

OPERATION AND MAINTENANCE OF STREAM GAGING STATIONS

Purpose This Water Quality and Hydrology Group (ENV-WQH) procedure describes the operation and maintenance of surface water gaging stations and partial record stations.

Scope This procedure applies to ENV-WQH personnel, contractors, and students conducting operation and maintenance of stream gaging stations.

In this procedure This procedure addresses the following major topics:

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Integrated Work Management The work specified in this procedure is conducted in accordance with applicable Integrated Work Documents, in accordance with LANL IMP 300-00-00, Integrated Work Management for Work Activities.

Signatures

Prepared by. Signature on file _____ Ryan Romero, ENV-WQH	Date: 11/8/05 _____
Approved by. Signature on file _____ Mike Alexander, ENV-WQH Team Leader	Date: 11/29/05 _____
Approved by. Signature on file _____ Steve Rae, ENV-WQH Group Leader	Date: 12/6/05 _____

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General Information About This Procedure

Attachments This document has the following attachments:

Number	Attachment Title	No. of pages
1	Equipment and Supplies	1
2	Gaging Station Field Log	1
3	Configurations for ISCO Sampler	1
4	Form 9-275-G, USGS Discharge Measurement Notes	1
5	Form 9-276, USGS Level Notes	1

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	10/01	New document
1	8/03	Annual review
2	5/05	Added safety precautions and excavation permit requirements.
3	10/05	Removed steps for storm water sample collection and created new procedure, ENV-WQH-SOP-011, Collection of Storm Water Runoff Samples

Who requires training to this procedure

The following personnel require training before implementing this procedure:

- Personnel assigned to the gaging station operation and maintenance

Training method

The training method for this procedure is self-study and documented in accordance with the procedure for training (RRES-WQH-QP-024, *Personnel Training*).

Conducting discharge measurements requires on-the-job training in accordance with the procedure for training (RRES-WQH-QP-024, *Personnel Training*).

General Information About This Procedure, continued

Prerequisites In addition to training to this procedure, the following training is also required prior to performing this procedure:

- Training Plan #7347, General Field Work
- Training Plan #7578, Conduct Field Support
- Training Plan #7574, Operate Stream Gaging Stations

Recommended training includes:

- Manual for Sutron datalogger, 5600-0131-1, operation overview
- Manual for Geomation datalogger, operation overview
- Manual for ISCO sampler, operation overview
- Manual for Probe Milltronics, PL-426, operation overview
- Manual for Shaft Encoder, 8800-1082, operation overview
- Manual for cell phone system
- Manual for multimeter
- United States Geological Survey available training

Note Actions specified within this procedure, unless preceded with “should” or “may,” are to be considered mandatory guidance (i.e., “shall”).

Preparing for Field Work

Personnel needs ENV-WQH follows the ‘two person rule’ for all areas that are in “effective isolation” when performing any field work.

Effective isolation includes the following locations:

- E038 Head of DP Canyon
- E055 Acid/E056 Pueblo Canyon
- E070 Bayo Canyon
- E089 Rendija Canyon
- E090 Guaje Canyon
- E123 Sandia Canyon below wetlands
- E241 Pajarito Canyon at TA-22
- E242 Starmers Gulch at TA-22
- E242.5 Arroyo de la Delph
- E243 Pajarito above mouth of Two Mile Canyon
- E244 Two Mile Canyon
- E260 Water Canyon above mouth of S-Site Canyon
- E261 Mouth of S-Site Canyon
- E262 Mouth of Valle Canyon
- E262.5 Water Canyon Area AB
- E265 Lower Water Canyon
- E267.5 Fence Canyon
- E275 Lower Ancho Canyon
- E338 Chaquehui South Site at TA-33
- E340 Chaquehui Main Site at TA-33
- E2929 Garcia Canyon
- S001 SWSC Line Springs
- S002 Burn Ground Springs
- S003 Martin Springs

Two person rule is required for:

- Field work during inclement weather conditions
- Remote gage locations accessible only by foot
- Wading
- Any other conditions that may pose increased risk of incident as determined by the Team Leader

Individuals may be allowed to travel to the field alone under the following conditions:

- Performing routine gage maintenance, and
 - Gage location is accessible by vehicle, and
 - Two forms of communication (radio and cell phone) are taken to the field and enhanced communication policy is followed
-

Preparing for Field Work, continued

Personnel needs, cont'd Under all conditions, personnel must sign in and out when performing any work away from the office.

Follow the procedure RRES-WQH-SOP-002, *General Field Work*, and RRES-ES-Field, *General Field Safety for All Employees*. All field personnel must have a radio and some other means of communication (such as a cell phone) or as specified by the facility owner or other Laboratory requirements.

Time of visits All station work will take place during normal work hours and during daylight hours. The Operations Team Leader, with concurrence from the Group Leader, may approve exceptions.

Clock times When at a site, station equipment clock times on both the datalogger and ISCO sampler will be synchronized and verified. Station equipment clocks must have time set to Mountain Standard Time (MST) at all times, without any daylight-savings time adjustment in the spring and fall.

Before going to the field, check and set your watch to the precise time. This can be done by calling the Laboratory's time system (667-TIME or 667-8463) or by logging on to the time page at www.time.gov (or click on the clock icon on the lab's internal home page).

Equipment needed for station maintenance work Collect the equipment and supplies before traveling out to the field to perform operations and maintenance on stations. Reference Attachment 1 for a list of equipment and supplies.

Excavation activities

Excavation permit requirements When installing wells, field markers, stakes or posts, or when pounding anything below the surface of the ground, obtain an Excavation Permit in accordance with LIR 402-880-01, *Excavation/Soil Disturbance Permit Process*.

ENV-WQH personnel shall be on-site during excavation work as prescribed by the Excavation Permit.

Upon completion of excavation work performed by KSL:

- ENV-WQH personnel shall sign the KSL Work Order indicating work was completed per specifications
- Documentation of successful completion is maintained in the KSL Work Order Documentation System
- Copies of above documentation are maintained by ENV-WQH.

Upon completion of excavation work performed by a BOA contractor:

- ENV-WQH shall conduct a technical evaluation indicating excavation work was completed per specifications
- Documentation of technical evaluation is maintained by the BOA contractor
- Copies of above documentation are maintained by ENV-WQH.

Checking Stations

Equipment at the stations Stations are equipped with a variation of the following equipment:

- Datalogger
 - Sutron Data Recorder/Transmitter 8200
 - Geomation 2380
- Stage sensor, one of the following:
 - Shaft encoder in a stilling well (Sutron)
 - Bubbler in a conduit
 - Ultrasound over the water surface (Miltronics), staff gage
- Communication: Cell phone or radio
- Power source
 - Battery charged by solar panel
- ISCO sampler connected to datalogger
- Sampler intake
- Teflon tubing
- ISCO 3700, 6100

How automatic sample stations work

Runoff samples are collected using automated samplers. When a stage sensor detects a pre-programmed stage level of flow, the ISCO sampler completes a sequence of a rinse and flush before and after every sample collected to prevent cross contamination of samples. The datalogger activates the cell phone or radio to call three different programmed numbers, in sequence, with an alarm message, or places a radio transmission to a central computer. A pre-recorded, audible message notifies the call receiver that the station has a water sample that needs collection. The data logger also activates the ISCO sampler to start collecting water.

Stations equipped with Geomation datalogger equipment and a radio system (primarily the partial record stations) will transmit to the base station or alarm notification where a record of the call is logged into a computer database located at TA-64. It is then necessary to visit the computer at TA-64 Building 64 to review the real time base station records to determine the extent of the flow event for these stations.

Checking Stations, continued

Routine maintenance To check the condition of equipment at an automated station, perform the following steps:

Step	Action
1	<p>Scroll through the options on the datalogger (consult the manual for operating instructions) and check the following parameters:</p> <ul style="list-style-type: none"> • For Sutron dataloggers: <ul style="list-style-type: none"> — Date and time (set to Mountain Standard Time, even during summer daylight savings time). Refer to “Clock times”, page 6 of this document. — “Recording” mode is on — Alarm condition is “normal” • For Geomation dataloggers: <ul style="list-style-type: none"> — Verify power light is on — Verify charge light is on. If fully charged, “float” light will be also be on — Verify light from Miltronics probe comes on for ten seconds every minute — If power was removed, verify that Ran 2 lights for Rcv and Xmt are active after power is restored.
2	<p>Check the phone system to ensure it is on and operating (consult operating manual).</p>
3	<p>If there is no sign of flow:</p> <ul style="list-style-type: none"> — Verify that the inside stage reading is accurate with the outside staff gage; if not, clean stilling well. — For Miltronics probe, remove dirt under sensor. <p>If there is flow:</p> <ul style="list-style-type: none"> — Verify that the inside stage reading corresponds with the outside staff gage. — Obtain a high water mark and record on the Gaging Station Field Log Sheet (Attachment 2). — Record inside and outside gage heights
4	<p>If there has been a sample flow, follow the steps in the section to collect the samples from the ISCO sampler.</p>

Continued on next page.

Checking Stations, continued

Routine maintenance (continued)

Step	Action
5	<p>If there has been no flow, check the status of the station:</p> <ul style="list-style-type: none"> • For Sutron dataloggers: <ul style="list-style-type: none"> — Check Sutron clock with synchronized personal watch. Refer to “Clock times”, page 6 of this document. — Check the internal clock time on both the datalogger and the ISCO; reset if more than two minutes different from actual time. NOTE: Sutron clock is more accurate than the ISCO clock. — Check that datalogger “recording” mode is on. — Check that phone is on (for Sutron). — Check ISCO sampler displays “bottle 1 after 1 pulse” • For Geomation dataloggers: <ul style="list-style-type: none"> — Geomation clock is synchronized with the base station automatically.
6	Visually inspect the integrity of the sampling tubes, electrical wiring, and other components at the station
7	Complete the Gaging Station Field Log (Attachment 2).
8	Close and lock station.

Configurations for data logger

Refer to Attachment 3 for the configuration settings for ISCO Sampler 12- and 24-bottle bottom setup.

Program settings for data logger

The program settings for ISCO Model 3700 Sampler 12-and 24-bottle bottom setup are as follows:

Prompt	Setting
Flow mode	1,000ml samples
Start flow count at	Flow
Sample every	1 flow pulses
No multiplexing	
# of feet of suction head	Varies according to station

Checking Stations, continued

Arming the Geomation computer

To enable the Geomation to sample the next rain event, or arm the Geomation, perform the following steps:

Step	Action
1	Locate and select the “Labeled Arm Sampler” folder in the monitor program. This will display all the partial records stations.
2	Highlight the station(s) to be armed.
3	Click on “Force Highlighted Evaluation” icon located on the far upper left corner of the tool menu. This will arm the station, or enable the station to sample the next event. (Multiple stations may be armed at the same time).
4	Locate the “ISCO” folder and click on the “NFIL” subfolder. This will display a list of partial record stations.
5	Highlight the station. Click on the “Enter Data for Component Highlighted” icon, located on the tool bar. <ul style="list-style-type: none"> — Change the “value” to 0.0 — Click “Download” — Complete this on every station individually (multiple stations can not be reconfigured at the same time)
6	Locate “Station Status” folder and click on the “Sampler Trig” subfolder. This will list display a list of partial record stations.
7	Highlight the station. Click on the “Enter Data for Component Highlighted” icon, located on the tool bar. <ul style="list-style-type: none"> — Change the “value” to 12 or 24 for the number of bottles in the ISCO carousel (reference Attachment 3) — Click “Download” — Complete this on every station individually (multiple stations cannot be reconfigured at the same time)

Measuring Flowing Water at a Station

Measurements to make if water is flowing at station

For field measurements at a station:

- When measuring pH and temperature, see set of steps below.
 - Measure the flow rate using either the current flow meter or the modified Parshall Flume
 - Document measurements on Form 9-275 (Attachment 4)
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Field readings of water

If water is flowing at the station at the time of sample collection or retrieval, take pH and temperature measurements with a portable pH meter.

To take field readings of the flowing water, perform the following steps:

Step	Action
1	Place the pH electrode directly into the flowing water near the station, slightly downstream of the sample intake. Read the pH and repeat until three consecutive pH readings are within 0.1 standard pH units.
2	Take temperature reading.
3	Record the pH and temperature reading on the Surface Water Sampling Field Sheet and Chain of Custody along with the date, time, and name of the person performing the readings.
4	Calibrate and maintain pH and temp probe in accordance with procedure (in development).

Measuring flow with current meter

If the water level is deep enough, use the current flow meter to measure the stream flow. For use of the meter, see Geological Survey Water-Supply Paper 2175, "Measurement and Computation of Stream Flow: Volume 1, Measurement of Stage and Discharge, Chapter 5.

Measuring flow with the Parshall flume

If the flow is too shallow to use the current flow meter, use the modified Parshall 3" flume to measure stream flow. For use of the flume, see Geological Survey Water-Supply Paper 2175, "Measurement and Computation of Stream Flow: Volume 1," Measurement of Stage and Discharge, Chapter 8.

Measuring Flowing Water at a Station, continued

Computation of past flows If there is no flow at the time of visit and there has been a high stage, call the Storm Water Sampling Leads to confirm whether it is necessary to flag the high water mark. If necessary, flag the high water mark, preferably in a location where the channel is narrowing slightly and has a straight reach. For slope area, the reach must be a minimum of 75 times the mean depth.

At a later time, take appropriate survey measurements to allow for a later calculation of flow and document on Form 9-276 (Attachment 5). This method uses various surveying techniques and high water marks from flow events. Some types of indirect measurements are slope area, critical depth, step back water and computation through a culvert. See Techniques of Water Resources Investigations of the United States Geological Survey, Measurement of Peak Discharge by the Slope-Area Method, Book 3, Chapter A2.

Records Resulting from this Procedure

Records The following records generated as a result of this procedure are to be filed in TA-64-64-102.

- Gaging Station Field Log sheets
- Form 9-275-G: USGS Discharge Measurement Notes (when collected)
- Form 9-276: USGS Level Notes (when collected)
- Photographs taken of the described activities (when taken)
- Documentation of assessment of work conducted under an excavation permit

[Click here to record self-study training to this document.](#)

Equipment and Supplied Needed for Station Maintenance Work

- Dedicated and equipped field truck
- Field tool bag
- Discharge measuring equipment

Los Alamos National Laboratory ENV-WQH Gaging Station Field Log	
E#:	Station Name:
Date:	Time:
Party:	
Inside Gage Reading:	Outside Gage Reading:
Battery Reading:	High Water Mark:
Data Retrieval Complete:	Start Date:
Trip Level:	Phone Number:
<input type="checkbox"/> Recording On	<input type="checkbox"/> Sampler On
<input type="checkbox"/> Phone On	<input type="checkbox"/> Gage Operational
<input type="checkbox"/> Clocks coincide between Data Loggers and Samplers	
<input type="checkbox"/> Stilling Well / Stage Sensors cleaned and inspected	
<input type="checkbox"/> Levels Obtained	<input type="checkbox"/> Samples Collected
To do list, including maintenance and replacement:	
Comments:	

Configurations for ISCO Sampler

Prompt	Setting
Set Clock	Mountain Standard Time Refer to "Clock times", page 6 of this document.
Bottle and sizes	12 or 24 bottles
Bottle volume	1,000 ml
Suction line	3/8 inch
Suction line is	Teflon
Suction line length is	(will vary according to station)
Liquid detector	Enable
Rinse cycles	2
Enter head manually	Yes
Retry up to	2 times
Calibrate sampler	Enable
Start time delay	0
Enable pin master slave mode	No
Sample upon disable	No
Sample upon enable	Yes
Reset sample interval	No
Inhibit countdown	No (N/A)
Select option event mark	Pulse At beginning of purge
Purge counts	100 pre sample counts 1,000 post sample counts
Tubing life	165,149 pump counts Warning at 500,000
Rest pump counter	No
Pump count to warning	500,000
Program lock	Disable
Sample ID	-----
Run diagnostics	
Software revision	#46
Testing RAM	
Testing ROM	
Pump count test	
Reinitialize	No
Exit Configuration	

Example – Form 9-275-G

9-275-G U.S.G.S. Meas. No.
(Rev. 10-81) STANDARD DISCHARGE MEASUREMENT Comp. by.
NOTES

Sta. No. DISCHARGE MEASUREMENT NOTES Checked by

Date 20 Party
Width Area Vel. G. H. Disch.
Method No. secs. G. H. change. in hrs. Susp.
Method coef. Hor. angle coef. Susp. coef. Meter No.
Type of meter Date rated Tag checked
Meter ft. above bottom of wt. Spin before meas. after
Meas. plots. % diff. from rating. Levels obtained

GAGE READINGS					WATER QUALITY MEASUREMENTS	
Time	Inside	ADR	Graphic	Outside	No	Yes
					Time	
					Samples Collected	
					No	Yes
					Method Used	
					EDI	EWI Other
					SEDIMENT SAMPLES	
					No	Yes
					Method Used	
					EDI	EWI Other
					BIOLOGICAL SAMPLES	
					Yes	Time
					No	Type

Weighted M.G.H.
G. H. correction
Correct M.G.H.
Check bar. chain found changed to at
Wading, cable, ice, boat, upstr., downstr., side bridge. feet, mile, above, below gage.
Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%); based on the following cond:
Flow
Cross section
Control
Gage operating Weather
Intake/Orifice cleaned Air °C@ Water °C@
Record removed Extreme Indicator: Max. Min.
Manometer N₂ Pressure Tank Feed Bbl rate per min.
CSG checked Stick reading
Observer
HWM outside, in well
Remarks

G.H. of zero flow ft. Sheet No. of sheets
G-163

