Survey in the high flow channel may support conducting near real time fish surveys for further evaluation of fish stranding during rain events.

Temperatures in the pools were higher than the adjacent channel when the river flow was lower (2000-3000 cfs). Changes in connectivity between pools and the high flow channel would be reflected by the increasing differences in diurnal temperatures. These temperature changes may provide silvery minnows specific cues for emigration from the pools. Specific experiments are needed to document this hypothesis.

The trends with dissolved oxygen indicate good water exchange the river, the channel, and the pools. The higher dissolved oxygen in the pools later in the day indicates local primary productivity by algae.

Literature Cited

Porter, M.D. and G. Dean 2007. Annual Report-2007, Rio Grande Fish Community Surveys. U.S. Bureau of Reclamation, November 2007, 14 pg.

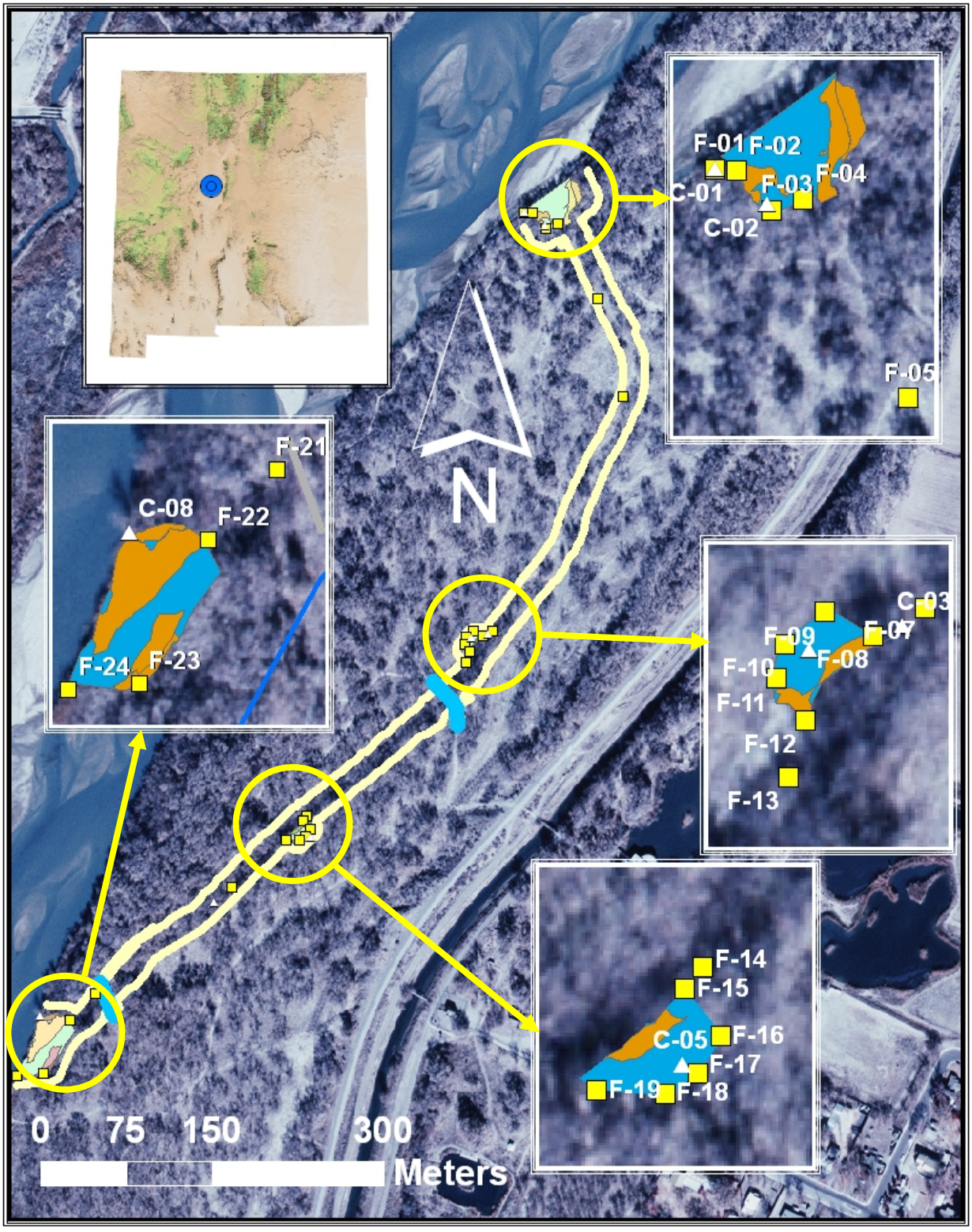


Figure 1.Map of Rio Grande Nature Center restoration project.

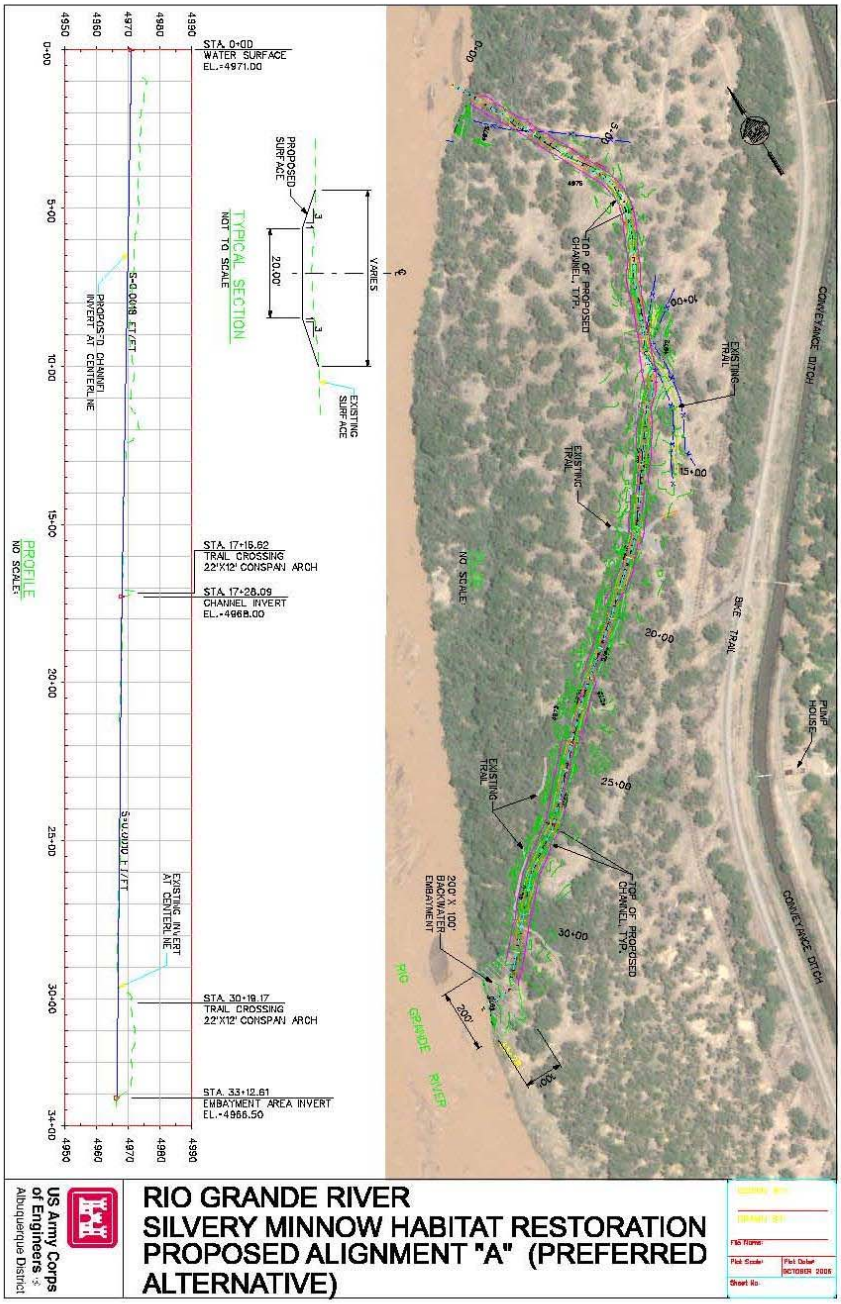


Figure 2 – Location Map of Streamflow Monitoring Site


Figure 3. Groundwater Monitoring Well Locations

Table 1. Dimensions of constructed habitat features at Rio Grande Nature Center restoration project.

| Constructed Habitat Features | Area ($m^2$) | | Perimeter (m) | UTM NAD 83 | |
|---|---|---|---|---|---|
| | Pools | Bars | | Easting | Northing |
| North Inlet / Pool 2 | 1172.6 | | 139.4 | 346509 | 3889362 |
| North Inlet Bar 1 | | 125.8 | 98.7 | | |
| North Inlet Bar 2 | | 81.4 | 67.7 | | |
| Pool 4 | 157.4 | | 54.8 | 346446 | 3889011 |
| Pool 4 Inlet Bar | | 43.0 | 63.1 | | |
| Pool 5 | 209.1 | | 62.5 | 346301 | 3888837 |
| Pool 5 Inlet Bar | | 36.3 | 34.5 | | |
| South Inlet Pool 7 | 1534.7 | | 162.3 | 346084 | 3888683 |
| South Inlet Bar 1 | | 579.0 | 134.4 | | |
| South Inlet Bar 2 | | 49.8 | 40.3 | | |
| South Inlet Bar 3 | | 81.4 | 61.7 | | |
| South Inlet Bar 4 | | 132.4 | 64.6 | | |
| Total Area | 3073.8 | 1129.1 | | | |

Table 2. Summary of fish collection data for Rio Grande Nature Center restoration project.

| | | 2-4-5-7 All pools connected to channel | 2-4-5-7 Pool connected to channel | 4 Pool connected to channel | 4 Pool connected to channel | 4 Isolated pool | 5 Pool connected to channel | 5 Isolated pool |
|---|---|---|---|---|---|---|---|---|
| Flow at Albuquerque Gage (cfs) | | 3960 | 4410 | 2550 | 2600 | 2060 | 2290 | 1020 |
| Species | Total | 5/29/2008 | 6/3/2008 | 6/19/2008 | 6/24/2008 | 6/27/2008 | 7/2/2008 | 7/7/2008 |
| Carpiodes carpio | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| Catostomus commersoni | 122 | 1 | 1 | 8 | 56 | 3 | 51 | 2 |
| **Cyprinella lutrensis** | **487** | **289** | **110** | **0** | **83** | **1** | **2** | **2** |
| Cyprinus carpio | 503 | 0 | 0 | 0 | 37 | 39 | 313 | 114 |
| Gambusia affinis | 14 | 0 | 0 | 0 | 1 | 3 | 4 | 6 |
| **Hybognathus amarus** | **268** | **66** | **40** | **0** | **77** | **0** | **85** | **0** |
| Lepomis macrochirus | 4 | 2 | 1 | 0 | 0 | 0 | 1 | 0 |
| Micropterus salmoides | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **Pimephales promelas** | **40** | **4** | **5** | **7** | **7** | **9** | **7** | **1** |
| Total Fish | 1444 | 364 | 158 | 15 | 261 | 57 | 463 | 125 |
| Area sampled | | 88.39 | 88.39 | 15.00 | 88.39 | 88.39 | 88.39 | 88.39 |
| CPUE (all) | | 411.80 | 178.75 | 100.00 | 295.27 | 64.48 | 523.80 | 141.41 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CPUE RGSM | 74.67 | 45.25 | 0.00 | 87.11 | 0.00 | 96.16 | 0.00 |

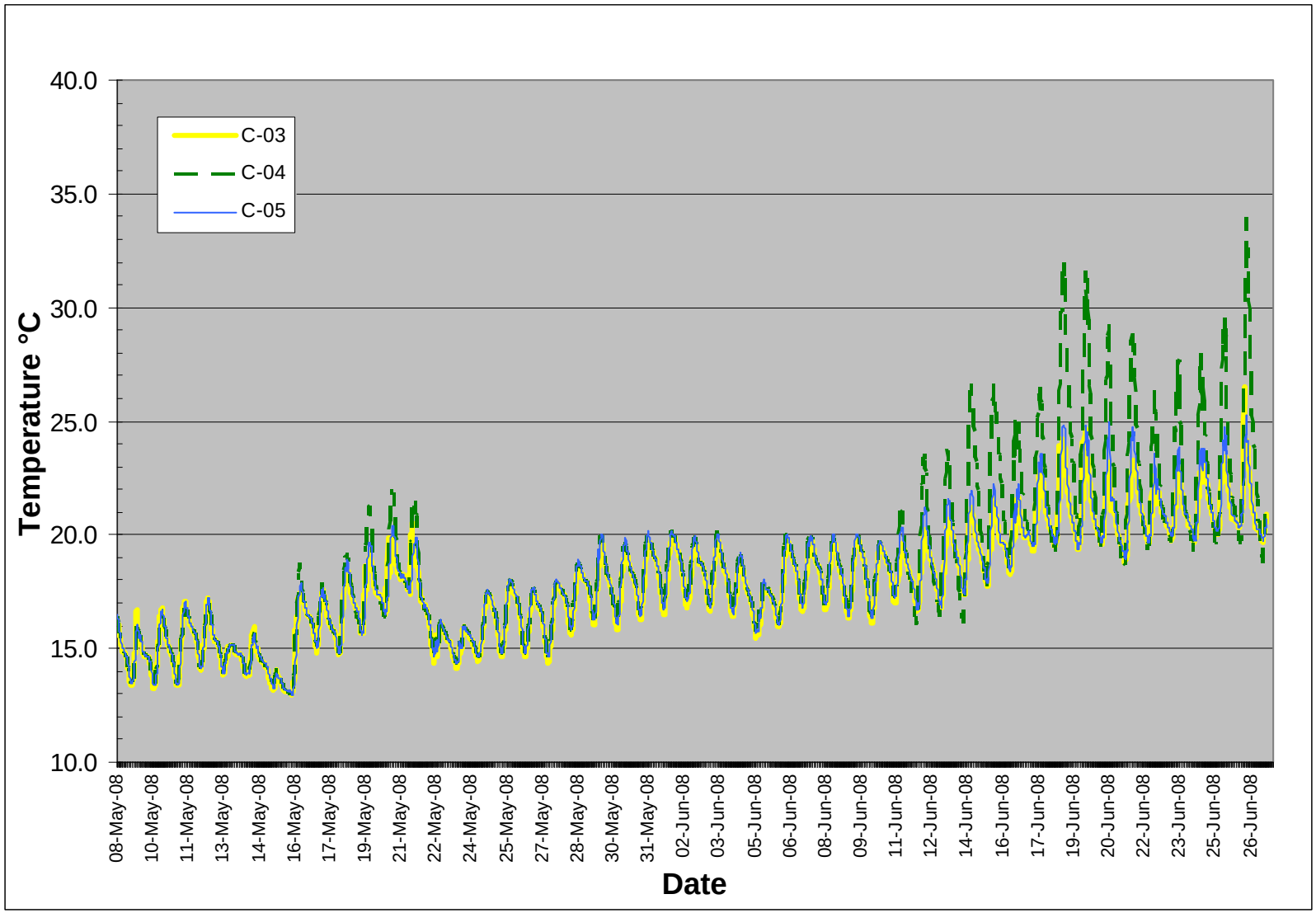


Figure 2. Water temperature from data loggers in the Rio Grande Nature Center channel.

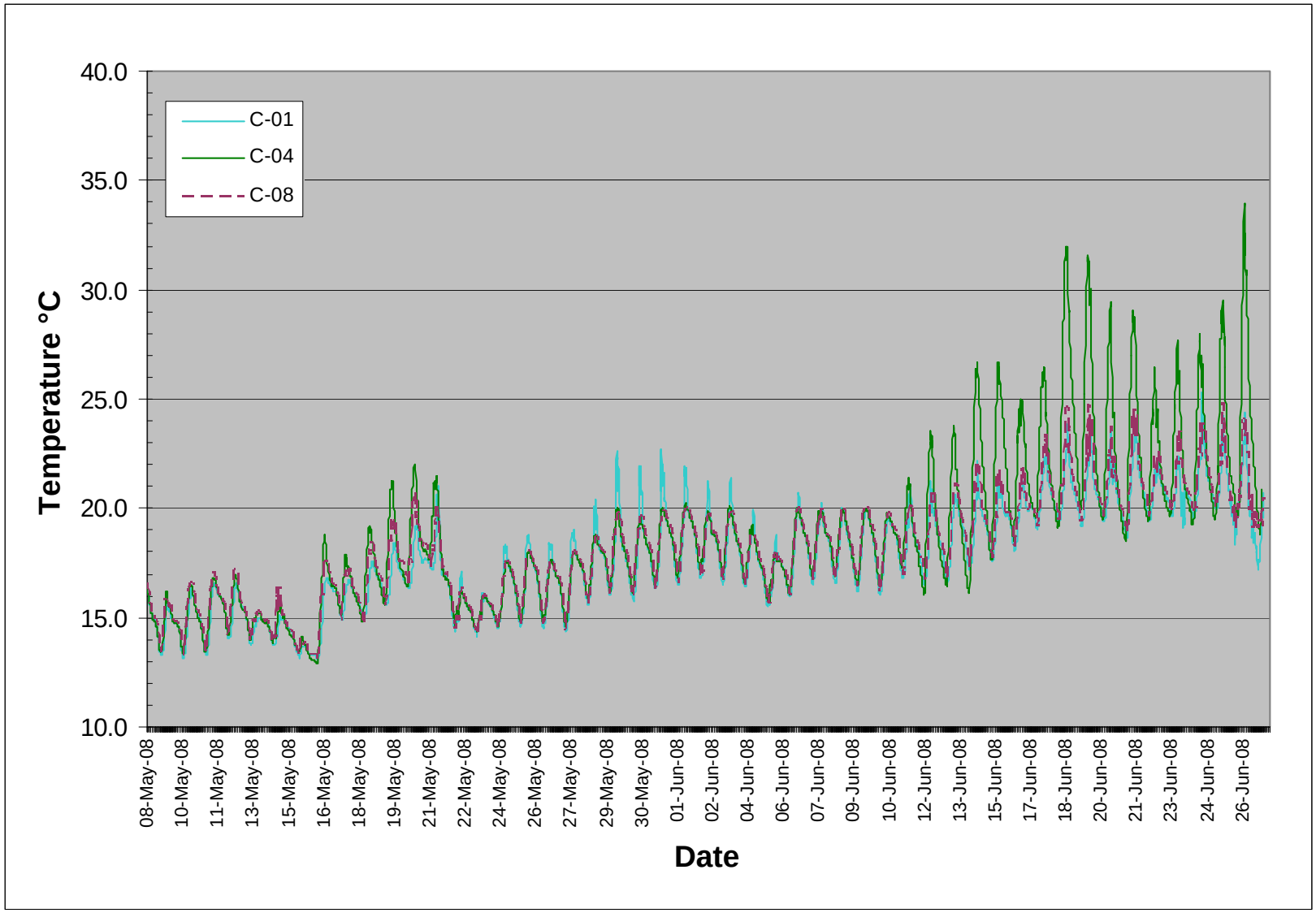


Figure 3. Comparison of water temperature from data loggers in Rio Grande (C-01 / C-08) and an embayment in the Rio Grande Nature Center channel (C-04).

Table 3. Sampling locations in NAD83 UTM coordinates (m).

| Corps temperature recorder | EAST | NORTH |
|---|---|---|
| C-01 | 346487.66 | 3889384.11 |
| C-02 / pool | 346505.01 | 3889372.72 |
| C-03 | 346455.50 | 3889014.87 |
| C-04 / pool | 346440.15 | 3889011.06 |
| C-05 / pool | 346299.91 | 3888836.83 |
| C-06 | 346215.23 | 3888779.05 |
| C-07 / pool | 346084.33 | 3888683.81 |
| C-08 | 346062.91 | 3888679.63 |

Table 4. Friends of Rio Grande Nature Center sample locations

| | EAST | NORTH |
|---|---|---|
| F-01 | 346487.66 | 3889384.11 |
| F-02 | 346494.77 | 3889383.63 |
| F-03 | 346506.39 | 3889370.75 |
| F-04 | 346516.78 | 3889374.34 |
| F-05 | 346551.47 | 3889309.05 |
| F-06 | 346573.59 | 3889223.10 |
| F-07 | 346459.25 | 3889017.95 |
| F-08 | 346450.63 | 3889013.36 |
| F-09 | 346442.82 | 3889017.30 |
| F-10 | 346436.10 | 3889011.99 |
| F-11 | 346434.83 | 3889006.36 |
| F-12 | 346439.56 | 3888999.52 |
| F-13 | 346436.84 | 3888990.21 |
| F-14 | 346296.55 | 3888855.28 |
| F-15 | 346293.54 | 3888851.64 |
| F-16 | 346299.42 | 3888843.91 |
| F-17 | 346295.62 | 3888837.81 |
| F-18 | 346290.24 | 3888834.44 |
| F-19 | 346279.04 | 3888835.00 |
| F-20 | 346231.21 | 3888793.28 |
| F-21 | 346111.40 | 3888700.13 |
| F-22 | 346088.52 | 3888676.95 |
| F-24 | 346042.64 | 3888627.79 |
| F-23 | 346065.99 | 3888629.95 |

Table 5. Water temperature data recorded by the Friends of the Rio Grande Nature Center.

| Water Temperature | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/2 | 5/3 | 5/6 | 5/7 | 5/8 | 5/16 | 5/20 | 5/20 | 5/27 | 5/29 | 5/31 | 6/2 | 6/6 | 6/10 | 6/16 | 6/19 | 6/26 | 6/28 | 7/3 | 7/9 | 7/14 |
| Start time | 9:37 | 14:09 | 10:32 | 13:00 | 16:33 | 9:05 | 8:38 | 14:05 | 12:50 | 10:09 | 8:22 | 8:27 | 13:37 | 11:01 | 14:27 | 15:30 | 14:50 | 15:28 | 9:20 | 10:41 | 14:32 |
| End time | 10:24 | 15:08 | 11:34 | 13:56 | 17:30 | 10:22 | 10:00 | 15:20 | 13:35 | 11:06 | 9:19 | 9:48 | 14:11 | 0:00 | 0:00 | 16:23 | 15:52 | 16:19 | 9:57 | 11:11 | 14:59 |
| Flow | 3470 | 3430 | 3620 | 3420 | 3680 | 3420 | 2950 | 2950 | 4710 | 3960 | 4150 | 4440 | 4480 | 4980 | 3180 | 2550 | 2100 | 2060 | 2050 | 653 | 958 |
| Station | | | | | | | | | | | | | | | | | | | | | |
| 1 | 10.6 | 14.2 | 13.8 | 16.0 | 16.2 | 13.4 | 17.6 | 19.6 | 15.8 | - | 16.1 | 16.7 | 18.8 | 16.6 | 21.0 | 23.4 | 23.3 | 22.3 | 21.6 | 23.1 | 25.0 |
| 2 | 10.6 | 14.6 | 14.4 | 15.9 | 0.0 | 13.7 | 17.5 | 22.9 | 15.9 | - | 16.1 | 16.8 | 18.4 | 16.7 | 20.7 | - | - | - | - | - | - |
| 3 | 10.7 | 14.3 | 14.0 | 15.4 | 16.8 | 13.5 | 17.0 | 19.3 | 16.1 | - | 16.1 | 17.0 | 18.3 | 16.7 | 21.0 | 26.8 | 25.3 | 25.9 | - | - | - |
| 4 | 10.4 | 14.2 | 13.9 | 15.0 | 16.8 | 13.5 | 16.6 | 19.2 | 16.0 | - | 16.1 | 16.9 | 18.1 | 16.9 | 20.3 | 22.9 | 22.8 | 22.0 | - | - | - |
| 5 | 10.5 | 14.6 | 14.0 | 15.2 | 16.4 | 13.5 | 17.4 | 19.5 | 16.2 | - | 16.1 | 16.9 | 18.2 | 16.8 | 20.7 | 22.5 | 22.9 | 22.3 | - | - | - |
| 6 | 10.5 | 14.2 | 14.2 | 15.3 | 16.6 | 13.9 | 17.2 | 19.5 | 16.6 | - | 16.1 | 17.0 | 18.1 | 17.1 | 20.6 | 22.1 | 22.7 | 22.6 | - | - | - |
| 7 | 10.8 | 14.8 | 14.0 | 15.8 | 16.8 | 13.3 | 17.1 | 19.2 | 16.1 | - | 16.2 | 17.0 | 18.5 | 16.6 | 21.0 | 22.5 | 23.0 | 22.7 | - | - | - |
| 8 | 10.7 | 16.2 | 14.9 | 15.9 | 16.7 | 13.2 | 17.1 | 21.8 | 16.5 | - | 16.5 | 17.0 | 18.5 | 16.9 | 22.6 | 26.7 | - | - | - | - | - |
| 9 | 11.4 | 15.8 | 15.1 | 16.8 | 16.8 | 13.5 | 17.0 | 21.5 | 16.6 | - | 16.4 | 17.4 | 18.6 | 17.0 | 23.5 | 28.1 | 28.7 | 28.8 | - | - | - |
| 10 | 11.3 | 15.1 | 15.4 | 17.2 | 16.8 | 13.6 | 17.1 | 21.6 | 16.7 | - | 16.5 | 17.5 | 18.7 | 16.8 | 23.7 | 26.7 | 28.1 | 29.8 | - | - | - |
| 11 | 11.1 | 14.3 | 14.8 | 16.4 | 16.9 | 13.4 | 17.8 | 21.8 | 16.7 | - | 16.5 | 17.2 | 18.4 | 16.7 | 24.0 | 28.1 | 28.7 | 27.5 | - | - | - |
| 12 | 10.8 | 14.5 | 14.6 | 15.9 | 17.2 | 13.6 | 17.1 | 20.4 | 17.3 | - | 16.5 | 17.1 | 18.4 | 16.7 | 21.1 | 24.5 | - | - | - | - | - |
| 13 | 10.8 | 14.4 | 15.2 | 15.8 | 17.7 | 13.9 | 16.8 | 20.2 | 16.8 | - | 16.7 | 17.2 | 18.4 | 16.7 | 20.7 | 23.0 | 23.2 | 23.0 | 22.4 | 26.7 | 28.9 |
| 14 | 10.7 | 14.5 | 14.3 | 15.9 | 16.3 | 14.2 | 16.9 | 19.2 | 16.7 | 17.5 | - | 17.5 | 18.5 | 17.9 | 20.6 | 22.7 | 24.1 | 23.5 | 22.3 | - | - |
| 15 | 10.8 | 14.4 | 14.8 | 16.0 | 16.7 | 13.8 | 17.1 | 20.0 | 16.7 | 16.9 | - | 17.3 | 18.7 | 16.8 | 20.8 | 23.3 | 23.7 | 24.4 | - | - | - |
| 16 | 10.8 | 14.0 | 14.5 | 15.8 | 16.6 | 13.5 | 17.1 | 19.8 | 16.6 | 17.2 | - | 17.1 | 18.6 | 16.5 | 20.8 | 23.0 | 23.3 | 24.0 | 22.0 | - | - |
| 17 | 10.8 | 13.8 | 14.6 | 15.6 | 16.5 | 13.6 | 17.4 | 19.6 | 16.6 | 17.5 | - | 17.0 | 18.5 | 16.3 | 20.7 | 23.2 | 23.3 | 23.5 | 22.6 | - | - |
| 18 | 10.8 | 13.9 | 14.6 | 15.4 | 16.5 | 13.5 | 17.3 | 19.6 | 16.6 | 17.3 | - | 16.9 | 18.5 | 16.8 | 20.6 | 23.0 | 23.2 | 23.2 | 22.2 | - | - |
| 19 | 10.7 | 14.0 | 14.8 | 15.2 | 16.4 | 13.5 | 17.1 | 19.5 | 16.6 | 17.5 | - | 16.9 | 18.5 | 16.8 | 21.0 | 22.9 | 23.2 | 23.2 | - | - | - |
| 20 | 10.6 | 14.4 | 14.6 | 15.6 | 16.4 | 14.2 | 17.2 | 19.6 | 16.6 | 17.1 | - | 16.8 | 18.4 | 17.0 | 21.5 | 23.0 | 23.1 | 23.3 | - | - | - |
| 21 | 10.6 | 15.2 | 14.3 | 15.6 | 16.4 | 14.2 | 16.7 | 19.2 | 16.4 | 17.4 | - | 16.9 | 18.5 | 17.1 | 21.0 | 22.7 | 23.0 | 23.3 | 21.7 | 22.2 | 27.6 |
| 22 | 10.7 | 16.1 | 14.5 | 15.4 | 16.7 | 13.8 | 16.8 | 19.3 | 16.5 | 17.3 | - | 17.0 | 18.4 | 16.9 | 21.2 | 23.1 | 23.0 | 22.8 | - | - | - |
| 23 | 11.0 | 15.8 | 14.6 | 15.6 | 16.7 | 13.8 | 17.2 | 19.8 | 16.9 | 17.4 | - | 17.1 | 18.5 | 16.9 | 21.6 | - | - | - | - | - | - |
| 24 | 11.1 | 15.1 | 14.9 | 15.4 | 16.9 | 13.8 | 17.7 | 20.4 | 17.1 | 17.3 | - | 16.9 | 18.5 | 17.2 | 21.9 | 23.9 | 23.1 | 23.4 | 21.7 | 22.7 | 25.2 |

Table 6. Dissolved oxygen data recorded by the Friends of the Rio Grande Nature Center.

| | Dissolved Oxygen | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/2 | 5/3 | 5/6 | 5/7 | 5/8 | 5/16 | 5/20 | 5/20 | 5/27 | 5/29 | 5/31 | 6/2 | 6/6 | 6/10 | 6/16 | 6/19 | 6/26 | 6/28 | 7/3 | 7/9 | 7/14 |
| Station | | | | | | | | | | | | | | | | | | | | | |
| 1 | 8.9 | 8.8 | 8.5 | 8.3 | 8.4 | 8.5 | 7.5 | 8.6 | 8.0 | - | 7.7 | 7.6 | 7.5 | 7.6 | 7.2 | 7.1 | 7.0 | 7.3 | 7.0 | 7.1 | 6.8 |
| 2 | 8.9 | 8.9 | 8.6 | 8.6 | 8.3 | 9.0 | 9.7 | 13.8 | 8.0 | - | 7.7 | 7.6 | 7.6 | 7.6 | 7.2 | - | - | - | - | - | - |
| 3 | 9.0 | 8.8 | 8.5 | 8.6 | 8.4 | 8.5 | 7.9 | 8.1 | 8.0 | - | 7.7 | 7.6 | 7.7 | 7.6 | 7.5 | 8.4 | 8.2 | 8.6 | - | - | - |
| 4 | 9.0 | 8.7 | 8.4 | 8.5 | 8.3 | 8.4 | 7.7 | 7.8 | 8.0 | - | 7.7 | 7.6 | 7.7 | 7.5 | 7.4 | 7.3 | 7.1 | 7.5 | - | - | - |
| 5 | 8.9 | 8.7 | 8.4 | 8.5 | 8.2 | 8.4 | 7.5 | 7.8 | 8.0 | - | 7.7 | 7.6 | 7.7 | 7.6 | 7.3 | 7.3 | 7.1 | 7.4 | - | - | - |
| 6 | 8.9 | 8.8 | 8.4 | 8.5 | 8.3 | 8.3 | 7.7 | 7.8 | 7.9 | - | 7.7 | 7.6 | 7.7 | 7.5 | 7.3 | 7.4 | 7.1 | 7.3 | - | - | - |
| 7 | 9.0 | 8.8 | 8.5 | 8.5 | 8.3 | 8.5 | 7.6 | 8.2 | 8.0 | - | 7.7 | 7.5 | 7.6 | 7.6 | 7.2 | 7.4 | 7.1 | 7.3 | - | - | - |
| 8 | 8.9 | 9.1 | 8.6 | 8.9 | 8.6 | 8.7 | 9.3 | 12.2 | 8.0 | - | 7.7 | 7.6 | 7.8 | 7.6 | 8.0 | 7.9 | - | - | - | - | - |
| 9 | 8.8 | 9.2 | 8.5 | 8.9 | 8.6 | 8.8 | 8.5 | 12.0 | 8.0 | - | 7.7 | 7.6 | 7.8 | 7.6 | 8.1 | 8.0 | 8.5 | 9.9 | - | - | - |
| 10 | 8.8 | 8.9 | 8.5 | 9.0 | 8.5 | 8.5 | 8.4 | 11.3 | 7.9 | - | 7.7 | 7.6 | 7.8 | 7.6 | 8.3 | 8.6 | 8.4 | 10.0 | - | - | - |
| 11 | 8.9 | 8.8 | 8.4 | 8.9 | 8.4 | 8.8 | 8.3 | 9.6 | 7.9 | - | 7.7 | 7.6 | 7.7 | 7.6 | 8.0 | 8.9 | 8.4 | 10.8 | - | - | - |
| 12 | 8.9 | 8.8 | 8.4 | 8.6 | 8.3 | 8.5 | 7.9 | 8.7 | 7.7 | - | 7.7 | 7.5 | 7.7 | 7.6 | 7.3 | 7.5 | - | - | - | - | - |
| 13 | 8.9 | 8.8 | 8.2 | 8.6 | 8.1 | 8.4 | 7.8 | 7.9 | 7.8 | - | 7.8 | 7.5 | 7.7 | 7.6 | 7.4 | 7.4 | 7.0 | 7.3 | 7.4 | 7.1 | 9.9 |
| 14 | 8.9 | 8.7 | 8.6 | 8.3 | 0.0 | 8.3 | 7.8 | 7.9 | 8.0 | 7.7 | - | 7.4 | 7.7 | 7.2 | 7.4 | 7.4 | 6.9 | 7.3 | 7.2 | - | - |
| 15 | 9.0 | 8.9 | 8.7 | 8.6 | 8.5 | 8.7 | 7.9 | 8.1 | 8.0 | 7.7 | - | 7.5 | 7.8 | 7.5 | 7.5 | 7.5 | 7.1 | 7.5 | - | - | - |
| 16 | 8.9 | 8.9 | 8.6 | 8.7 | 8.4 | 8.5 | 7.8 | 8.1 | 8.0 | 7.7 | - | 7.5 | 7.8 | 7.6 | 7.4 | 7.5 | 7.1 | 7.5 | 6.0 | - | - |
| 17 | 8.9 | 8.9 | 8.5 | 8.7 | 8.4 | 8.6 | 7.8 | 8.0 | 7.9 | 7.8 | - | 7.5 | 7.7 | 7.6 | 7.4 | 7.5 | 7.1 | 7.5 | 6.2 | - | - |
| 18 | 9.0 | 8.8 | 8.5 | 8.6 | 8.3 | 8.5 | 7.7 | 7.9 | 7.9 | 7.8 | - | 7.5 | 7.7 | 7.6 | 7.4 | 7.5 | 7.2 | 7.6 | 6.8 | - | - |
| 19 | 8.9 | 8.8 | 8.4 | 8.5 | 8.3 | 8.5 | 7.7 | 7.8 | 7.9 | 7.7 | - | 7.5 | 7.7 | 7.5 | 7.3 | 7.4 | 7.2 | 7.6 | - | - | - |
| 20 | 8.9 | 8.7 | 8.4 | 8.4 | 8.2 | 8.3 | 7.7 | 7.8 | 7.9 | 7.7 | - | 7.5 | 7.7 | 7.5 | 7.2 | 7.3 | 7.1 | 7.4 | 0.0 | 0.0 | 0.0 |
| 21 | 8.9 | 8.8 | 8.4 | 8.4 | 8.2 | 8.4 | 7.8 | 7.9 | 8.0 | 7.7 | - | 7.5 | 7.7 | 7.6 | 7.3 | 7.3 | 7.1 | 7.3 | 7.4 | 9.1 | 8.5 |
| 22 | 8.9 | 9.0 | 8.4 | 8.5 | 8.2 | 8.5 | 7.7 | 7.8 | 7.9 | 7.7 | - | 7.5 | 7.7 | 7.6 | 7.3 | 7.2 | 7.1 | 7.4 | - | - | - |
| 23 | 8.9 | 8.9 | 8.4 | 8.6 | 8.3 | 8.7 | 7.8 | 7.9 | 7.9 | 7.7 | - | 7.6 | 7.7 | 7.6 | 7.5 | - | - | - | - | - | - |
| 24 | 8.8 | 8.9 | 8.3 | 8.5 | 8.2 | 8.5 | 7.5 | 7.7 | 7.8 | 7.7 | - | 7.6 | 7.7 | 7.5 | 7.1 | 7.1 | 7.1 | 7.3 | 7.1 | 7.2 | 6.8 |
| 25 | - | 8.8 | - | - | - | - | - | - | - | - | - | - | - | 7.6 | - | - | - | - | - | - | - |

| Table 6. Rio Grande Nature Center Habitat Restoration Project | | | |
|---|---|---|---|
| Groundwater Well data | | | |
| | | | |
| RGNC-N | H20 LEVEL | CASING HEIGHT | **DEPTH TO GW** |
| 5/3/2007 | 9.85 | 3.1 | **6.75** |
| 8/24/2007 | 9.9 | | **6.8** |
| 6/3/2008 | 7.8 | | **4.7** |
| | | | |
| RGNC-M | H20 LEVEL | CASING HEIGHT | **DEPTH TO GW** |
| 5/3/2007 | 10 | 3.1 | **6.9** |
| 8/24/2007 | 10.2 | | **7.1** |
| 6/3/2008 | 8.7 | | **5.6** |
| | | | |
| RGNC-S | H20 LEVEL | CASING HEIGHT | **DEPTH TO GW** |
| 5/3/2007 | 9.3 | 3.5 | **5.8** |
| 8/27/2007 | 9.8 | | **6.3** |
| 6/3/2008 | 8.1 | | **4.6** |

Appendix A
USGS Stage Gage Quarterly Report, October – December 2008

# Quarterly Report: Oct. – Dec., 2008

**Investigation NM:** Albuquerque metro area surface-water data collection (NM 8637-9L801)
**Period of Investigation:** June 1992 – Present

**Investigation Chief:** Todd Kelly

**Cooperators:** City of Albuquerque Storm Drainage Division and AMAFCA jointly; Bernalillo County Public Works Division; Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA), and Corps of Engineers in summer 2008

**Principal Cooperator Contacts:** Kathy Verhage at City Storm Drainage Division, Jerry Lovato and John Kelly at AMAFCA, Patricia Dominguez and Dan McGregor at Bernalillo County Division of Public Works, David Stoliker and Gerhard Schoener at SSCAFCA, and Steve Boberg at Corps of Engineers.

**Objective:** To obtain surface-water data that can be used in rainfall/runoff modeling, storm-flow predictions (flood frequency), and water-quality constituents loading analysis and to characterize stormwater quality for drainage basins in the Albuquerque and Rio Rancho metropolitan areas. Corps of Engineers project is to monitor flows in a manmade side-channel of the Rio Grande through the Nature Center that has been designed to provide silvery-minnow habitat.

## ARMY CORPS OF ENGINEERS

U. S. Geological Survey personnel met with Steve Boberg from the Army Corps of Engineers on April 2, 2008, to discuss installing and maintaining a stream-flow gage on a newly constructed manmade channel through the Nature Center grounds in Albuquerque. This channel is the first of many planned side-channels to the Rio Grande, which will provide additional spawning grounds for the endangered silvery minnow. This particular site at the Nature Center was filled with Rio Grande water during the 2008 spring snow-melt season and will also be used for an educational display. The USGS will monitor the amount of flow in the by-pass channel because it has been designed to only contain water during high flows in the Rio Grande. The gage installation occurred on October 8, 2008. The Fiscal Year 2009 Joint Funding Agreement was approved as of September 30, 2008.

**Project stage:** Ongoing.