Immediate Procedure Change (IPC) Cover		
Section 1 – Originator Request		
Document No.: EP-DIV-SOP-10005	Revision No.: 1	IPC No.: 1
Title: Operation and Maintenance of Gage Stations for Storm Water Projects		
Description of need and requested action (Attach document mark-up and numbered additional sheets, if needed): Attachment 1 revised to show updated examples of Work Order forms, Attachments 4 and 5 added to show electronic example of Work Order forms and information traveler. Minor revisions to text to update references to "Excel files" and "Additional Notes" form sections to "PDF attachments", and update references to 'work order header" information to "traveler spreadsheet." Added text discussing work order form formatting changes.		

Originator Name (print):	Organization:	Z#:	Date:
Shannon Smith	ER-DO	184219	4/27/16

Section 2 – Reviews

Discipline	Name	Signature	Date
SME	Thaddeus Kostrubala	/s/ Thaddeus Kostrubala	05/04/16
SME	Jeff Walterschied	/s/ Jeff Walterschied	05/06/16
SME	Daria Cuthbertson	/s/ Daria Cuthbertson	05/03/16
Maintenance Connection WO Generator/Data Entry Prime	Deirdre Espinosa	/s/ Deirdre Espinosa	05/04/16

USQ/USI Number: EWMO-16-108-S, R.0 ☐ N/A

Section 3– Final Approvals

FOD Concurrence Signature	Print Name and Title	Z#	Date
NA	NA	NA	NA
☒ Permanent ☐ Limited Use	Effective Date: 5-20-16 Expiration Date:		
Comments: Classification 4 : Billy Turney May, 11, 2016 BTurney			
Responsible Line Manager Signature	Print Name, Title Gerald Fordham	Z# 216054	Date 5/19/16

EP-DIV-SOP-10005, R.1 IPC-1

OPERATION AND MAINTENANCE OF GAGE STATIONS FOR STORM WATER PROJECTS

Effective Date: 3/21/2013

Procedure Owner:	Signature:	Date:
Steve Veenis	Steve Veenis	3/20/13

REVISION HISTORY

Document No./ Revision No.	Issue Date	Action	Description
ENV-WQH-SOP-009, R0	10/2001	New procedure	
ENV-WQH-SOP-009, R1	08/2003	Revision	Annual review
ENV-WQH-SOP-009.3, R0	05/2005	Revision	Added safety precautions and excavation permit requirements.
ENV-WQH-SOP-009.3, R1	10/2005	Revision	Removed steps for storm water sample collection and created new procedure, ENV-WQH-SOP-011, Collection of Storm Water Runoff Samples.
EP-DIV-SOP-10005, R0	09/2010	Revision	New document (issued as EP-DIV-SOP-10005, R0) supersedes ENV-WQH-SOP-009.3. Reformatted and revised; updated organization.
EP-DIV-SOP-10005, R1	03/2013	Major Revision	Reformatted and revised to reflect current equipment, including radio telemetry.
EP-DIV-SOP-10005, R1	5/20/2016	IPC-1	Updated Attachment 1 and added Attachments 4 and 5 to reflect form changes in Maintenance Connection. Minor updates in text to align with changes.

TABLE OF CONTENTS

1. PURPOSE AND SCOPE

This procedure describes the installation, activation, inspection, maintenance, seasonal deactivation, and permanent decommissioning of (1) stream gaging stations and (2) rain gages installed at some gage stations or as stand-alone installations. This procedure also describes how to measure the rate of stream flow (discharge) when flow is present and how to verify the stage-discharge relationship used to compute continuous discharge from the recorded stage.

This procedure applies to Storm Water Program and subcontractor personnel conducting operation and maintenance activities at stream gaging stations.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Gage stations throughout Los Alamos National Laboratory (LANL) are maintained in support of the Compliance Order on Consent (the Consent Order), the Memorandum of Understanding between the Department of Energy and Buckman Direct Diversion Board (DOE/BDDB), and as part of the Environmental Surveillance Program. At each gage station, a device measures water level (stage) at 5-min intervals and sends the value to an on-site electronic datalogger. Some gage stations include a vertical corrugated metal pipe (stilling well) with perforations to provide a calm water surface for a float gage to measure. A weir or flume may be installed a short distance downstream to provide a stable, consistent control of flow. A rain gage is located at some gage stations to measure the intensity and depth of liquid precipitation. An ISCO programmable automatic water sampler is installed at most stations, and the sampling routine is activated by the Sutron datalogger when the stage reaches a particular preprogrammed level.

Gage stations will be inspected at varying frequencies according the appropriate program's schedule, sampling analysis plan requirements, when inspection findings occur at a station, and when the automated sampler is triggered. Every gage station includes the following:

- Sutron 9210 electronic datalogger
- 12-V battery(or batteries)
- Solar panel and charge regulator
- Radio telemetry equipment (radio transceiver and antennae)
- Water-level (stage) measurement instrument(s) (at least one)

2.1 Background (continued)

- Float gage and digital encoder
- Air-purge bubbler and pressure sensor
- Ultrasonic probe
- Pressure transducer

The stations may also include the following:

- Water control structure(s)
- Flume
- Weir
- Stilling well
- Tipping-bucket rain gage
- ISCO automated water sampler

Personnel performing this procedure shall be familiar with the most current versions of the following related procedures and operation manuals, copies of which are available at Pueblo Complex, Technical Area 00, Bldg. 1237, Room 207.

- Manual for Sutron 9210 Xlite datalogger, 8800-1144
- Manual for Sutron Accububble bubbler system Model 5600-0131-1, 8800-1102
- Manual for Trace C-12 power regulators
- Manual for Microwave Data Systems 4170 radio transceiver
- Manual for tipping bucket rain gage
- Manual for ISCO automated sampler
- Manual for ultrasonic transmitters, The Probe, Rev. 03/2010
- Manual for shaft encoder, 8800-1137

2.2 Precautions

This procedure is used with an approved integrated work document (IWD), if needed, and/or other safety documents, as required.

If the work will require any on-site excavation activities for a new installation, excavation permits must be obtained in accordance with P-101-17, Excavation/Fill/Soil Disturbance. For existing sites, excavation may be performed under the following limits: only hand tools may be used, existing soil must remain on the site, and excavation may not exceed a depth of 1.5 ft.

Before going to the field, field personnel shall check and set a team member's watch to the precise time by calling the LANL time system (667-TIME or 667-8463), by logging on to the time page at www.time.gov, or by clicking on the time icon on the LANL internal home page. At the site, station equipment clock times on both the datalogger and ISCO sampler need to be synchronized and verified that the time is correct. Station equipment clocks must be set to Mountain Standard Time (MST) at all times, with no daylight savings time adjustment.

Inspections may be discontinued during periods or conditions that may make sites dangerous for worker safety or prevent personnel from safely accessing sites (e.g., weather-related events such as flash floods, red-flag conditions, lightning storms, wildfires, hail, icy or slick roads, deep snow, heavy winds, and hazardous LANL operations).

3. EQUIPMENT AND TOOLS

The following are required for inspections:

- Copy of this procedure
- Copies of appropriate equipment manuals
- Copy of the IWD
- Excavation permit (as necessary)

IPC 1

- Issued work order (see sample in Attachment 1, Form 10005-1, Example of Gage Station Equipment Inspection)
- Dedicated and equipped field truck
- Field tool bag
- Synchronized time piece set to MST

3. EQUIPMENT AND TOOLS (continued)

- Voltage meter
- Spare batteries
- Leather gloves
- Shovels
- Plastic wire zip ties
- Wooden stakes
- Backpacks (if needed)
- Ball-point pens (indelible dark ink)
- Felt-tip markers (indelible dark ink)
- Leatherman-type multitool
- Two-way LANL radio
- Pager
- Cell phone (government-issued cell phones only in secure areas)
- Necessary access and station keys
- Laptop computer for downloading data from Sutron datalogger

IPC 1

- Government issued iPad (for electronic data collection)

4. STEP-BY-STEP PROCESS DESCRIPTION

4.1 <u>Preparing for Fieldwork</u>

<u>Subcontractor Route Lead</u>

[1] Receive the work order indicating the sampler or field instrumentation inspections have been approved by the LANL Field Team Lead and authorized by the subcontractor technical representative (STR). Schedule work in coordination with the operations assignee for the plan of the day. Scheduled work must be completed by the target date appearing on the work order(s).

IPC 1

[2] Review the hard copy work orders issued and compare them with PDF attachments in email(s) accompanying each batch of work orders to ensure all work orders issued were received.

IPC 1

[3] If conducting electronic data collection via MCExpressLE: Using the Safari web browser, on the iPad, navigate to mcxle.maintenanceconneciton.com and log into the Express LE application. Confirm that the work order list displayed in the "My WO's" section matches the issued list for your route. If work orders are not displayed, click "Sync" to refresh the application. If the work order lists still do not match, contact the LANS Field Team Lead for clarification.

[4] Disconnect the application from constant internet accessibility by clicking the Menu Button and select the "Disconnect." (The time stamp in the upper right hand corner will change to red).

NOTE: *This step is necessary for electronic data collection in areas where 4g network coverage on LANL property is not available*

4.1 Preparing for Fieldwork (continued)

[3] Notify the appropriate access control offices before entry and work approval at Weapons Facility Operations and nuclear environmental sites (NES). Part II of the IWD addresses specific requirements and training for these sites.

[4] Obtain any necessary additional paperwork before conducting this work, including IWDs and excavation permits (if necessary).

[5] Gather the required equipment for the work to be performed (see Section 3.0).

[6] Set watch(s) to the precise standard time (MST) so the ISCO clock can be set to the correct current local time (see Section 2.2).

Subcontractor Project Manager

[7] Conduct a pre-job briefing with field personnel using the current IWD and obtain worker signatures on new or revised IWDs. Ensure two people are present to perform field work. Ensure work is performed only during daylight hours. Extended work hours, if needed, must be approved by a supervisor.

4.2 Checking Gage Station and Datalogger upon Arrival

Subcontractor Field Team Member

IPC 1

NOTE: The hosted MainConn database system configuration is subject to change. This will affect how hard-coded sections in forms print to hard copy. Sections shown in the Attachment 1 with a red strikeout line indicate that they should be disregarded if printed on a hard-copy form, and should not be used for recording inspection information. For all tasks on the Work Order form record a "Yes" answer by choosing "Complete" *or* a "No" answer by selecting "Failed". (See Attachment 4 for examples of data collection using the electronic copy work order.)

[1] Provide the names and Z numbers of the field personnel performing the work on the signature page of the hard copy work order (Attachment 1, **Item 1**).

NOTE: *The route lead must be listed first and must sign the hard copy form.*

Electronic version: Provide the names and Z numbers of the field personnel performing the work on the Labor Report section (Attachment 4 Item 23).

[2] Record the Responded (i.e. arrival) date and time on the hard copy Work Order (**Item 2)**

Electronic version: Select the appropriate Work Order from the My WOs page and select "Responded" from the Status dropdown.

NOTE: *If you are conducting electronic data collection alongside hard copy data collection, this date/time needs to be identical to the Responded date/time entered on the hard copy form SOP-10005-1*

[3] Scroll through the options on the datalogger (consult the manual for operating instructions) or inspect the condition of the gage station to check the following and obtain information requested on the "On Arrival" task section of the Work Order (see Attachments 1 or 4)

- Check that data recording is on (**Item 3**)
- Check datalogger time setting is within +/−1 min of MST (**Item 4**)

4.2 Checking Gage Station upon Arrival (continued)

IPC 1

- Check and record the battery voltage (**Item 5**). For electronic data collection, record the only the numeric measurement (e.g. 12.48, not 12.48v) in the 'Final Reading; field.
- Check and record the stage (ft) of all sensors at station (**Item 6**). For electronic data collection, record the measurement(s) in the "Final reading" field, (e.g. EN= 0.24, PR= -0.00, BU = -0.00). Record text in the comments field..
- Record the staff plate stage (ft) (**Item 7**). For electronic data collection record ***only*** the final numeric measurement in the "Final reading" field, (e.g. 0.66). Record text in the comments field.
- Check and record if trip level has changed from last known value (**Item 8**). For electronic data collection, record only the numeric measurement in the "Final reading" field (e.g. 0.44). Record text in the comments field..
- Check and record if the point of zero flow (PZF) has changed from last known value (**Item 9**). For electronic data collection, record only the numeric measurement in the "Final reading" field (e.g. 0.44). Record text in the comments field..
- Record if channel is flowing. If the stream is flowing and measurement of flow can be done safely, perform the steps in section 4.8. (**Item 10**) If channel is flowing record only the numeric measurement (or estimated measurement) in the "Final reading" text field (e.g. 0.01). Record text comments field.
- Record the new high-water mark (HWM) (**Item 11**) if there is any indication of recent flow. If HWM has changed, record only the numeric measurement (or estimated measurement) in the "Final reading" field (e.g. 2.5). Record text comments field.

  NOTE: If the HWM is above the height of the control structure or if the flow overtopped the bank of the open channel, contact the LANL Storm Water Team at the Pueblo Complex as soon as it is convenient to determine if it is necessary to flag HWMs for a subsequent indirect measurement of peak flow (see Section 4.9).

IPC 1

- Record if the new high water mark needs to be surveyed (**Item 12**).
- Record if the current rating curve is viable. (**Item 13**)

4.3 Checking Rain Gage upon Arrival

Subcontractor Field Team Member

[1] Complete the steps in this section if a rain gage is collocated at the gage station:

IPC 1

- Check if rain gage is on and operational (**Item 14**)
- Record the amount of rain observed (**Item 15**). For electronic data collection, record only the numeric measurement in the "Final reading" field (e.g. .015). Record text in the comments field
- Check the tipping bucket for debris (**Item 16**)

4.4 Checking Rain Gage upon Departure

Subcontractor Field Team Member

[1] Complete the steps in this section if a rain gage is collocated at the gage station:

IPC 1

- Check if rain gage is on and operational (**Item 17**)
- Ensure the tipping bucket is free of debris (**Item 18**). For electronic data collection, record only the numeric measurement in the "Final reading" field (e.g. .015). Record text in the comments field
- Indicate if rain gage is set or reset to zero (**Item 19**)

4.5 Stage and Precipitation Data Retrieval

Subcontractor Field Team Member

[1] Perform the following if data is retrieved from the gage station (approximately once per month):

- Connect laptop computer to Sutron datalogger using RS-232 data cable
- Open the command prompt, program 9210
- Follow the menu choices to download the data

IPC 1

- Record if data was retrieved (**Item 20**)
- Record that data file is copied to the Sutron folder, and record the file name, startdate, and size (in kB) (**Item 21**). For electronic data collection, record the file name, start date, and size in the comments field.

4.6 Checking Gage Station and Datalogger upon Departure

Subcontractor Field Team Member

IPC 1

[1] Record the Completed (i.e. departure) date and time on the hard copy work order Attachment 1 **Item 22**)

Electronic version: Select "Completed" from the Status dropdown.

NOTE: If you are conducting electronic data collection alongside hard copy data collection, this date/time needs to be identical to the Completed date/time entered on the hard copy form SOP-10005-1

[2] Scroll through the options on the datalogger (consult the manual for operating instructions) or inspect the condition of the gage station to obtain information requested on the "departure" section (see Attachments 1 and 4, and similar "arrival" Work Order **Items 3 through 13** in Section 4.2).

[3] Check that the model and serial numbers of the installed equipment match the numbers on the equipment traveler spreadsheet (see Attachment 5 for hard copy, see Attachment 4 for electronic version) Record any needed corrections in the Labor Report section (**Item 23**).

[4] If the battery voltage is below 12.0, replace the battery if judgment indicates it should be higher after considering the number of past cloudy skies, time of day, and other factors that could explain a lower voltage.

[5] If maintenance is required and can be completed during the inspection, check "complete" in **Item 24**, perform maintenance, and describe the nature of the maintenance work in the comment field. If follow-up maintenance is required, check "yes" in **Item 25** and describe the nature of the work. If additional space is required, use the Labor Report section of the work order (**Item 23**). See Section 4.7 for additional information on trouble-shooting gage station equipment.

[6] Confirm that every page in the hard copy work order package has been documented with the Work Order ID and page # of total # of pages (for additional work order task page(s), document in the lower right hand corner, on the signature page use the lines provided at the top of the page. (**Item 26).**

Subcontractor Route Team Member

[7] Have another field team member review the complete work order for accuracy, then certify that the information submitted is "true, accurate, and complete" by signing and dating "Lead Signature" line (**Item 27**).

4.6 Checking Gage Station upon Departure (continued)

IPC 1

[8] Electronic version: Click on the Signature bar to open the signature section. Type your full name and Z# in the "Comments" text field, then capture an electronic signature. The Lead Inspector is certifying that the information submitted is "true, accurate, and complete" by electronically signing work order.

NOTE: If you are conducting electronic data collection alongside hard copy data collection, the signatory needs to be the same signatory of the hard copy form SOP-10005-1.

[9] If electronic data collection was performed using MCExpressLE, navigate back to the "My WO"s page. Using the "Menu dropdown" **Item 28,** confirm you are in a Connected state, then select "Sync". All Work Orders placed in Completed status (see Item 22) since the last synchronization will be uploaded to the Maintenance Connection database. At the end of the work day, Log out of the application.

[10] Upon returning to the office, if a data file was retrieved (see **Items 20** and **21**), copy the file to folder H:\Hydstra\Sutron. Return completed work order to a member of the subcontractor's Field Planning and Work Authorization Team.

4.7 Trouble-Shooting Gage Station Equipment

Subcontractor Field Team Member

[1] Consult the appropriate equipment manual for trouble-shooting steps.

NOTE: To aid in the assessment and correction of the electronic stage data, record the inside gage reading before and after any maintenance. If the inside gage height is reset to a known reference elevation, record the reference method and elevation. For a float gage, ensure that the float is in the same position (i.e., seated at the same spot on the sediment in stilling well or floating on a steady water surface) for both before and after readings. Record possible cause(s) and any evidence of the incorrect gage height reading (e.g., rapid rise in water level caused the encoder tape to jump track, debris in flow knocked orifice or

probe out of position, etc.). Enumerated in the steps below are some of the more common problems with gage stations.

[2] If there is no power to any instrumentation, check the electrical panel for blown fuses and replace as needed.

4.7 Trouble-Shooting Gage Station Equipment (continued)

[3] At all locations with a stilling well and encoder, ensure a datum has been set and the encoder measures the correct stage value.

NOTE: In most cases, the datum is the bottom of the stilling well door, and the value of this known height is recorded at each site. To ensure an accurate stage measurement, raise the water ring on the float level to the reference point and compare the live reading with the known height of datum. If the values are different, adjust the reading to the known value to reset. Remove debris and sediment from stilling well, ensure the float is not punctured and stilling well tape is correctly attached to wheel, and resets inside gage height if needed (see above note).

[4] To clear the bubbler line, run the bubbler to purge any debris. If debris is not dislodged, insert a cleaning tool into intake of bubbler tubing (taking care not to push debris deeper in) and circle the tubing while running bubbler to dislodge debris. Reset inside gage height if needed (see above note).

[5] To correct the inside gage height, either (1) set the height directly to the known elevation of a reference point (bottom of stilling well door cutout, staff plate marks, home plate referenced to staff plate for ultrasonic probes) or (2) use a ruler, measuring tape, and level, as needed, to measure the difference between the known reference elevation and the measuring point on the float or bubbler orifice. Follow the Sutron datalogger menu to configure the sensors and change the levels accordingly.

4.8 Measuring Discharge if Water Is Flowing at Gage Station

Subcontractor Field Team Member

[1] Use a current meter to measure the discharge if the flow is sufficiently deep. Record the stage before and after the discharge measurement as well as during the measurement (as time permits and without sacrificing discharge measurement quality) during the discharge

measurement. Record all data on an original USGS Form 9-975 (Attachment 2). Perform the necessary calculations to determine the total measured discharge.

NOTE: Refer to Rantz, et al. 1982, Chapter 5, for specific guidance on current-meter measurements, including equipment care and calibration, measurement methodology and accuracy, and computations.

4.8 Measuring Discharge if Water Is Flowing at Gage Station (continued)

[2] Use a portable Parshall flume to measure the discharge if the flow is too shallow for use of the current meter. Place the flume in the channel and uses channel bed material to seal the flume to the channel bed and banks, forcing all flow through the flume. After the flow stabilizes, take gage-height readings at 10-min intervals for 30 min (total of 4 readings). Record all data on an original USGS Form 9-975 (see Attachment 2). After measuring the flow, remove the flume and return channel to arrival conditions. Calculate the mean value of the recorded values to determine the gage height for the discharge measurement. Use Attachment 3, Table 2, to obtain the discharge for each flume reading and calculates the mean to determine the measured discharge.

NOTE: Refer to Rantz, et al. 1982, Chapter 8, for additional guidance on the Parshall flume use and computations.

4.9 Computation of Previous Peak Flows

Subcontractor Field Team Member

[1] If there is evidence of recent high flow, record the stage of the most distinct and representative HWM near the gage. If deemed necessary by the LANL Storm Water Team, use flags/flagging to mark high-water indicators for a slope-area indirect measurement of peak discharge (Dalrymple and Benson 1967). Mark the locations of at least 10 to 15 HWMs on each of the two (left and right) banks, spanning a channel length of at least 75 times the mean depth of the high flow.

NOTE: The flagged reach should also drop at least 0.5 ft, which will almost always be satisfied for high flows at LANL, given the 75-times-depth length rule. Flagging should be done no more than a few days following the high flow because some of the most accurate representations of high stage (e.g., fine debris lines, wash lines, or wet lines) fade quickly or may be obliterated by subsequent rain events. The flagged reach should be as near the

gage as possible, preferably including the gage site. However, clear and abundant HWMs as well as straight, slightly narrowing channels are the priorities in choosing a survey reach.

4.9 Computation of Previous Peak Flows (continued)

[2] After flow ceases, take appropriate survey measurements of the high-water profile and three to five channel cross-sections for the slope-area method of peak discharge determination (Dalrymple and Benson 1967).

NOTE: The high-water profile will likely include subreaches of relatively constant slope, separated by break points. The cross-sections should be distributed along the reach such that each of the constant-slope subreaches includes a surveyed cross-section. Make plan view and cross-section view sketches of the reach, including determined Manning's *n* values and any subdivision locations for the *n* values. In unclassified LANL areas, photograph the reach and cross-sections, making sure to provide them to a Derivative Classifier before downloading or distributing them.

[3] Perform the calculation of peak discharge using the slope-area computation program from the U.S. Geological Survey (Fulford 1994).

5. RECORDS MANAGEMENT

The following records are generated as a result of this procedure and will be submitted to and maintained in the Storm Water Records Management System:

- 10005-1 Gage Station Equipment Inspection Work Order (Attachment 1)
- 10005-2 USGS Form 9-275 (Attachment 2) if flow measurements were performed
- Photographs (as applicable)

6. REFERENCES

Dalrymple, Tate, and Benson, M.A., 1967, Measurement of peak discharge by the slope-area method: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chap. A2, 12 pp.

Fulford, J.M., 1994, User's guide to SAC, a computer program for computing discharge by the slope-area method: U.S. Geological Survey Open-File Report 94-360, 31 pp.

Rantz, S.E., et al., 1982, Measurement and computation of streamflow, Volume 1. Measurement of stage and discharge: U.S. Geological Survey Water-Supply Paper 2175, 284 pp.

7. ATTACHMENTS

IPC 1

Attachment 1:Hard Copy Gage Station Equipment Inspection Work Order (EXAMPLE)

Attachment 2:USGS Form 9-275 (EXAMPLE)

Attachment 3:Parshall Flume Capacities and Discharge Tables

Attachment 4: Electronic Gage Station Equipment Inspection Work Order (EXAMPLE)

Attachment 5:Equipment Configuration Traveler Spreadsheet Example

Reference

IPC 1

Attachment 1
Hard Copy Example of Gage Station Equipment Inspection Work Order
Page 1 of 3

Los Alamos National Lab

Work Order ES-53066
Environmental Surveillance
Printed 4/27/2016 - 1:06 PM (Duplicate Copy)

Maintenance Details

Requested: 4/18/2016 10:58:00 AM
Taken By: Smith, Shannon
Procedure: Gage Station + Rain Gage inspection (SOP-10005-1 IPC 1)
Last PM: 3/18/2016
Project: Example Project (P-ES-4686)

Target: 5/1/2016
Priority/Type: / Inspection

Watershed Monitoring (LAP, ESR)
RG240
E240

Contact:
Phone:

Reason: SOP-10005-1 IPC 1 Gage station inspection example

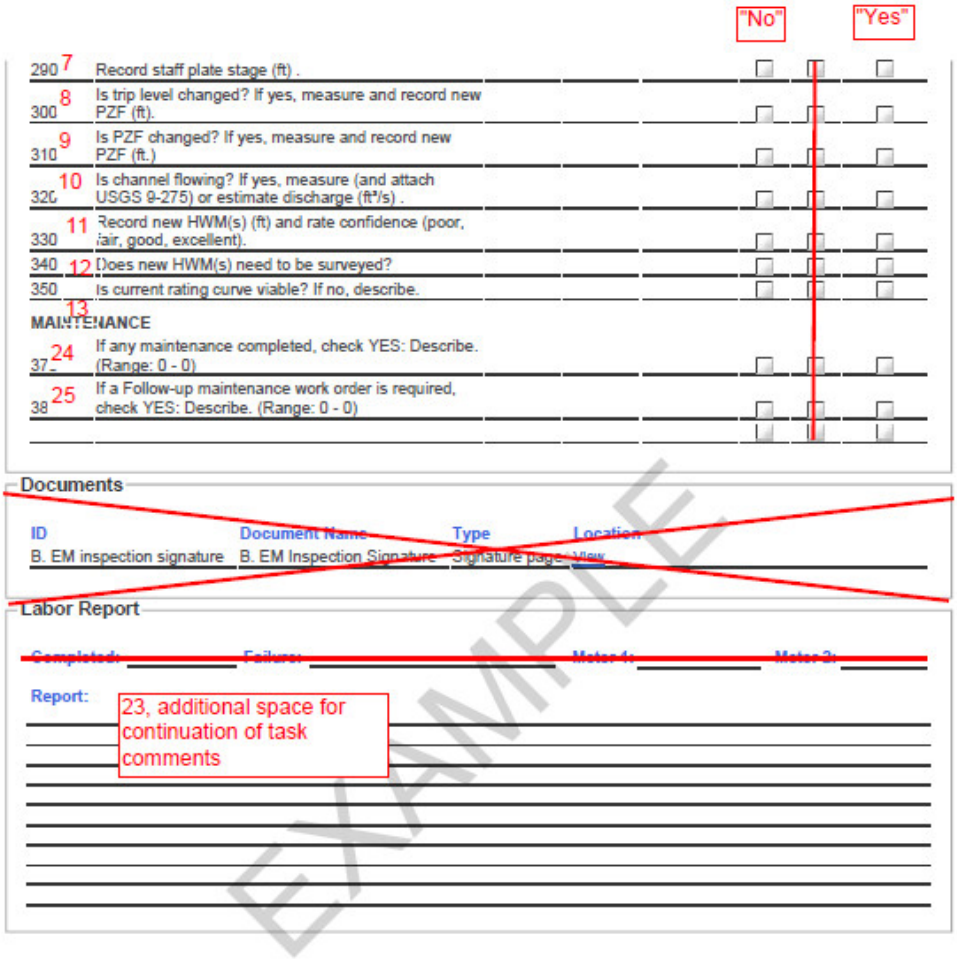
"No" "Yes"

Tasks

#	Description	Rating	Meas.	Initials	Failed	N/A	Complete
	GAGE AND DATALOGGER ON ARRIVAL						
20 3	Is data logger recording?				☐	☐	☐
30 4	Is data logger time +/- 1 min (MST)?				☐	☐	☐
40 5	Record battery voltage.				☐	☐	☐
50 6	Record stage (ft) of all sensors at station.				☐	☐	☐
60 7	Record staff plate stage (ft).				☐	☐	☐
70 8	Is trip level changed? If yes, measure and record new PZF (ft).				☐	☐	☐
80 9	Is PZF changed? If yes, measure and record new PZF (ft). (Range: 0 - 0)				☐	☐	☐
90 10	Is channel flowing? If yes, measure (and attach USGS 9-275) or estimate discharge (ft³/s).				☐	☐	☐
100 11	Record new HWM(s) (ft) and rate confidence (poor, fair, good, excellent). (Range: 0 - 0)				☐	☐	☐
110 12	Does new HWM(s) need to be surveyed? (Range: 0 - 0)				☐	☐	☐
120 13	Is current rating curve viable? If no, describe. (Range: 0 - 0)				☐	☐	☐
	RAINGAGE ON ARRIVAL						
140 14	RG240 [RG240] 2: Is Rain Gage on?				☐	☐	☐
150 15	RG240 [RG240] 2: Record rain gage reading.				☐	☐	☐
160 16	RG240 [RG240] 2: Is tipping bucket free of debris?				☐	☐	☐
	RAINGAGE ON DEPARTURE						
180 17	RG240 [RG240] 2: Is Rain Gage on ?				☐	☐	☐
190 18	RG240 [RG240] 2: Record rain gage reading .				☐	☐	☐
200 19	RG240 [RG240] 2: Is tipping bucket free of debris ?				☐	☐	☐
	STAGE AND PRECIPITATION DATA						
220 20	Retrieved data?				☐	☐	☐
230 21	Is data file copied to Sutron folder? Record data file name, start date, and file size.				☐	☐	☐
	GAGE AND DATALOGGER ON DEPARTURE						
250 3	Is data logger recording ?				☐	☐	☐
260 4	Is data logger time +/- 1 min (MST) ?				☐	☐	☐
270 5	Record battery voltage				☐	☐	☐
280 6	Record stage (ft) of all sensors at station .				☐	☐	☐

IPC 1

Attachment 1
Hard Copy Example of Gage Station Equipment Inspection Work Order
Page 2 of 3



IPC 1

Attachment 1
Hard Copy Example of Gage Station Equipment Inspection Work Order
Page 3 of 3

WO ID: 27 Page 27 of _____

Responded Date: 2 Time:_____ Completed Date: 22 Time:_____

Name/Z#: 1
Name/Z#:_____
Lead Signature: 27

"I confirm the information as recorded is true, accurate and complete."

LANL PERSONNEL USE ONLY (initials and dates)

Accepted_____ **Tech QC**_____ **FTL**_____

Attachment 2
USGS Form 9-275
Page 1 of 2

9-275-G
(Rev. 10-81)

U.S.G.S.
STANDARD
DISCHARE MEASUREMENT
NOTES

Meas. No. . . . . .
Comp. by. . . . . .

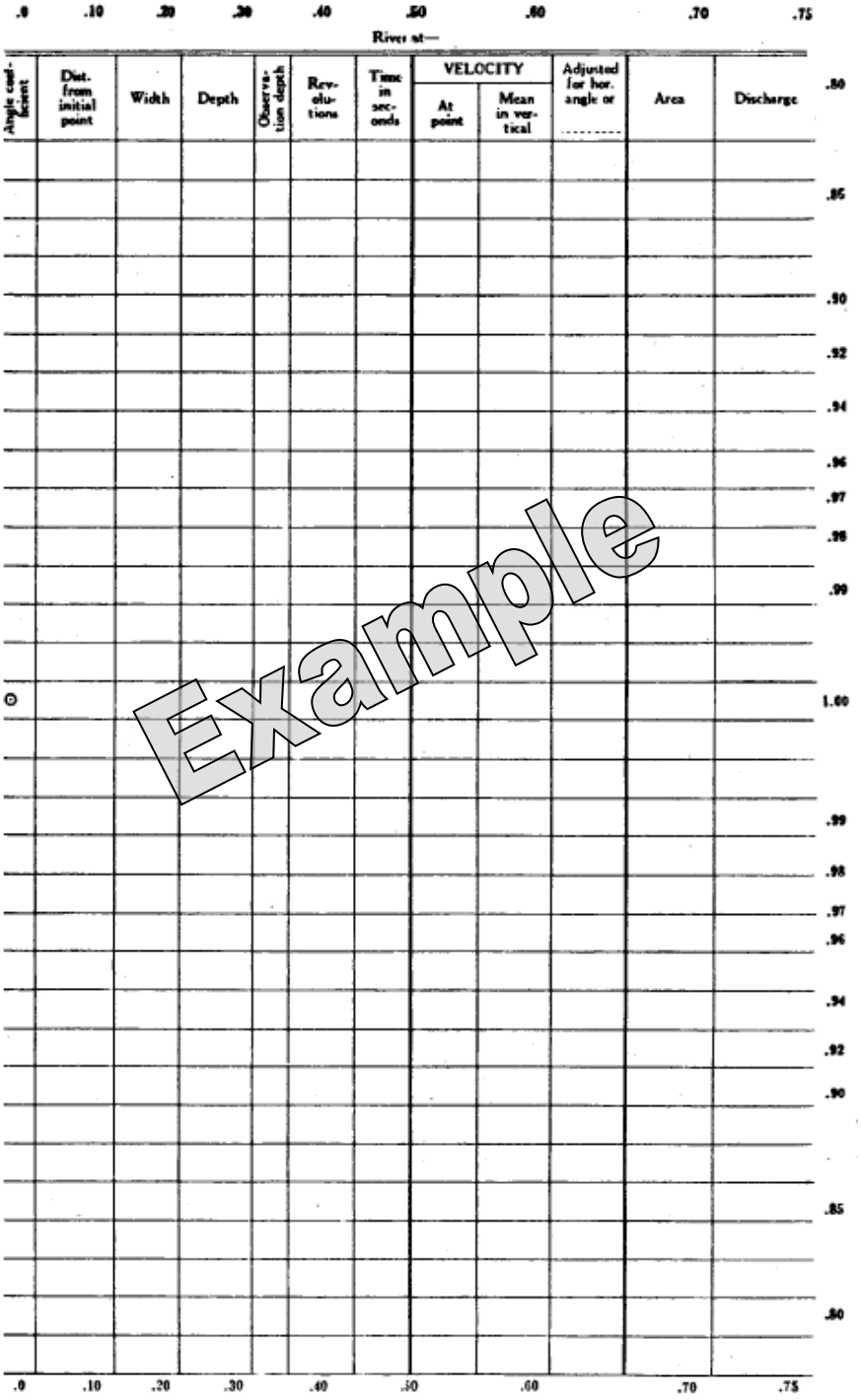
Sta. No. . . . . **DISCHARGE MEASUREMENT NOTES** Checked by . . . . .

. . . . . .
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. . . . . Time . . . . .
						Method Used
						EDI . . . . . EWI . . . . . Other. . . . .
						SEDIMENT SAMPLES
						No . . . . . Yes. . . . . Time . . . . .
						Method Used
						EDI . . . . . EWI . . . . . Other. . . . .
Weighted M.G.H.						BIOLOGICAL SAMPLES
G. H. correction						Yes. . . . . Time . . . . .
Correct M.G.H.						No . . . . . Type . . . . .

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 N_2 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

Attachment 2
USGS Form 9-275
Page 2 of 2



Attachment 3
Parshall Flume Capacities and Discharge Tables
Page 1 of 3

RATING TABLE FOR 3" MODIFIED PARSHALL FLUME

Gage height (ft)	Discharge (ft^3/s)	Gage height (ft)	Discharge (ft^3/s)	Gage height (ft)	Discharge (ft^3/s)
0.01	0.0008	0.21	0.097	0.41	0.280
.02	.0024	.22	.104	.42	.290
.03	.0045	.23	.111	.43	.301
.04	.0070	.24	.119	.44	.312
.05	.010	.25	.127	.45	.323
.06	.013	.26	.135	.46	.334
.07	.017	.27	.144	.47	.345
.08	.021	.28	.153	.48	.357
.09	.025	.29	.162	.49	.368
.10	.030	.30	.170	.50	.380
.11	.035	.31	.179	.51	.392
.12	.040	.32	.188	.52	.404
.13	.045	.33	.198	.53	.417
.14	.051	.34	.208	.54	.430
.15	.057	.35	.218	.55	.443
.16	.063	.36	.228	.56	.456
.17	.069	.37	.238	.57	.470
.18	.076	.38	.248	.58	.483
.19	.083	.39	.259	.59	.497
.20	.090	.40	.269		

Attachment 3
Parshall Flume Capacities and Discharge Tables
Page 2 of 3

RATING TABLE FOR 6", 9", AND 12" PARSHALL FLUMES

Gage Height (ft)	Discharge (ft^3/s)			Gage Height (ft)	Discharge (ft^3/s)		
	6″	9″	12″		6″	9″	12″
0.10	0.05	0.09	----	0.50	0.69	1.06	1.39
0.11	0.06	0.10	----	0.51	0.71	1.10	1.44
0.12	0.07	0.12	----	0.52	0.73	1.13	1.48
0.13	0.08	0.14	----	0.53	0.76	1.16	1.52
0.14	0.09	0.15	----	0.54	0.78	1.20	1.57
0.15	0.10	0.17	----	0.55	0.80	1.23	1.62
0.16	0.11	0.19	----	0.56	0.82	1.26	1.66
0.17	0.12	0.20	----	0.57	0.85	1.30	1.70
0.18	0.14	0.22	----	0.58	0.87	1.33	1.75
0.19	0.15	0.24	----	0.59	0.89	1.37	1.80
0.20	0.15	0.26	0.35	0.60	0.92	1.40	1.84
0.21	0.18	0.28	0.37	0.61	0.94	1.44	1.88
0.22	0.19	0.30	0.40	0.62	0.97	1.48	1.93
0.23	0.20	0.32	0.43	0.63	0.99	1.51	1.98
0.24	0.22	0.35	0.46	0.64	1.02	1.55	2.03
0.25	0.23	0.37	0.49	0.65	1.04	1.59	2.08
0.26	0.25	0.39	0.51	0.66	1.07	1.63	2.13
0.27	0.26	0.41	0.54	0.67	1.10	1.66	2.18
0.28	0.28	0.44	0.58	0.68	1.12	1.70	2.23
0.29	0.29	0.46	0.61	0.69	1.15	1.74	2.28
0.30	0.31	0.43	0.64	0.70	1.17	1.78	2.33
0.31	0.32	0.51	0.68	0.71	1.20	1.82	2.38
0.32	0.34	0.54	0.71	0.72	1.23	1.80	2.43
0.33	0.36	0.56	0.74	0.73	1.26	1.90	2.48
0.34	0.38	0.59	0.77	0.74	1.28	1.94	2.53
0.35	0.39	0.62	0.80	0.75	1.31	1.98	2.58
0.36	0.41	0.64	0.84	0.76	1.34	2.02	2.63
0.37	0.42	0.67	0.88	0.77	1.36	2.06	2.68
0.38	0.45	0.70	0.92	0.78	1.39	2.10	2.74
0.39	0.47	0.73	0.95	0.79	1.42	2.14	2.80
0.40	0.48	0.76	0.99	0.80	1.45	2.18	2.85
0.41	0.50	0.78	1.03	0.81	1.48	2.22	2.90
0.42	0.52	0.81	1.07	0.82	1.50	2.27	2.96
0.43	0.54	0.84	1.11	0.83	1.53	2.31	3.02
0.44	0.56	0.87	1.15	0.84	1.56	2.35	3.07
0.45	0.58	0.90	1.19	0.85	1.59	2.39	3.12
0.46	0.61	0.94	1.23	0.86	1.62	2.44	3.18
0.47	0.63	0.97	1.27	0.87	1.65	2.48	3.24
0.48	0.65	1.00	1.31	0.88	1.68	2.52	3.29
0.49	0.67	1.03	1.35	0.89	1.71	2.57	3.35
0.90	1.74	2.61	3.41	1.32	----	4.69	6.10
0.91	1.77	2.66	3.46	1.33	----	4.75	6.17

Attachment 3
Parshall Flume Capacities and Discharge Tables
Page 3 of 3

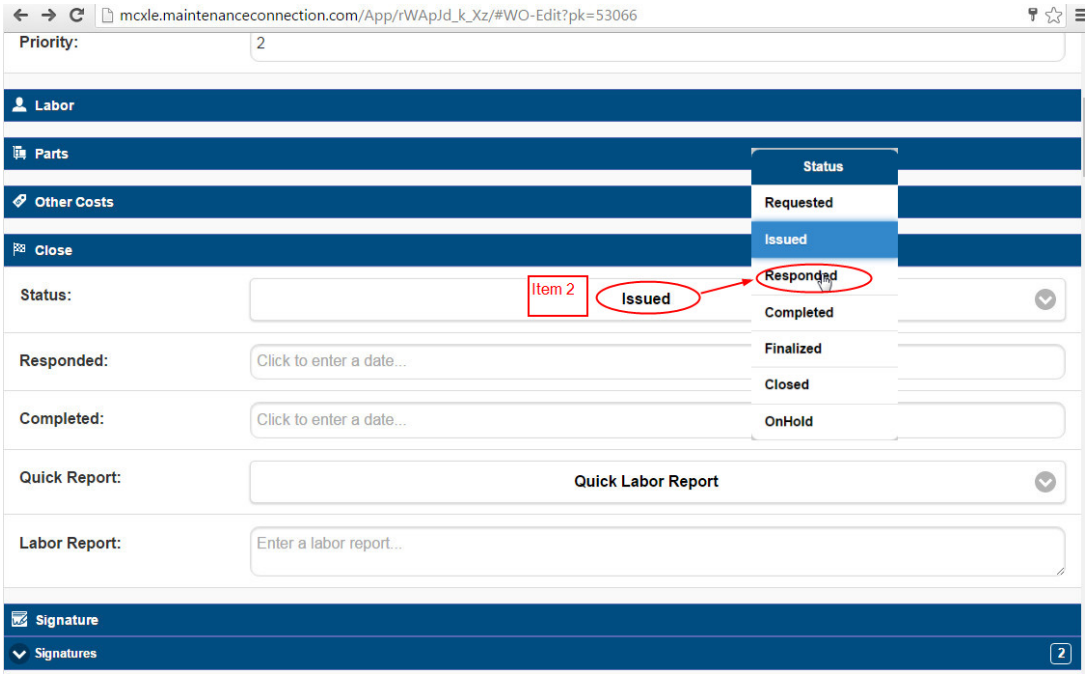
RATING TABLE FOR 6", 9", AND 12" PARSHALL FLUMES

Gage Height (ft)	Discharge (ft^3/s)			Gage Height (ft)	Discharge (ft^3/s)		
	6"	9"	12"		6"	9"	12"
0.92	1.81	2.70	3.52	1.34	----	4.80	6.24
0.93	1.84	2.75	3.58	1.35	----	4.86	6.32
0.94	1.87	2.79	3.64	1.36	----	4.91	6.39
0.95	1.90	2.84	3.70	1.37	----	4.97	6.46
0.96	1.93	2.88	3.76	1.38	----	5.03	6.53
0.97	1.97	2.93	3.82	1.39	----	5.08	6.60
0.98	2.00	2.98	3.88	1.40	----	5.14	6.68
0.99	2.03	3.02	3.94	1.41	----	5.19	6.75
1.00	2.06	3.07	4.00	1.42	----	5.25	6.82
1.01	2.09	3.12	4.06	1.43	----	5.31	6.89
1.02	2.12	3.17	4.12	1.44	----	5.36	6.97
1.03	2.16	3.21	4.18	1.45	----	5.42	7.04
1.04	2.19	3.26	4.25	1.46	----	5.48	7.12
1.05	2.22	3.31	4.31	1.47	----	5.54	7.19
1.06	2.26	3.36	4.37	1.48	----	5.59	7.26
1.07	2.29	3.40	4.43	1.49	----	5.65	7.34
1.08	2.32	3.45	4.50	1.50	----	----	7.49
1.09	2.36	3.50	4.56	1.51	----	----	7.57
1.10	2.46	3.55	4.62	1.52	----	----	7.64
1.11	2.43	3.60	4.68	1.53	----	----	7.72
1.12	2.46	3.65	4.75	1.54	----	----	7.79
1.13	2.50	3.70	4.82	1.55	----	----	7.79
1.14	2.53	3.75	4.88	1.56	----	----	7.87
1.15	2.57	3.80	4.94	1.57	----	----	7.95
1.16	2.60	3.85	5.01	1.58	----	----	8.02
1.17	2.64	3.90	5.08	1.59	----	----	8.10
1.18	2.68	3.95	5.15	1.60	----	----	8.18
1.19	2.71	4.01	5.21	1.61	----	----	8.26
1.20	2.75	4.06	5.28	1.62	----	----	8.34
1.21	2.78	4.11	5.34	1.63	----	----	8.41
1.22	2.82	4.18	5.41	1.64	----	----	8.49
1.23	2.86	4.22	5.48	1.65	----	----	8.57
1.24	2.89	4.27	5.55	1.66	----	----	8.65
1.25	----	4.32	5.62	1.67	----	----	8.73
1.26	----	4.37	5.69	1.68	----	----	8.81
1.27	----	4.43	5.76	1.69	----	----	8.89
1.28	----	4.48	5.82	1.70	----	----	8.97
1.29	----	4.53	5.89				
1.30	----	4.59	5.96				
1.31	----	4.64	6.03				

IPC 1

Attachment 4
Electronic Copy Example of Gage Station Equipment Inspection Work Order

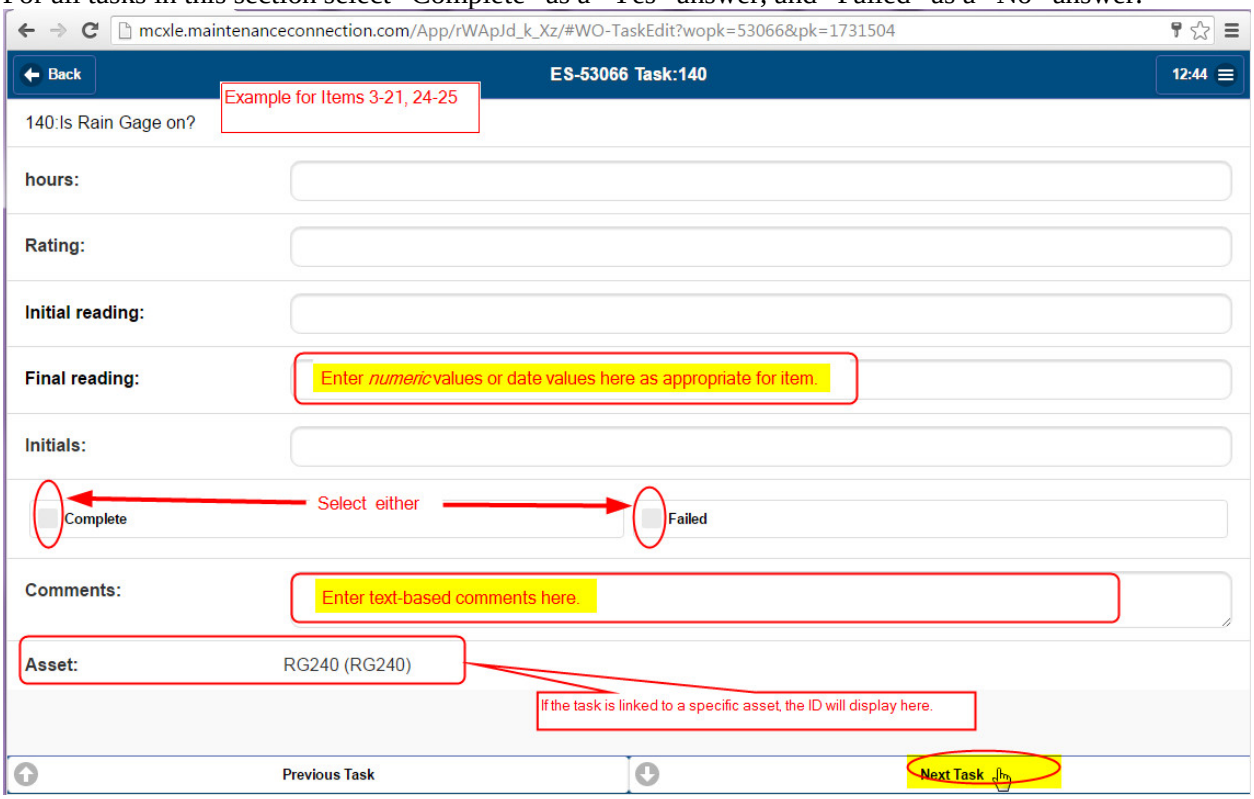
Page 1 of 3



IPC 1

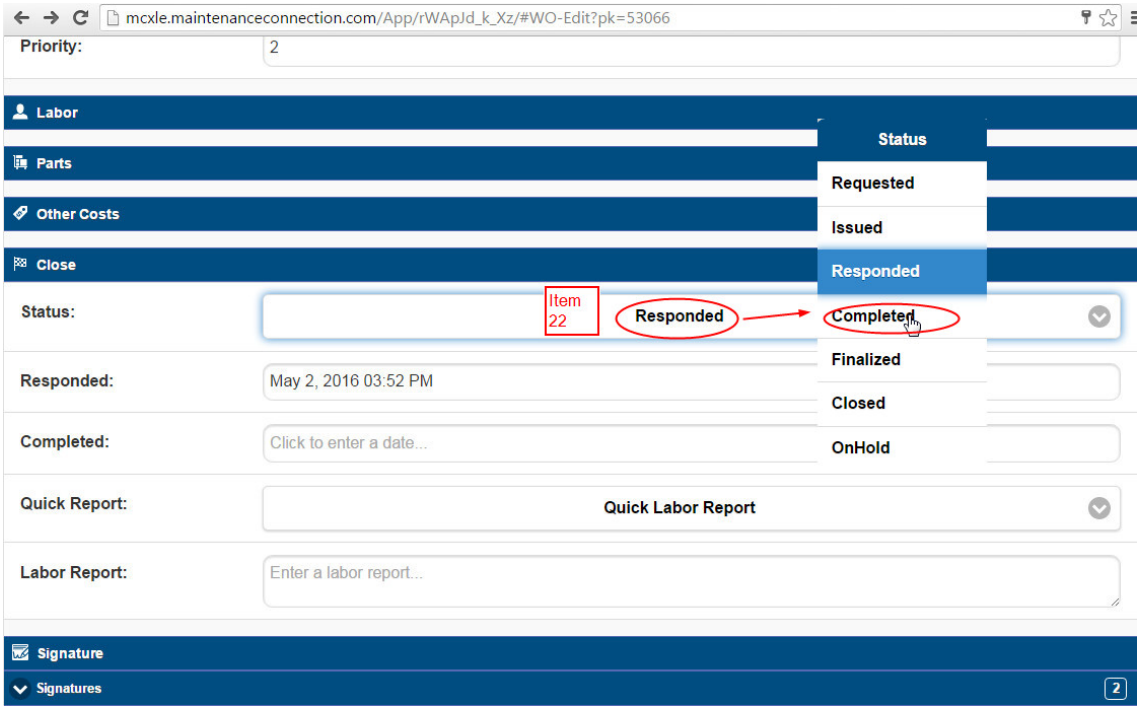
Attachment 4
Electronic Copy Examples of Gage Station Equipment Inspection Work Order
Page 1 of 3

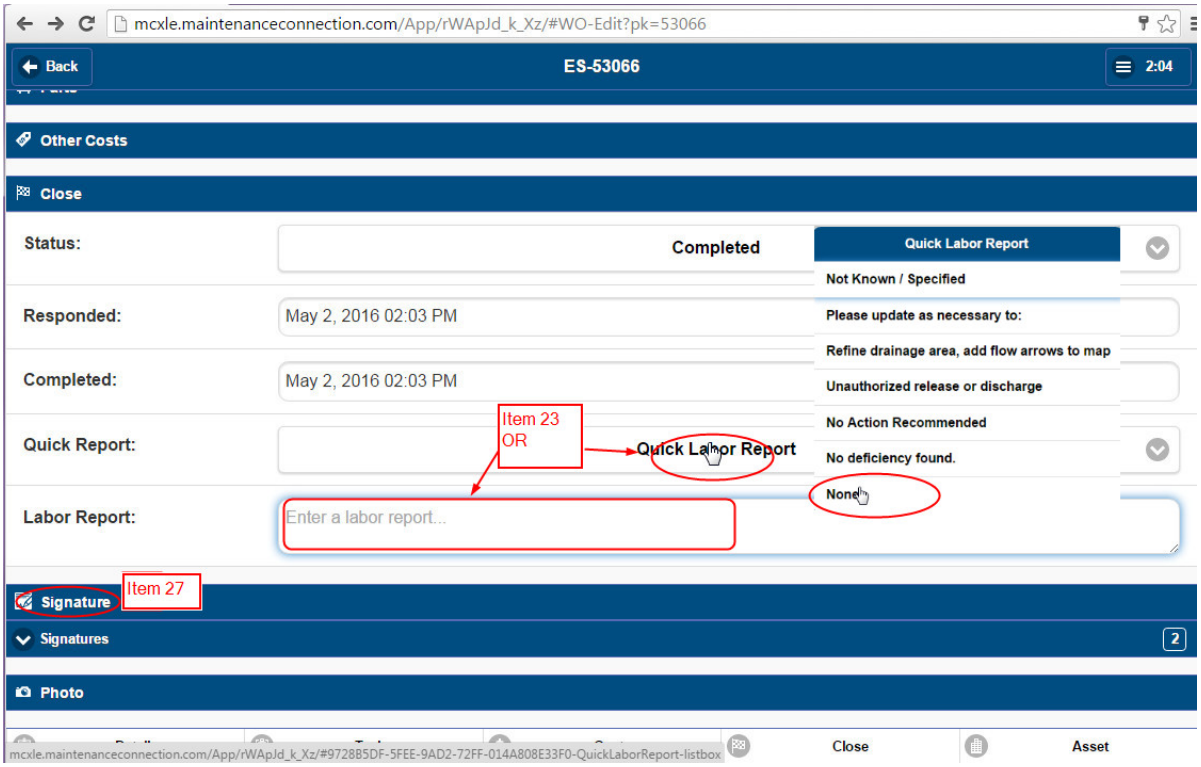
Note: The display of the web application is hard coded to show "Complete" and "Failed" checkboxes. For all tasks in this section select "Complete" as a "Yes" answer, and "Failed" as a "No" answer.



Reference

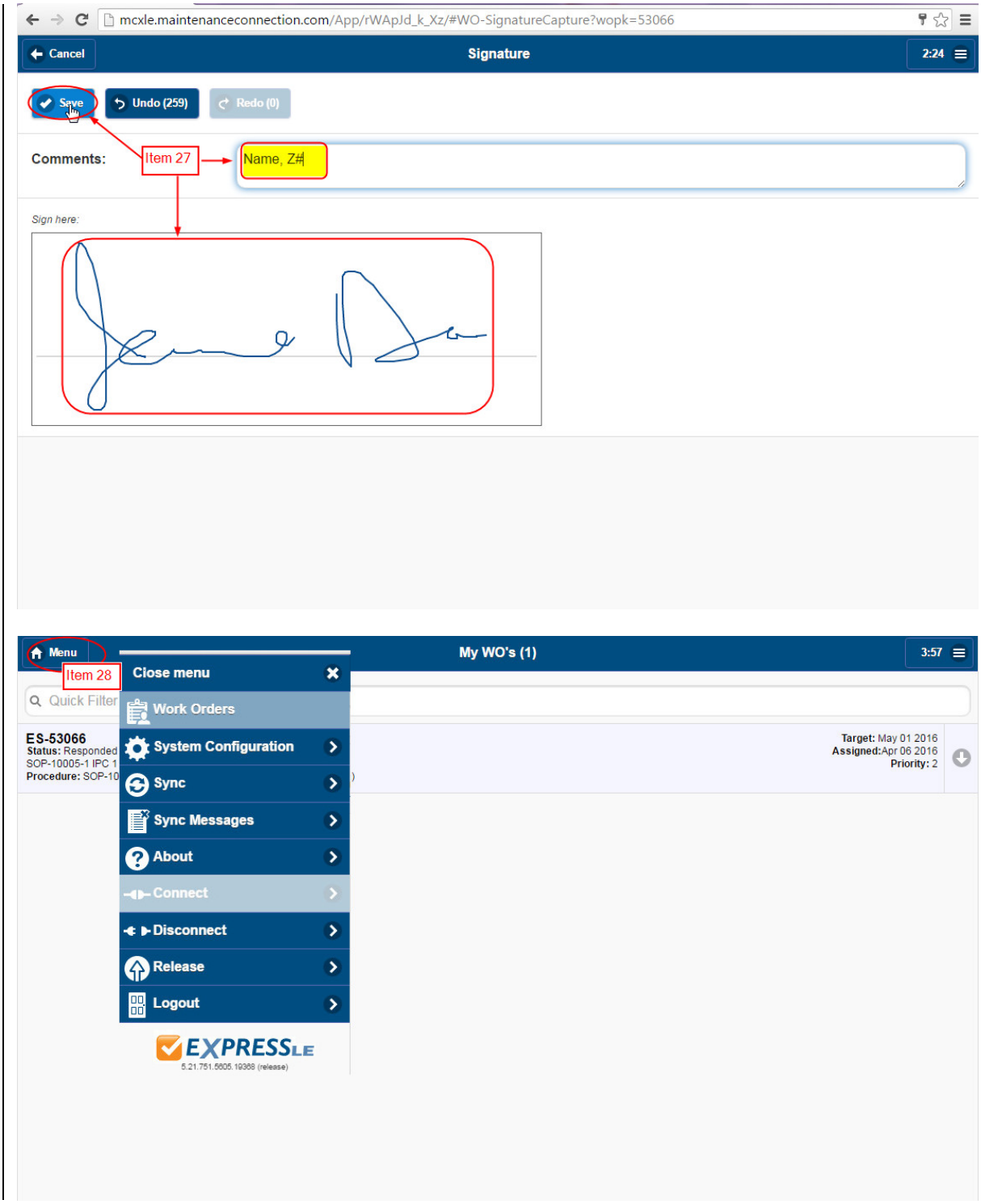
IPC 1





Reference

IPC 1



Attachment 5
Example of Gage Station Configuration and Equipment Configuration

IPC 1

Gage Station Equipment Traveler

Parent Location	HWM	PZF (ft)	Trip Level	Data Transceiver	Encoder	Station Phone	Sutron Datalogger	ISCO 3700 Sampler
E240	2.5	0.44	1.35	2131466	570	412-8646	1109474	198G01740