

**SURFACE WATER STATION DESCRIPTION**  
**RINCON CREEK NEAR MADRONA RANGER STATION – 320745110365701**  
**SAGUARO NATIONAL PARK**

Updated by:	<u>Gwen Gerber</u>	Date:	<u>08/13/2009</u>
Reviewed by:	<u>Chris Gable</u>	Date:	<u>08/10/2009</u>
Reviewed by:	<u>Paul Christensen</u>	Date:	<u>08/20/2009</u>
Approved by:	<u>Bill Hansen</u>	Date:	<u>09/02/2009</u>

LOCATION

The National Park Service’s Water Resource Division – Water Rights Branch (NPS-WRB) surface water gaging station (Station) on Rincon Creek within Saguaro National Park (SAGU) is located at Latitude 32°07’45”, Longitude 110°36’57” (NAD83) just east of Tucson in Pima County, Arizona (NE ¼ SW ¼ NW ¼ Section 16, T15S, R17E). The Station is located at Pool A, the upstream-most of three pools (A, B, and C) located along the middle reach of Rincon Creek on the southern boundary of the eastern district of Saguaro National Park (hydrologic unit code 15050302) (**Figure 1**). The middle reach of Rincon Creek stretches from the confluence of Rincon and Chiminea creeks to a point about one-half mile downstream. A staff gage at Pool B is located approximately 0.2 miles downstream of Pool A and a staff gage at Pool C is located 300 feet downstream of Pool B. USGS gage 09485000 (Rincon Creek Near Tucson, AZ) is located 0.6 miles downstream of the NPS Station. NPS also installed seven monitoring wells (RC-1 through RC-7) in the shallow alluvium adjacent to Rincon Creek in May 2005 to determine the connection between the Creek and the alluvial aquifer (**Figure 2**). Data for Pool B, Pool C, and the RC-Wells are available in separate Station (WY) folders.

Contact Don Swann at SAGU (520-733-5177) prior to accessing the Station. Don will notify the X-9 Ranch gate house. To access the Station from SAGU park headquarters drive southeast on Old Spanish Trail approximately 8.7 miles. Turn left (northeast) on the X-9 Ranch Road. Drive approximately 3.8 miles on the gravel road to the gate house. Identify yourself as NPS personnel and continue on the road. After approximately 1000 feet, take the first left (northwest). Follow the road straight towards Rincon Creek. As the road veers west park in the large pull-out. Walk upstream (east) approximately ¼ miles to the Station (**Figure 3**).

ESTABLISHMENT

The Rincon Creek Station was installed on June 10 and 11, 2003. The Station began recording at 15 minute intervals starting on June 11, 2003. The Station was established to support instream flow claims for Rincon Creek. Station data work-up by NPS-WRB was discontinued after the first quarter of water year 2008. Station operation, maintenance, and data-workup responsibilities were transferred to the Park.

ELEVATION

The elevation of the station is approximately 3,156 feet above the North American Vertical Datum (NAVD), 1988 as determined from a GPS<sup>1</sup> survey in April 2007.

HYDROLOGIC CONDITIONS / DRAINAGE AREA

Rincon Creek lies within the Santa Cruz River basin and drains the Rincon Mountains of SAGU and Coronado National Forest. Drainage area is 40 square miles (based on EPA software: Basins 3.1). Rincon Creek is classified as an intermittent stream. Streamflow in Rincon Creek generally occurs during two “wet” seasons: 1) late winter / early spring characterized by sustained flows; and 2) late summer / early fall or the monsoon season characterized by brief periods of flow. The climate in the Tucson area is classified as subtropical desert with an average of 12 inches of precipitation per year (<http://www.friendsofsaguaro.org/climate.html>).

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<sup>1</sup> Global Positioning System

The total number of days for water years 2003 - 2008 that Pool A experienced flow, had standing water with no flow, or was completely dry is shown in **Table 1**. For the 1,665 days of record approximately 48% of the time Pool A was dry, 44% of the time Pool A had flow, and 8% of the time Pool A had standing water with no flow (see individual water year *Station Analyses* for more information).

**Table 1:** 2003 - 2008 Water Year Statistics

TOTALS:	# of Days	Average %
Days on record	1665	
Days with flow	726	43.6%
Days with pool	142	8.5%
Days dry	797	47.9%

Due to the variability in precipitation in the Rincon Creek drainage basin three weather stations have been used to relate precipitation to Station flow events. The Vail 7N weather station is located within the Rincon Creek drainage basin at an elevation of 2980 feet and 6.4 miles west (downstream) of the Station. The data from the Vail 7N weather station is available on-line from the *National Climate Data Center* (<http://www.ncdc.noaa.gov/oa/ncdc.html>). The Rincon RAW's (remote automated weather) Station is located at an elevation of 8240 feet and is located within the Rincon Creek drainage basin in the Rincon Mountains, approximately 6.5 miles north of the Station. The Rincon RAW's Station data is available from the following web-site: <http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?azARIN>. The Madrona Weather Station is located 1.6 miles northeast of Pool A and was installed and operated by the NPS Sonoran Desert Network and the University of Arizona. See **Figure 4** for a Weather Station Location map.

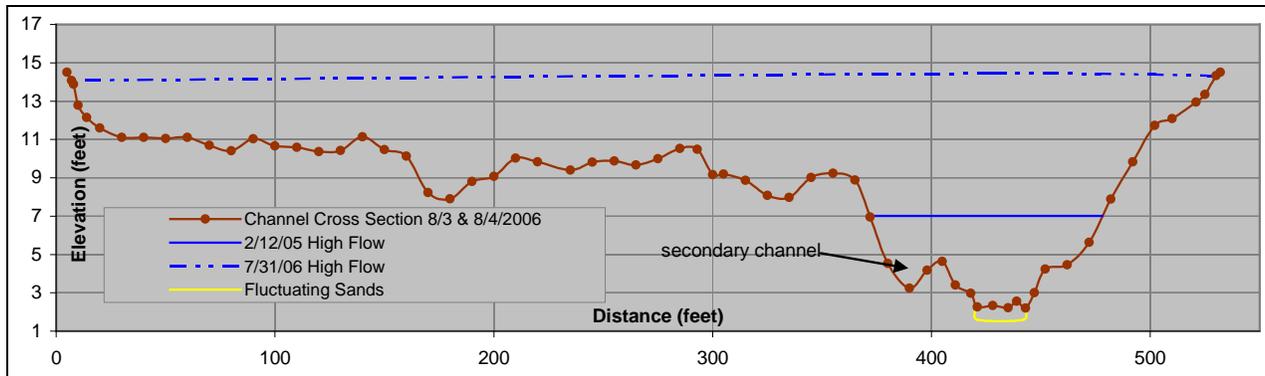
Vegetation, from the dry saguaro forest above 2,000 feet to cool moist coniferous forests of Mica Mountain at 8,666 feet, includes seven distinct biotic communities: desert scrub, desert grassland, chaparral, oak woodland, pine-oak woodland, pine forest, and mixed conifer forest (<http://www.friendsofsaguaro.org/biotic.html>). The geology of the lower Rincon Creek basin consists of a thin veneer of alluvium on top of the Pantano Formation (cemented conglomerate). Higher elevations consist of metamorphic rocks (<http://www.friendsofsaguaro.org/geology.html>). The majority of the Rincon Creek drainage basin consists of national park and national forest lands with a few residential and grazing properties.

## CHANNEL AND CONTROL

The channel bottom is composed of sand with some silt and medium to large embedded cobbles and small boulders. Banks are stable in low to mid-flows and are covered with woody vegetation, rootwads, and some exposed boulders (**Figure 5**). The channel is underlain by the Pantano Formation which is found exposed 200 feet downstream of the Station (**Figure 6**). The channel is straight for 30 feet upstream and 100 feet downstream. A secondary channel on the left bank conveys flow during flow events greater than approximately 250 cfs (or at gage heights greater than 4.5 feet, **Chart 1**). Floodplains are composed of moderately heavy riparian vegetation.

Sand moves through the system during high flow events as shown in photographs from February 2004 and August 2004 (**Figures 7 and 8**). The high flow during this period was 95 cfs. During the two highest events on record (1,350 cfs on February 12, 2005 and 14,000 cfs on July 31, 2006), some bank erosion and scouring and filling sequences occurred with up to two feet of sand moving through the gage pool (documented by recording the aggradation line on staff gage).

Prior to the July 31, 2006 high flow event the control at low to mid-flows was a riffle approximately 40 feet downstream of the Station's staff gages (**Figure 5**). Due to sand moving in and out of the gage pool following the July 31, 2006 high flow event, the point of zero flow has fluctuated between 1.6 and 2.2 feet (**Chart 1**) and has been located between 40 and 100 feet downstream of the gage pool. Rating shifts as much as 0.6 feet have been necessary and change rapidly with fluctuating flows as shown by the 9 discharge measurements taken in August 2006. The control at higher flows is the channel.



**Chart 1:** Cross Section at Control (from 8/3 and 8/4/2006 surveys)

## GAGE

The stage sensor is a Design Analysis Water Log® Series Model H-350XL logger and H-355 bubbler system. This unit serves as the data collection platform (DCP), but may also be referred to as the ‘logger’ or ‘datalogger’. The DCP is housed in a Hoffman steel enclosure mounted to 4 x 4 inch wood posts (**Figure 9**). The datalogger is programmed to purge every two days to displace sediment and keep the orifice clear. Gage height data are logged at 15 minute intervals.

The orifice line is encased in 1½ inch galvanized steel pipe (**Figure 10**). The pipe is anchored with concrete and rocks buried into the stream bank and is also attached to a concrete anchor on the stream bed. The orifice line is encased in 1 inch PVC from the steel enclosure housing to the galvanized pipe. The orifice was installed about 0.15 foot above the stream bed. The base gage is an enameled outside vertical staff (OVS) in two sections reading from 0.00 to 6.74 feet, mounted on treated 2 x 6 inch wood boards (**Figure 11**). A crest stage gage (CSG) composed of a 4 foot long piece of 2 inch galvanized pipe was installed on two 4 x 4 inch wood posts in May of 2005 to confirm peak flows. The CSG was lost in the July 31, 2006 high flow event and not replaced.

The NPS-WRB has a cooperative agreement with the Lakewood, Colorado District of the USGS to use their database for processing stream flow records (Automated Data Processing System, ADAPS, version 4.4). Streamflow records for the Rincon Creek Station are processed on a water year basis under the ADAPS station name and number: Rincon Creek Near Madrona Ranger Station, AZ #320745110365701.

## HISTORY

The USGS has been measuring stream discharge within the middle reach of Rincon Creek, approximately 0.6 miles downstream of the NPS gage, since 1952. During the years 1975 to 1984 only the annual maximum peak streamflow was collected.

The NPS Station has remained at its original location since establishment in June, 2003. A chronological log of the Station history is shown below.

June 10 and 11, 2003	NPS Station installed
June 25, 2004	Three reference marks <sup>2</sup> (RM’s) installed
February 12, 2005	High flow event (1,320 cfs)
May 24, 2005	CSG installed
July 31, 2006	Highest flow on record (14,000 cfs), CSG lost
August 17, 2006	DCP no longer logging data sent in to Design Analysis for repair
January 23, 2007	DCP re-installed
December 31, 2008	Data work-up by NPS-WRB discontinued

<sup>2</sup> A reference mark is a permanent marker installed in the vicinity of the gage. Its elevation above the gage datum is determined via levels survey.

## REFERENCE AND BENCHMARKS

A base<sup>3</sup> (the ground rod), three reference marks (RM-1, RM-2, and RM-3), and three measuring points (bolts on the OVS's and CSG) have been established at the Station for elevation control. See **Table 1** for elevations. See *Section 4* of the water year folder for a sketch map, photo, and a description of each survey point.

Pool A gage datum elevation (NAVD in feet) surveyed in April, 2007 by NPS-WRB and Tim Smith (GPS Program Coordinator) was used in order to compare water level elevations of Rincon Creek with the shallow alluvial aquifer (monitoring wells RC-1 through RC-7). The resultant elevation of the Pool A staff gage (OVS-1) at 0.00 feet is 3155.51 feet. See SAGU – Rincon Creek “*Elevation Survey / Levels*” folder for elevation survey data.

Date	Party	Ground rod (base) <sup>1</sup>	RM-1	RM-2	RM-3	OVS 1 (lower staff gage)	OVS 2 (upper staff gage)	CSG	Remarks
06/11/03	Grover / Filippone	9.33				3.08	5.51		
06/25/04	Gerber / Albright	9.33	6.61	4.95	5.62	3.08	5.51		RM-1, RM-2, and RM-3 established on this day
05/24/05	Gerber / Daniels	9.33	6.62	4.96	5.63	3.09	5.51	4.95	Preliminary survey completed on 5/23/05 to raise OVS-2 (tree fell on it during 2/12/05 high flow event). CSG installed on 5/24/05.
08/03/06	Gerber / Perger						5.48		The CSG was lost during the 7/31/06 high flow event. OVS-2 was leaning slightly. OVS-2 shifted -0.03 according to the 8/3/06 survey, and -0.05 on the 8/4/06 survey. OVS-2 was not adjusted due to the saturated ground. Datum corrections of +0.03 and +0.05 were applied to staff gage readings from OVS-2 as a result. It is likely that the elevation of OVS-2 remained unstable until the ground dried out. The levels survey on 4/27/07 showed OVS-2 within 0.01 feet of its original elevation so no adjustments were made.
08/04/06	Gerber / Perger	9.33	6.61	4.95	5.62	3.09	5.46		
4/25/07 <sup>2</sup>	Gerber / Perger	9.33	6.61	4.96	5.62	3.09	5.50		Survey completed relating Pool A gage datum to RC-1. Elevation survey completed. Elevation of OVS-1 at 0.00 feet is 3155.51.
03/26/08	Gerber / Perger	9.33	6.61	4.95	5.62	3.09	5.50		

**Table 1:** Base, reference, and measuring point elevations.

## DISCHARGE MEASUREMENTS

Wading discharge measurements at low and mid-flows (less than 100 cfs) are taken at a cross-section approximately 20 feet downstream of the Station's staff gages. Very low flow discharge measurements (less than 5 cfs) are taken further downstream (approximately 200 feet) where bedrock is exposed and constricts the channel (**Figure 6**). These wadeable cross-sections are generally good with uniformly distributed flow, a generally smooth channel bottom (with few cobbles/boulders), and stable banks. During flows less than 1 cfs a portable weir plate was used starting in March, 2008 to measure flow. Discharge measurements over 100 cfs need to be determined via indirect methods because of the danger of wading these flows.

## FLOODS

According to 54 years of record at the downstream USGS gage the average annual peak flow is about 1,950 cfs. Flows exceed 5,000 cfs about once every 10 years. Flows did not exceed 10,000 cfs during the 54 years of record until July 31, 2006 when a flow of approximately 14,000 cfs occurred at the NPS gage. The highest peak flow (9,660 cfs) on record prior to 2006 occurred during a monsoon event on August 19, 1971. USGS gaging equipment did not survive the 2006 event. NPS equipment remained intact until 18 days following the event when the DCP stopped logging data.

## POINT OF ZERO FLOW

The point of zero flow (PZF) is the deepest part of the channel at the control of the gage pool. Since lenses of sand move through the gage pool during and after high flow events the low flow control has fluctuated between 1.4 and 2.2 feet and has been located between 40 and 100 feet downstream of the gage pool.

<sup>3</sup> The base is the reference mark on which all reference mark elevations are based (it is considered the most stable).

## WINTER FLOW

No ice effect has been noted on Rincon Creek. Winter temperatures rarely drop below the freezing point with average daily winter temperatures in the low 50's.

## REGULATION AND DIVERSION

No known dams, stockponds, or diversions are located upstream of the Station. Several domestic water wells and at least one public water supply well are located within the Rincon Creek drainage basin. It is unknown if these wells influence surface water levels.

## ACCURACY

During low and mid-flows (less than 100 cfs) accuracy of the Station equipment and data is good. During high flows (> 100 cfs) accuracy of the Station data decreases to fair due to the inability to collect direct discharge measurements. Since the July 31, 2006 high flow event, moving sand has created shifts in the rating of up to -0.60 feet. Until the channel re-equilibrates the accuracy of the record is subject to downgrading.

## LOCAL PARK PARTNER

The following personnel from SAGU performs discharge measurements, downloads the data logger, and obtains regular staff gage readings:

Chuck Perger (Park Volunteer) (520)-885-7401 (home)

Matt Daniels (520)-733-5175

Colleen Filippone (520)-546-1607 3#

Don Swann (520)-733-5177

Saguaro National Park

3693 South Old Spanish Trail

Tucson, AZ 85730-5601

## REFERENCES

Kennedy, E. J., 1983. Discharge Ratings at Gaging Stations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A10. 59 p

# Project Location Map: Rincon Creek Study Reach

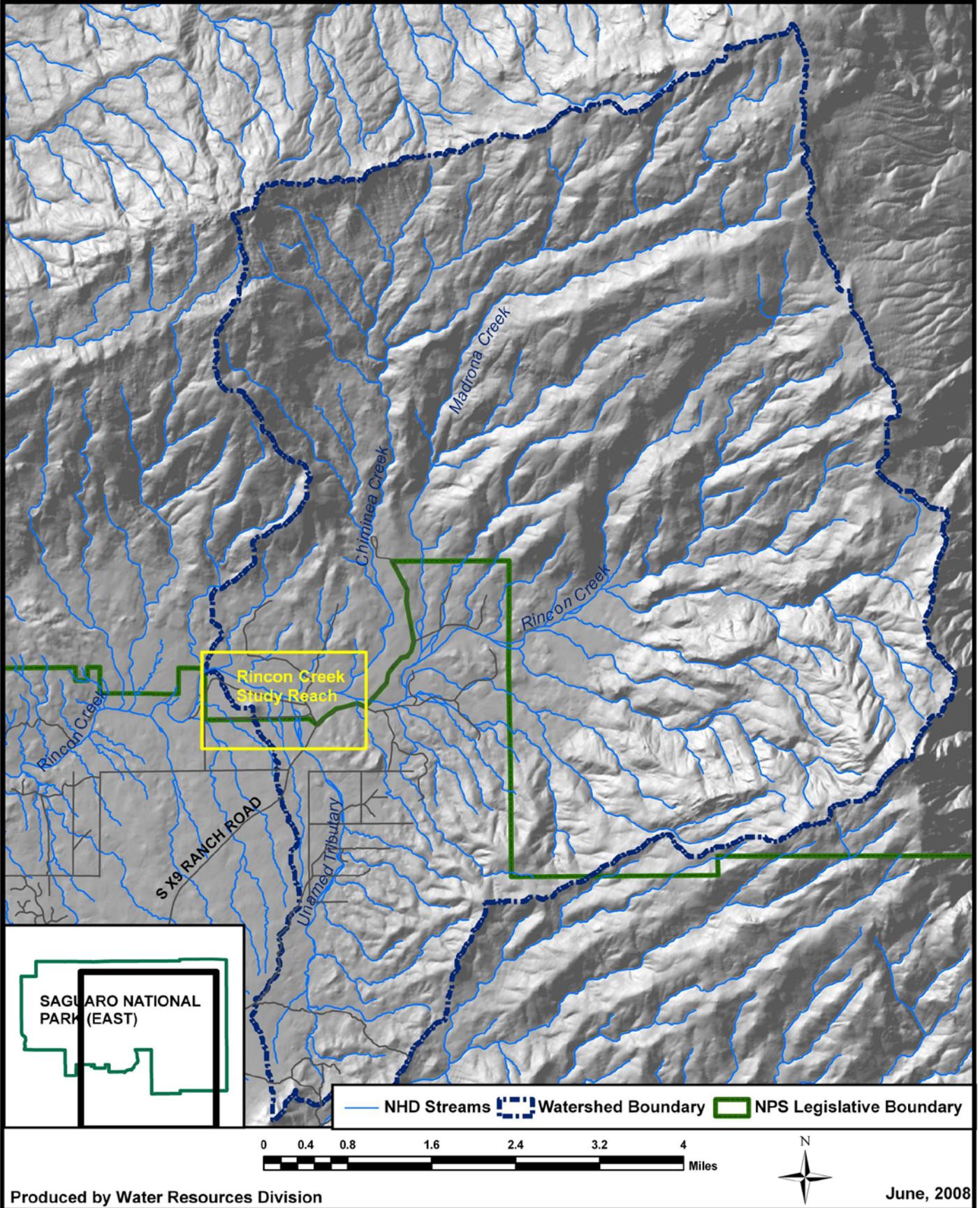


Figure 1: Project Location Map

# Project Location Map: Middle Reach of Rincon Creek

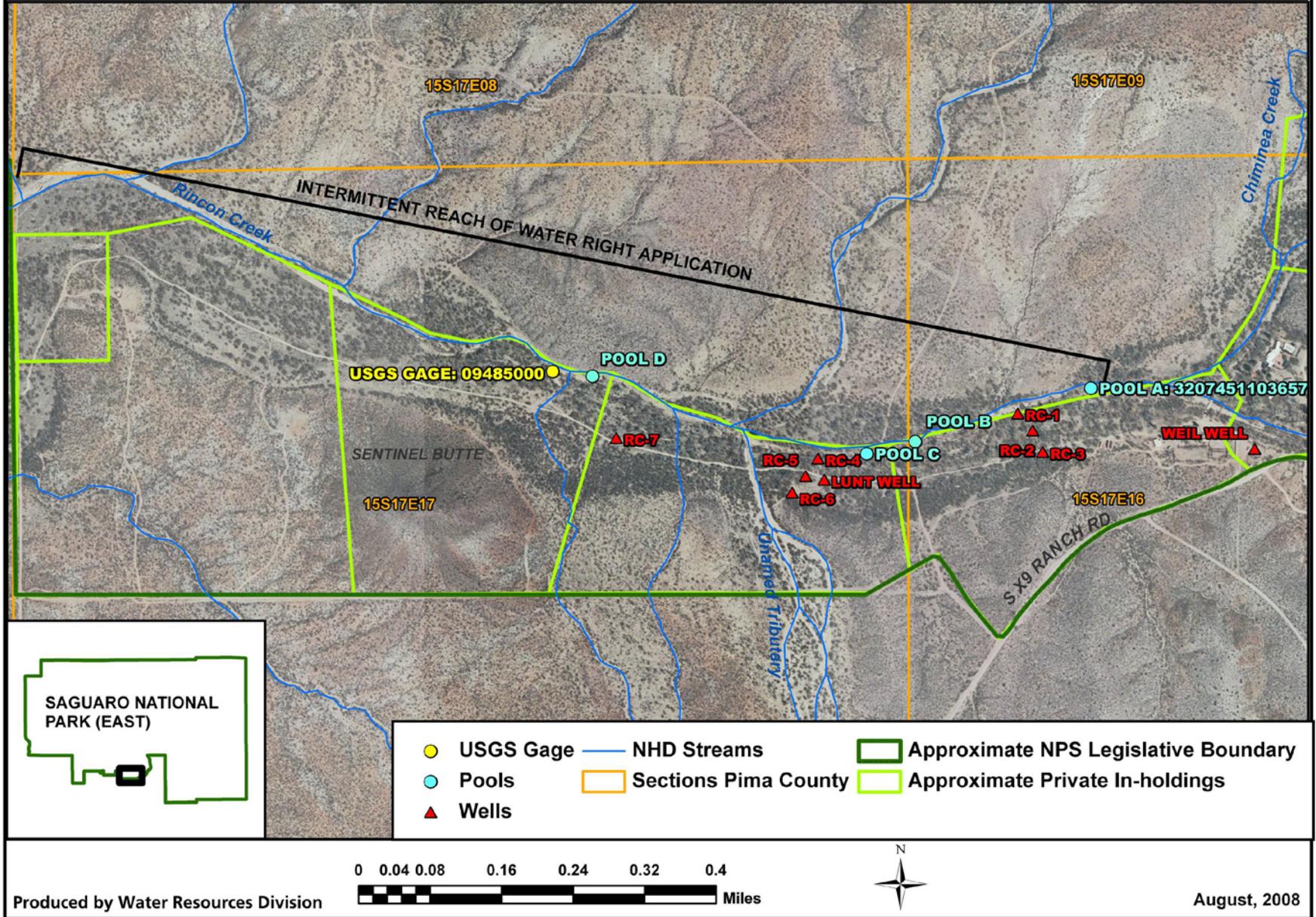
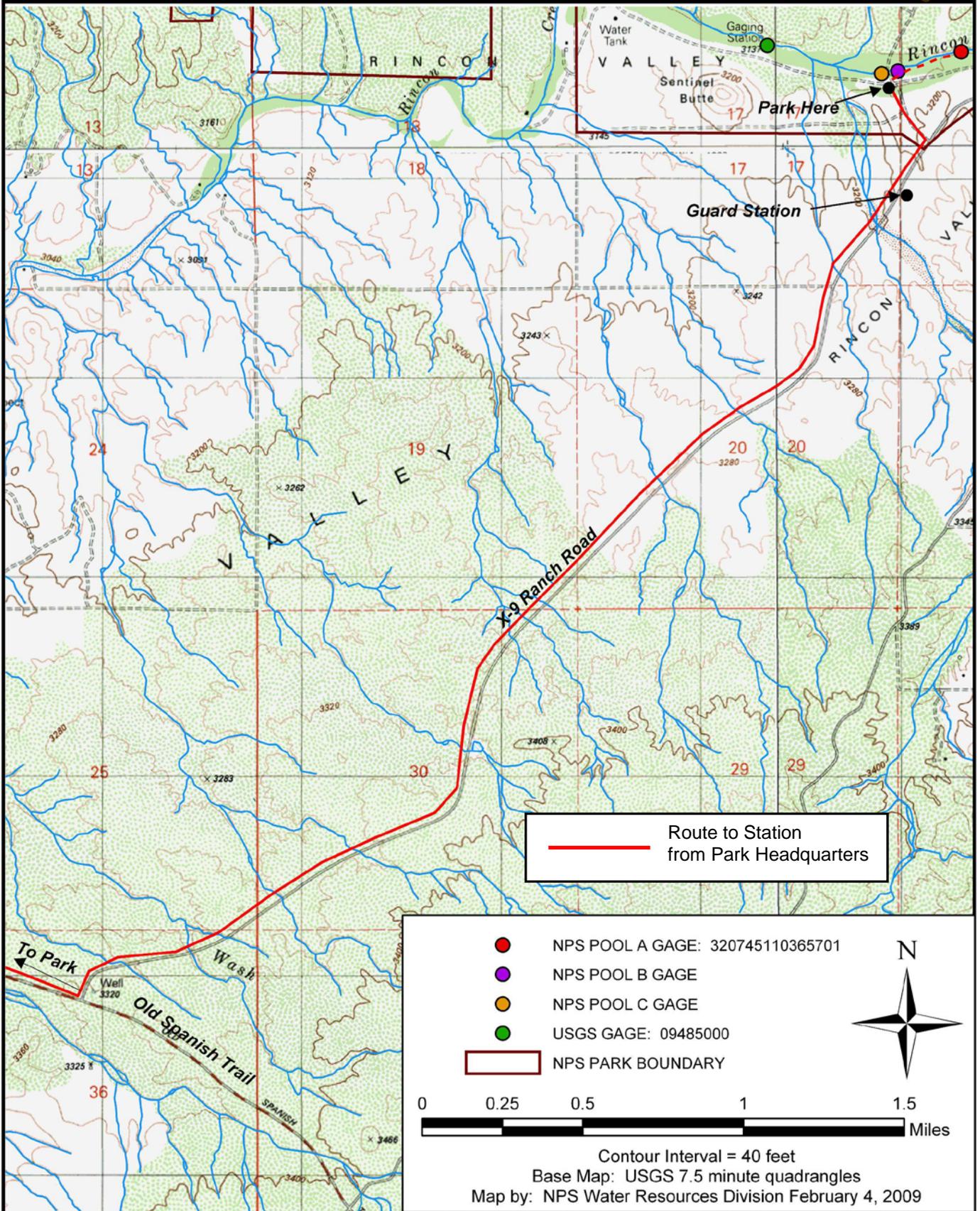


Figure 2: Study Area Map

# Rincon Creek Gage Location Map



Route to Station from Park Headquarters

	NPS POOL A GAGE: 320745110365701
	NPS POOL B GAGE
	NPS POOL C GAGE
	USGS GAGE: 09485000
	NPS PARK BOUNDARY

0 0.25 0.5 1 1.5 Miles

Contour Interval = 40 feet  
 Base Map: USGS 7.5 minute quadrangles  
 Map by: NPS Water Resources Division February 4, 2009

**Figure 3:** Station Location Map  
 SAGU Station Description

# Weather Station Location Map

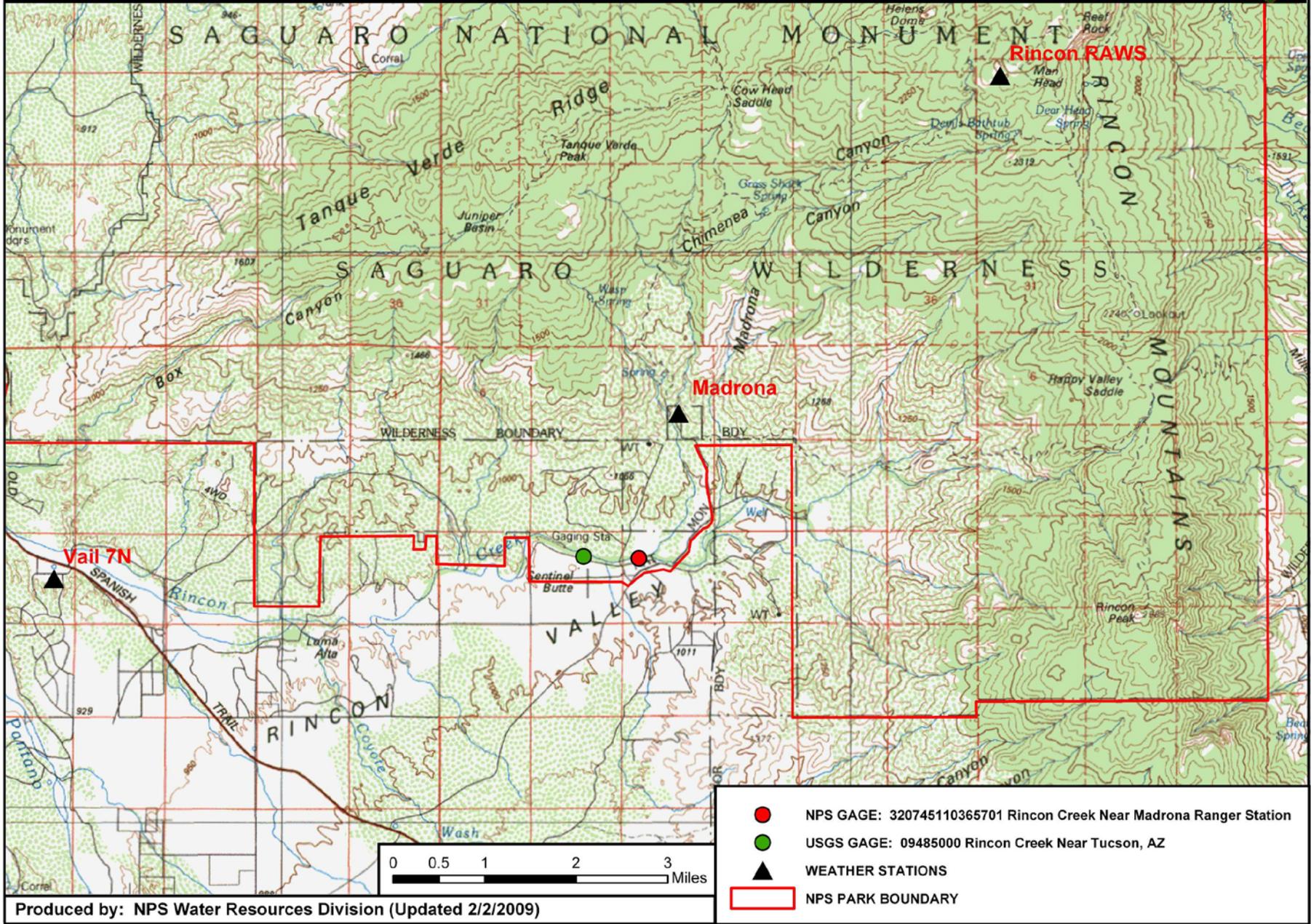


Figure 4: Weather Station Location Map



**Figure 5:** Photo of Station's gage pool looking downstream at control (photo taken 5/1/03 by Paul Christensen)



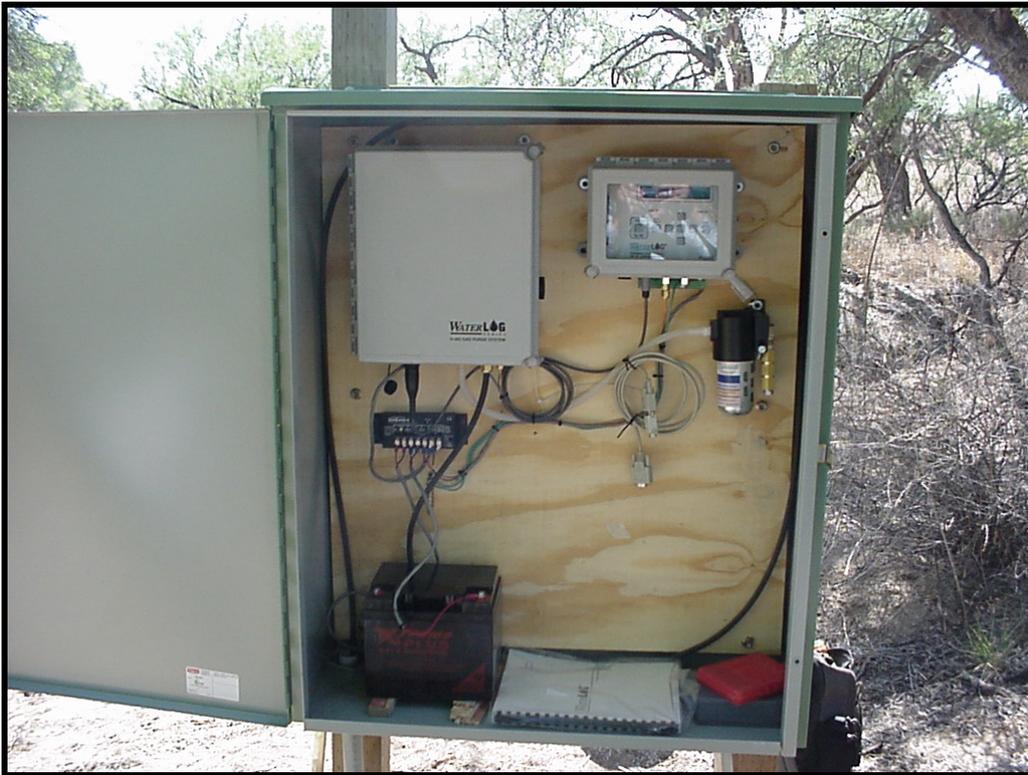
**Figure 6:** Photo of the Pantano Formation and low flow measuring point downstream of Station (photo taken 5/1/03 by Paul Christensen)



Figure 7: Photo looking upstream in February 2004 (photo taken 2/04/04 by Colleen Filippone)



Figure 8: Photo looking upstream in August of 2004 (photo taken 8/21/04 by Gwen Gerber)



**Figure 9:** Photo of data Collection Platform (photo taken 6/11/03 by Scott Grover)



**Figure 10:** Photo of orifice (photo taken 8/21/04 by Gwen Gerber)



**Figure 11:** Photo of lower and Upper Staff Gages (photo taken 8/21/04 by Gwen Gerber)