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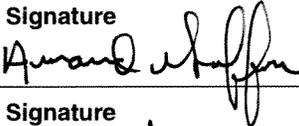
Next Review Date: 9/16/2012

Environmental Programs Directorate Corrective Actions Program

Standard Operating Procedure

for **MANAGING ELECTRONIC PRECIPITATION DATA
FOR STORM WATER PROJECTS**

APPROVAL SIGNATURES:

Subject Matter Expert: Armand Groffman	Organization ADEP-ET	Signature 	Date 09/13/2010
Responsible Line Manager: Steve Veenis	Organization PMFS-DO	Signature 	Date 9.13.10

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1.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) states the responsibilities and describes the process for managing electronic precipitation measurement data collected for use by Los Alamos National Laboratory (LANL) storm water programs. Electronic data management processes include: downloading electronic data from remote data loggers and/or the LANL Weather Machine; processing the raw data files; uploading electronic data from the remote data loggers into Hydstra ©; calculating the 24-hour cumulative amount, storm duration, and maximum 30-minute storm intensity; and transferring the calculated precipitation results to the Storm Water Tracking System (SWTS) .

This procedure also describes the process for applying data qualifier codes and qualifier reasons to the calculated precipitation results stored in SWTS; estimating precipitation results when rain gage equipment failures occur; and producing the SWTS daily precipitation report on demand for dissemination to storm water project personnel.

This procedure is to be used by field operations personnel assigned to operation and maintenance of the storm water project rain gage network; and storm water project technical personnel familiar with: operation of the Sutron data loggers used with the rain gage network; dial-up modems used to retrieve data from remote dataloggers; and/or use of the Hydstra © and SWTS applications.

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

Measurement, collection, and management of precipitation data and calculated results are required by the Laboratory's National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Permit (MSGP, NMR05GB21), Construction General Permit (CGP), and the NPDES Individual Permit (IP) for Storm Water Discharge from SWMUs and AOCs (NM0030759) issued to LANL by the Environmental Protection Agency (EPA). The precipitation data reports are used for the NPDES permit compliance activities, including

- triggering rain-event inspections of best management practices and storm water control measures;
- triggering rain-event inspections of monitoring station equipment and sample retrieval after measurable storm events; and
- determining the discharge status of storm water outfalls (e.g., 'measurable discharge' determinations)

The 24-hour precipitation report that results from this procedure meets the regulatory requirements of the NPDES storm water permits. The daily precipitation report is also used by Consent Order and environmental surveillance storm water projects to guide field activities such as monitoring station inspections and sample retrieval.

The storm water programs use precipitation data collected at LANL meteorological towers and reported on the LANL Weather Machine. In addition, a seasonal rain gage network is deployed during the months of April through November to coincide with the monitoring periods. Using a geospatial information system (GIS), storm water monitoring stations and permitted features are assigned to an individual rain gage using the method of Thiessen polygons. The seasonal assignment of monitoring stations to rain gage Thiessen polygons is managed in SWTS by Field Planning and Work Authorization personnel. The use of the extended rain gage network allows the storm water projects to optimize field team response to only those areas where precipitation likely resulted in runoff or exceeded a pre-established trigger amount.

2.2 Precautions

Before initiating the SUTRON remote data download process, user(s) must check and set a watch or clock to the precise time by: calling the Laboratory's time system (667-TIME or 667-8463); logging on to the time page at www.time.gov ; or clicking on the time icon on the LANL internal home page. Gage station equipment clock time including the SUTRON data logger must be synchronized and verified. Station equipment clocks must be set to Mountain Standard Time (MST) at all times, with no daylight saving time adjustments made.

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3.0 PREREQUISITE TRAINING

To download and process Sutron data files, workers must have familiarity with:

- The Hydstra © commercial off-the shelf application configuration for LANL stations for uploading and manipulating electronic rain data files in Hydstra ©.
- The use of a "dial-up" modem for retrieving precipitation data from remote Sutron data loggers at the gage station locations.

To generate the precipitation report from SWTS, workers must have familiarity with:

- Extended rain gage network and Thiessen polygon assignments.
- Operational and meteorological issues that may affect recorded precipitation values.
- The SWTS user menus and the precipitation report application.

4.0 EQUIPMENT

To download and process Sutron data files, the following equipment is required:

- LANL PC 32-bit workstation equipped with the following:
 - Dial-up modem
 - SUTRON software applications for downloading data and converting LOG files to PRN files most current definition files for Symantec Endpoint Protection software
 - New Sutron XConnect software will poll using the GE-MDS 4710 data telemetry radios designed to operate in a point-to-multipoint environment such as SCADA applications. This SOP will be modified once system upgrades are complete.
- Account license ("seat") for access to Hydstra application (contact Field Planning and Work Authorization Team Leader)
- Permissions to access the \Projects\Hydron folders on the win.lanl.gov\WES network drive (contact computer support)

To generate the precipitation report from SWTS:

- Storm water user account for access to the SWTS applications running on the Water Quality Database (WQDB) (contact Field Planning and Work Authorization Team Leader)
- Account license ("seat") for access to Hydstra application
- Permissions to access the \WQ\Surface Water Programs folders on the win.lanl.gov\ESHQ network drive (contact computer support)
- PERL software to execute scripts that retrieve and perform calculations on electronic data from the LANL Weather Machine and Hydstra ©, and to upload the calculated precipitation results to SWTS (installed on dedicated computers used for this procedure)

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5.0 STEP-BY-STEP PROCESS DESCRIPTION

5.1 Remotely Downloading Electronic Data

Assigned
Project
Personnel

1. During the monitoring season (when stations are not winterized), work orders will be issued to perform the data download steps in this section after 6:00 am MST (7:00 am MDT) every Monday (or the following business day if Monday is a holiday). Non-scheduled downloads will be requested using work orders for the following situations:
 - Following a rain event where a minimum of 0.10 inch is recorded at any LANL meteorology tower during the “storm day” (defined as 6:00 AM to 6:00 AM), or
 - At the e-mail request of the Project Manager for Surface Water and Canyons Investigations, or his designee.

Divide the downloading and processing workload by assigning personnel to call specific rain stations and to perform the Hydstra © data upload. Each person performing either the Sutron data download or Hydstra © data upload tasks must complete the corresponding sections on a single Remote Sutron Data Download form (see example in Attachment 1).

2. In the folder on the network drive \\win\wes\Projects\Hydron\SW Log\Rain Data 201X\, create a new subfolder with the name mm-dd-yy or mm-dd-yy-monday_download (where mm-dd-yy is the date of either the storm or Monday) for raw data download storage; inform other personnel assigned to do these steps.
3. Physically disconnect the workstation from the LANL yellow network by unplugging the appropriate network connection.
4. Dial up the remote data logger modem. Initiate the data file download onto the isolated workstation.
5. Save the raw data file as a LOG file on the workstation hard drive.
6. Indicate whether remote data retrieval was successful in **Item 3** on Remote Sutron Data Retrieval form (refer to red numbered blocks on example in Attachment 1).
If NO, provide explanation (e.g., low battery power due to cloud cover). Notify a Field Planning and Work Authorization team member and STR via e-mail that a site visit is required and there may be a delay.
7. If remote data logger cannot be successfully contacted, report the station problem to the STR to request the initiation of a work order to dispatch team leader, so the STR can request a field crew member to manually download the data file onto a laptop computer according to EP-DIV-SOP-10005, Operation and Maintenance of Gage Stations. Also complete the weekly Gage Station Inspection Form (see example in Attachment 1) (issued in weekly work order) during site visit.

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Assigned Project Personnel (cont.)

Check **Item 4** on work order to indicate whether data retrieval at the site was successful; if NO, describe deficiencies or problems at station. Notify the Field Planning and Work Authorization team and STR via e-mail that the data file could not be retrieved.

-
8. **Item 5:** Is phone on and operating?
 If modem connection is established answer YES.
 If NO, site visit is required. Refer to EP-DIV-SOP-10005 for gage inspection instructions.
-
9. **Item 6:** Is SUTRON data recording on? If modem connection is established, answer YES.
 If NO, site visit is required. Refer to EP-DIV-SOP-10005 for gage inspection instructions.
-
10. **Item 7:** Is SUTRON time within 1 minute of actual (MST)? If No, record adjustment.
-
11. **Item 8:** Record inside gage reading at start of remote download. If a site visit is required, enter the inside gage reading upon arrival at the station.
-
12. **Item 9:** Record inside gage reading on departure/finish.
-
13. **Item 10:** Enter battery voltage. Refer to EP-DIV-SOP-10005 for battery specifications to determine if voltage is acceptable.
-
14. **Item 11:** Is rain gage on? If YES, record rain gage reading.
 If NO, site visit is required. Refer to EP-DIV-SOP-10005 for gage inspection instructions.
-
15. **Item 12:** Rain gage reset to zero? Using the remote connection, the rain gage should be reset to zero after the data file download is complete. If NO, explain.
-
16. **Item 13:** Record LOG data file name as downloaded. If LOG file is renamed following download, provide the final data file name also.
-
17. **Item 14:** Record data file start date and data file size (Kb) Read the file start date and record; also record the file size in Kb.
-
18. When data file download is complete, conduct a security and virus scan of the downloaded files (select custom scan for selected files and folders) using the most current version of Symantec Endpoint Protection definitions and complete the Remote Sutron Data Retrieval form (see example in Attachment 1).
Item 15: Record whether scan was successful. If NO, immediately contact the Subcontract Technical Representative and/or the Security Responsible Line Manager.
-

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Assigned Project Personnel (cont.)

19. If no issues are identified in the security scan, reconnect the workstation to the LANL Yellow network, and transfer the .LOG files to the new subfolder created in <\\win\wes\Projects\Hydron\SW Log\Rain Data 201X>
20. **Item 16:** If known station problems affect electronic data quality, check YES and describe. Note deficiencies such as rain gage bucket blockage, power failure and/or damaged electrical connections.
21. **Item 17:** Indicate whether follow-on maintenance is required at the station. If equipment or operational deficiencies cannot be fixed on the same day the download was attempted, briefly describe the deficiency. A separate work order for the station maintenance will be issued by the Field Planning and Work Authorization team (after the completed download work order is returned).
22. **Item 1:** Sign and date the block for completion of data download.

5.2 Uploading Data into Hydstra ©

Assigned Project Personnel

1. Copy the .LOG data files from the <\\Er5\Pueblo\hydron\SW Log\Rain Data 201X\mm-dd-yy-event> folder to <\\win\wes\Projects\Hydron\SW Log\Rain Data 201X> folder. Run the Sutron program LOGPRN4.EXE on each raw data file to convert it to a .PRN file and save it in the same "Sutron" folder.
2. Log into Hydstra © and use the Workbench / Import data function to load .PRN files into Hydstra ©.
3. If Hydstra © indicates a negative precipitation amount, split the file into two files at the place where the precipitation amount goes to zero and load each file separately.
4. If files do not load properly, use a text editor (e.g., Notepad) to repair the data files as needed so that the import utility runs without errors. If file requires manual data correction in order to properly import, describe the correction on the Remote Sutron Data Download form on example in Attachment 1).
5. Perform a quality control review on the data loaded to Hydstra © to determine if corrections are required and apply data quality codes (Attachment 2) as necessary.
 - Use Hydstra © data quality code "1" to indicate good continuous records (e.g., unedited (raw) data).
 - Use Hydstra © data quality code "2" to indicate good quality edited data (e.g., text editor repairs, file splits).
 - Raw files containing missing data, data not recorded, or data not available may carry quality codes "151", "201" or "255", respectively.
 - Estimates for missing or unavailable precipitation data (11) are not required.

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Assigned Project Personnel (cont.)

6. After loading the data file into Hydstra ©, move the PRN file and the LOG file into a new subfolder in the “Sutron” folder with the name “mm_dd_yy”. Example: For a rain event on April 23, 2009 make folder [\\win\wes\Projects\Hydron\Sutron\04_23_09](#).
NOTE: Moving the data files out of the main Sutron folder into the event-dated subfolder serves as a tracking function. It is important to observe this protocol to help avoid missing locations or duplicating work.
7. **Item 18:** indicate whether data conversion and import into Hydstra is successful. Delete the PRN files to save disk storage space.
8. Move the LOG files to [\\win\wes\Projects\Hydron\SW_Log\WY201x](#) so that the stage level data files are available to storm water personnel for further processing.
9. **Item 19:** Communicate to the Field Planning and Work Authorization data manager via e-mail when data upload to Hydstra © is complete.
10. **Item 20:** Add additional notes as needed to clarify existing entries.
11. **Item 2:** Sign and date the block for completion of HYDSTRA data upload.
12. Deliver the form to a Field Planning and Work Authorization member.

5.3 Importing Meteorology Tower Data and Hydstra © Data to SWTS

Field Planning and Work Authorization Data Manager

1. Run “ExportMET.Bat” PERL script stored in the [\\win\eshq\env\rcra\WQ\WQDBStormWater](#) folder after 6:00 am MST (7:00 am MDT) to electronically retrieve data from the LANL Weather Machine and to process and load the data into the SW_PRECIP table in the SWTS.
NOTE: The “ExportMET.Bat” PERL script applies data processing algorithms to summarize cumulative precipitation, cumulative duration, maximum precipitation intensity over a 30-minute period, and days since last recorded precipitation at each station for each 24-hr period. For the storm water program, a “day” starts and ends at 6:00 am. Any events occurring after midnight are considered part of the day that began the previous 6:00 am.
2. After notification that the electronic data upload to Hydstra © is complete, run “ExportHydstra.Bat” PERL script stored in the [\\win\eshq\env\rcra\WQ\WQDBStormWater](#) folder to electronically retrieve data from Hydstra © and to process and load the data into the SW_PRECIP table in SWTS.
NOTE: The “ExportHydstra.Bat” PERL script applies data processing algorithms to summarize cumulative precipitation, cumulative duration, maximum precipitation intensity over a 30-minute period, and days since last recorded precipitation at each station for each 24-hr period. For the storm water program, a “day” starts and ends at 6:00 am. Any events occurring after midnight are considered part of the day that began the previous 6:00 am.

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5.4 Reviewing and Qualifying Calculated Precipitation Results in SWTS

- Field Planning and Work Authorization Data Manager
1. Open the SW_PRECIP form in SWTS and review and verify the data from each station to determine data problems and reliability concerns. If necessary, examine rain gage curves and graphs in Hydstra © to facilitate interpretation of a precipitation event. Confer with field operations personnel as needed to confirm station operating conditions.

NOTE: LANL meteorology tower data are obtained from the LANL Weather Machine and are not stored in Hydstra ©. The LANL Weather Machine is accessed at <http://weather.lanl.gov/>.

 2. Add any necessary qualifiers and qualifier reason codes in the appropriate report fields for each value as needed to describe qualified data. Attachment 3 provides a list of the basic qualifier codes used in the SWTS report. If needed, the Field Planning and Work Authorization data manager may define additional qualifier codes and reasons in the SWTS application.

 3. For stations with no data or suspect data, use precipitation data from adjacent Thiessen polygons and exercise best professional judgment to estimate rainfall totals, maximum 30-minute intensity, and duration. Document decisions in the “Comment” field of the SW_PRECIP form.

 4. Click on the “Commit” button to save data to SW_PRECIP table.

5.5 Generating 24-Hour Precipitation Report

- Field Planning and Work Authorization Data Manager
1. With the SW_PRECIP form still open, and after completing review of the calculated precipitation results, click on the “Run” button to generate the 24-hour precipitation report for a specified starting date. Rain gage stations that received rainfall over the triggering amount or intensity are highlighted on the report, which is generated as a PDF file. A sample report is shown in Attachment 4.

 2. Save the 24-hour precipitation report as a PDF file in the server folder \\WQ\Surface Water Program\02_Field Planning and Work Authorization_6P\3.Data Stewardship\Precipitation\Storm Events.

Apply an electronic signature to the report.

Distribute the PDF report via e-mail to storm water project personnel and storm water records management.

5.6 Submitting Records Resulting from this Procedure

- Data Manager
1. When complete, submit the following records to the Storm Water Records point of contact at TA-59, Bldg 53, utilizing the Storm Water Records Submittal form.
 - Remote Sutron Data Download form(s) (Attachment 1)
 - 24-Hour Precipitation Report PDF file(s) (Attachment 4)

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6.0 ATTACHMENTS

Attachment 1: Example of Remote SUTRON Data Download and instructions

Attachment 2: Hydstra © Data Quality Codes

Attachment 3: SWTS Qualifier Codes and Qualifier Descriptions for Precipitation Data

Attachment 4: Storm Water Tracking System Precipitation Report (EXAMPLE)

[Using a CRYPTO Card, click here for "Required Read" credit.](#)

If you do not possess a CRYPTOCARD or encounter problems, contact the EP Central Training Office.

7.0 REVISION HISTORY

Revision No. <i>[Enter current revision number, beginning with Rev.0]</i>	Effective Date <i>[DCC inserts effective date for revision]</i>	Description of Changes <i>[List specific changes made since the previous revision]</i>	Type of Change <i>[Technical (T) or Editorial (E)]</i>
0	9/16/2010	New procedure; New document control number assigned.	T/E

ATTACHMENT 2	
EP-DIV-SOP-10004-2 Hydstra © Data Quality Codes	

HYDSTRA © Data Quality Codes

Quality Code	Character	Description
1		Good continuous records
2		Good quality edited data
3	E	Excellent measurement
5	G	Good measurement
26	\$	Good daily read records
30	#	Irregular Time Rate Data - weekly/monthly read.
60	A	Above rating
70		Daily flow imported from WH
76	*	Reliable interpolation
77	*	Correlation with other station\044 same variable
79	*	Records partly estimated
80	A	Accumulated
81	R	Wet day within accumulated rainfall period
82	*	Linear interpolation across gap in records.
100	F	Fair measurement
104	?	Records estimated
120	P	Poor measurement
130	?	Estimate
140	!	Data not yet checked
145	U	Unknown measurement
150	^	Rating table extrapolated due to inadequate gauging information
151	M	Data Missing
160	A	Above rating
201	[Data not recorded
254	[Rating Table Exceeded
255	N.A.	Data not available

ATTACHMENT 3	
EP-DIV-SOP-10004-3 SWTS Precipitation Data Qualifier Codes and Descriptions	

SWTS Precipitation Data Qualifier Codes and Descriptions

Qualifier Codes	Qualifier Code Descriptions
A	Accepted
EST	Estimated Value
OE	Overestimated (melt from prior snowfall or hail)
UE	Underestimated (snowfall or hail prior to melt)

Qualifier Reason Codes	Qualifier Reason Code Descriptions
EQP	Equipment Failure
HAIL	Precipitation as Hail
INACTIVE	Station Inactive
INDETER	Indeterminate
MEAS ERR	Measurement Error
SNOW	Precipitation as Snow

ATTACHMENT 4

EP-DIV-SOP-10004-4

STORM WATER TRACKING SYSTEM PRECIPITATION REPORT



Water Quality Database
Storm Water Tracking System
Precipitation Report

LOS ALAMOS
NATIONAL LABORATORY

PRECIP DATE Between '12-OCT-09' And '12-OCT-09' And SR.RAINGAGE In ('RG-NCOM', 'RG-TA-06', 'RG-TA-53', 'RG-TA-54', 'RG038', 'RG055.5', 'RG121.9', 'RG203', 'RG240', 'RG245.5', 'RG253', 'RG257', 'RG262.4', 'RG267.4', 'RG340')

sw_precip_rpt.rdf

Rain Gauge	Precipitation Date	Total Precipitation (Inches)	Qualifier Code	Qualifier Reason Code	Thirty minute Max Intensity	Days Since Last Rain	Duration (hours)	Duration Qualifier	Duration Qual Reason	Comments
RG-NCOM	12-OCT-09	.49	A		.24	6	2	A	Import (LANL Weather Machine). QA: 30 Min. Max: 0.24 started at 0200 on 10-13-2009	
RG-TA-06	12-OCT-09	.63	A		.28	19	2	A	Import (LANL Weather Machine). QA: 30 Min. Max: 0.28 started at 0616 on 10-13-2009	
RG-TA-53	12-OCT-09	.81	A		.34	4	2	A	Import (LANL Weather Machine). QA: 30 Min. Max: 0.34 started at 0216 on 10-13-2009	
RG-TA-54	12-OCT-09	.06	A		.06	19	1	A	Import (LANL Weather Machine). QA: 30 Min. Max: 0.06 started at 0216 on 10-13-2009	
RG038	12-OCT-09	.62	A		.32	4	1	A	Import (Hydra). QA: 30 Min. Max: 0.32 started at 05:10 on 10/13/2009 .	
RG055.5	12-OCT-09	.40	A		.19	6	2	A	Import (Hydra). QA: 30 Min. Max: 0.19 started at 04:50 on 10/13/2009 .	
RG121.9	12-OCT-09	.42	A		.17	8	2	A	Import (Hydra). QA: 30 Min. Max: 0.17 started at 04:50 on 10/13/2009 .	
RG203	12-OCT-09	.73	A		.39	4	1	A	Import (Hydra). QA: 30 Min. Max: 0.39 started at 02:06 on 10/13/2009 .	
RG240	12-OCT-09	.36	A		.17	19	1	A	Import (Hydra). QA: 30 Min. Max: 0.17 started at 01:46 on 10/13/2009 .	
RG245.5	12-OCT-09	.66	A	EQP	.44	19	1	A	Import (Hydra). QA: 30 Min. Max: 0.44 started at 02:06 on 10/13/2009 .	Animal-inflicted cable damage. No data. Interpolated from RG240 and RG257.
RG253	12-OCT-09	.51	EST	EQP	.25	19	1	EST	Import (Hydra). QA: 30 Min. Max: 0.25 started at 02:06 on 10/13/2009 .	Est. 30 Min. Max 0.25 started at 02:06 on 10/13/2009.
RG257	12-OCT-09	.66	A		.32	19	1	A	Partial blockage. Intensity and duration estimated from RG257 and RG267.4.	
RG262.4	12-OCT-09	.38	EST	MEAS ERR	.29	19	1	EST	Import (Hydra). QA: 30 Min. Max: 0.29 started at 02:06 on 10/13/2009 .	Est. 30 Min. Max started at 02:06 on 10/13/2009.
RG267.4	12-OCT-09	.3	A		.26	19	1	A	Import (Hydra). QA: 30 Min. Max: 0.26 started at 02:06 on 10/13/2009 .	
RG340	12-OCT-09	.11	A		.07	25	0	A	Import (Hydra). QA: 30 Min. Max: 0.07 started at 05:35 on 10/13/2009 .	

Example

Digitally signed by Data Manager
DN: cn=Data Manager, o=ou,
email=email@lanl.gov, c=US
Date: 2010.04.26 12:53:32 -0600

Data
Manager