

EP-DIR-SOP-10004, R.0

**MANAGING ELECTRONIC
PRECIPITATION DATA FROM
RAIN GAGE STATIONS**Effective Date: 5-28-13

Procedure Owner:	Signature:	Date:
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REVISION HISTORY

Document No./Revision No.	Issue Date	Action	Description
EP-DIV-SOP-10004, Rev. 0	09/16/2010	New document	Initial release
EP-DIR-SOP-10004, Rev. 0	05/28/2013	Minor revision	Manual cell phone/modem telemetry replaced with automated radio telemetry. Changed Document title and procedure number to match ADEP Numbering Guide.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
TITLE PAGE.....	1
REVISION HISTORY.....	2
TABLE OF CONTENTS.....	3
1. PURPOSE AND SCOPE.....	4
2. BACKGROUND	4
3. PREREQUISITE TRAINING	5
4. EQUIPMENT	5
5. STEP-BY-STEP PROCESS DESCRIPTION.....	6
5.1 Validating and verifying precipitation data in Hydstra ©	6
5.2 Importing precipitation data into SWTS.....	7
5.3 Validating and verifying precipitation data in SWTS	8
5.4 Generating the 24-Hour Precipitation Report.....	8
6. RECORDS PROCESSING.....	9
7. REFERENCES	9
8. ATTACHMENTS.....	9
<u>Attachments</u>	
Attachment 1, Storm Water Tracking System 24-Hour Precipitation Report.....	10

1. 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: validating, verifying, and archiving the raw 5-minute precipitation data in Hydstra ©, calculating the 24-hour cumulative amount, storm duration, and maximum 30-minute storm intensity using automated scripts; transferring the calculated precipitation results to the Storm Water Tracking System (SWTS), and validating and verifying the daily data in 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 precipitation 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 precipitation gage network, and storm water project technical personnel familiar with operation of the Sutron dataloggers and radio telemetry equipment used with the precipitation gage network, and use of the Hydstra © and SWTS applications.

2. 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), Construction General Permit (CGP), and the NPDES Individual Permit (IP) for Storm Water Discharge from Storm Water Monitoring Units (SWMUs) and Areas of Concern (AOCs) issued to LANL by the Environmental Protection Agency (EPA). The precipitation data is used for NPDES permit compliance activities and environmental surveillance as follows:

- triggering rain-event inspections of best management practices (BMPs) 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 and the precipitation data is used to trigger rain-event inspections of BMPs and storm water control measures.

The storm water programs use precipitation data collected at LANL meteorological towers and reported on the LANL Weather Machine. In addition, an extended 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.

3. PREREQUISITE TRAINING

To process Hydstra © data files, workers must have familiarity with the Hydstra © commercial off-the shelf application configuration for LANL stations for manipulating electronic rain data files in Hydstra ©. To generate the 24-hour precipitation report from SWTS, workers must have familiarity with:

- extended rain gage network and Thiessen polygon assignments;
- rain gage equipment, including operation and maintenance;
- operational and meteorological issues that may affect recorded precipitation values; and
- SWTS user menus and precipitation report application.

4. EQUIPMENT

To process Hydstra © data files, the following equipment is required:

- account license for access to Sutron XConnect © software which polls the extended rain gage networks' dataloggers using radio telemetry and contains a temporary Microsoft Access © database of precipitation data;
- permission to access the Sutron server on EP-XConnect.lanl.gov;
- account license for access to Hydstra © application which contains a permanent Oracle © database where precipitation data is automatically transferred to; and
- permission to access the Hydstra server on datasrv1.lanl.gov.

To transfer the daily precipitation data to SWTS and generate the precipitation report from SWTS:

- storm water user account for access to SWTS on the Water Quality Database (WQDB) on eden.lanl.gov;
- account license for access to Hydstra application; permission to access pmfs\WQ\WQDBStormWater on eden.lanl.gov where Perl scripts are located that retrieve and perform calculations on data from the LANL Weather Machine and Hydstra © and upload the calculated 24-hour precipitation results to SWTS;

4. EQUIPMENT (CONTINUED)

- permission to access pmfs\ENV Data on eden.lanl.gov where the precipitation reports and weekly summary spreadsheets are archived; and
- permission for both WQDB_SWTS_PRECIP_USER and WQDB_SWTS_READ roles;
- Oracle user accounts for both Development and Production instances of SWTS on ESHQPRD1; and
- Perl Version ActiveState 15.14.2, Java 1.6.32, and Oracle Client 11g64-bit software.

5. STEP-BY-STEP PROCESS DESCRIPTION

5.1 Validating and verifying precipitation data in Hydstra ©

Storm Water Team Personnel

1. Log into Hydstra ©.
2. Open Programs by Function > Hydstra/TS – Time Series > Hydstra Data Management > HYDMWB – Data Managers Workbench, open the RAIN_GAGES Group.
3. Going through the stations one-by-one, make a copy of the archive (Station.A).
4. Open the archive copy (Station.B) and view the rainfall data (variable 11.00). Determine which period of time needs to be validated and verified. Add notes as necessary and assign a qualifier accordingly. A qualifier of “140 – Data not yet validated” or “151- Data missing” is automatically assigned to data when it is transferred into Hydstra ©. The following is a general guide to assigning qualifiers:
 - a. **Good Continuous Records** - if no problems are found and the data looks reasonable (e.g., no large gaps in time or space, reasonable magnitude, etc.), change the qualifier to “1 - Good continuous records;”
 - b. **Small Data Gap** - if there is a small data gap (i.e., one to three incorrect or missing measurements), determine if discharge or precipitation was measured at surrounding gages or across LANL. If not, change precipitation values to zero. If so, edit precipitation values accordingly (e.g., interpolate between gap bounding points to obtain missing data values). Change the qualifier to “2 - Good quality edited data.”
 - c. **Large Data Gap** - if there is a large data gap (i.e., more than three incorrect or missing measurements), determine if discharge or precipitation was measured at surrounding gages or across LANL. If not, change precipitation values to zero (within reason, e.g., not for a long period of time during the monsoon season) and change the qualifier to “2 - Good quality edited data.” If so, determine the cause of the gap and change the qualifier as follows:

5.3 Validating and verifying precipitation data in SWTS

Storm Water Team Personnel

1. Log into SWTS and open the PRECIP form.
2. Review and verify the data from each station to determine data problems and reliability concerns. If necessary, examine rain gage data and graphs in Hydstra © to facilitate interpretation of a precipitation event. Confer with field operations personnel as needed to confirm station operating conditions.
3. Add any necessary qualifiers and qualifier reasons in the appropriate report fields for each value as needed to describe the data. 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.
4. Document decisions in the “Comments” field of the PRECIP form and assign Precipitation and Duration Qualifiers as follows:
 - a. **A** – Accepted, if no data is missing or there is small data gap;
 - b. **EST** – Estimated Value, if estimating values for a large data gap;
 - c. **OE** – Overestimated (melt from prior snowfall or hail), if snow or hail remains frozen in the tipping bucket, then slowly melts causing it to register precipitation when none is falling; and
 - d. **UE** – Underestimate (snowfall or hail prior to melt), if snowfall or hail fell in the tipping bucket, but will underestimate the total amount of precipitation that fell because it has not melted yet.
5. Qualifier and Duration Reasons must also be assigned to each record as follows:
 - a. **EQP** – Equipment Failure;
 - b. **HAIL** – Precipitation as Hail;
 - c. **INACTIVE** – Station Inactive;
 - d. **INDETER** – Indeterminate;
 - e. **MEAS ERR** – Measurement Error; and
 - f. **SNOW** – Precipitation as Snow.
6. Click the COMMIT button to save data to the PRECIP form.

5.4 Generating the 24-Hour Precipitation Report

Storm Water Team Personnel

1. With SWTS and the PRECIP form still open, and after completing validation and verification of the calculated 24-hour precipitation results, click on the REPORT button.

5.4 Generating the 24-Hour Precipitation Report (continued)

2. Click “All Stations” in the top left corner to include all of the rain gages across LANL. In the top middle of the page, change the Report Output to PDF, enter the Begin Report Date and End Report Date (if you want to produce a report for one day, enter the same date in both the Begin and End Report Date fields). Click the Run Report button.
3. A 24-hour precipitation report for the specified date(s) will be generated as a PDF file in a new window. Rain gage stations that received rainfall over 0.25 inches in 30 minutes are highlighted in yellow in the report. A sample report is shown in Attachment 1.
4. If any records are highlighted in yellow (i.e., exceeded the 0.25 inches in 30 minutes threshold), save the 24-hour precipitation report as a PDF file in the folder eden.lanl.gov\pmfs\ENV Data\02_Compliance Tracking Reporting_6P\3.Data Stewardship\Precipitation\Storm Events YYYY\XQ YYYY (where YYYY is the current water year and XQ is the current water year quarter). Reduce the file size of the report and apply an electronic signature to the report. Distribute the report via e-mail to sw_precip@lanl.gov and submit to Records Management.
5. If no records are highlighted in yellow (i.e., the 0.25 inches in 30 minutes threshold was not exceeded), send an e-mail to sw_precip_noexceed@lanl.gov stating that the 24-hour precipitation data has been uploaded into SWTS, validated and verified, and that no stations exceeded the 0.25 inches in 30 minutes threshold.

6. RECORDS PROCESSING

If required, submit the 24-hour precipitation report PDF file(s), Attachment 1, to Records Management using the current records submittal process and in accordance with the documents listed in the References section.

7. REFERENCES

EP-DIR-QAP-0001, Quality Assurance Plan for the Environmental Programs
PD1020, Document Control and Records Management
P1020-1, Laboratory Records Management
EP-DIR-AP-10005, Records Processing
EP-DIR-PLAN-10002, ADEP Directorate Records Management Plan
EP-DIR-AP-10003, Records Management Procedure for ADEP Employees
EP-DIR-SOP-4004, Record Transmittal and Retrieval Process

8. ATTACHMENTS

Attachment 1: Storm Water Tracking System 24-Hour Precipitation Report (EXAMPLE)

**Managing Electronic Precipitation
Data from Rain Gage Stations**

Document No.: EP-DIR-SOP-10004

Revision: 0

Effective Date: 5/28/13

Page: 10 of 12

Reference

[Click here for "Required Read" credit.](#)

ATTACHMENT 1

Storm Water Tracking System 24-Hour Precipitation Report
Page 1 of 2

LOS ALAMOS
NATIONAL LABORATORY

Water Quality Database
Storm Water Tracking System
Precipitation Report

sw_precip_rpt.rdf

PRECIP_DATE Between '12-OCT-12' And '12-OCT-12' And SR.RAINGAGE In ('RG-NCOM','RG-TA-06','RG-TA-53','RG-TA-54','RG038','RG055.5','RG121.9','RG200.5','RG203','RG240','RG245.5','RG253','RG257','RG262.4','RG265','RG267.4','RG340','RG-TA-49','RG042','RG042.1','RG109.9')

Rain Gage	Precipitation Date	Total Precipitation (Inches)	Qualifier Code	Qualifier Reason Code	Thirty minute Max Intensity	Days Since Last Rain	Duration (hours)	Duration Qualifier	Duration Reason	Comments
RG-NCOM	12-OCT-12	.85	A		.35	14	3	A		ImpHYD. 30Max 0.35 began 13:30 on 10/12/2012.
RG-TA-06	12-OCT-12	1.02	A		.53	14	3	A		ImpHYD. 30Max 0.53 began 13:30 on 10/12/2012.
RG-TA-49	12-OCT-12	.28	A		.13	30	2	A		ImpHYD. 30Max 0.13 began 14:00 on 10/12/2012.
RG-TA-53	12-OCT-12	.56	A		.29	14	3	A		ImpHYD. 30Max 0.29 began 14:15 on 10/12/2012.
RG-TA-54	12-OCT-12	.14	A		.09	30	1	A		ImpWM. 30Max 0.09 began 14:15 on 10/12/2012.
RG038	12-OCT-12	1.15	UE	HAIL	.42	15	5	UE	HAIL	ImpHYD. 30Max 0.42 began 13:30 on 10/12/2012.
RG042.1	12-OCT-12	.24	UE	HAIL	.10	14	1	UE	HAIL	ImpHYD. 30Max 0.10 began 13:55 on 10/12/2012.
RG055.5	12-OCT-12	1.09	UE	HAIL	.27	14	4	UE	HAIL	ImpHYD. 30Max 0.27 began 13:25 on 10/12/2012.
RG109.9	12-OCT-12	.13	UE	HAIL	.09	30	1	UE	HAIL	ImpHYD. 30Max 0.09 began 14:15 on 10/12/2012.
RG121.9	12-OCT-12	1.07	UE	HAIL	.26	14	4	UE	HAIL	ImpHYD. 30Max 0.26 began 13:25 on 10/12/2012.
RG200.5	12-OCT-12	.74	UE	HAIL	.38	15	2	UE	HAIL	ImpHYD. 30Max 0.38 began 13:30 on 10/12/2012.
RG203	12-OCT-12	.55	UE	HAIL	.28	14	2	UE	HAIL	ImpHYD. 30Max 0.28 began 13:55 on 10/12/2012.
RG240	12-OCT-12	.8	UE	HAIL	.23	14	3	UE	HAIL	ImpHYD. 30Max 0.23 began 13:15 on 10/12/2012.
RG245.5	12-OCT-12	.38	UE	HAIL	.22	30	2	UE	HAIL	ImpHYD. 30Max 0.22 began 13:55 on 10/12/2012.
RG253	12-OCT-12	.81	UE	HAIL	.33	14	4	UE	HAIL	ImpHYD. 30Max 0.33 began 13:10 on 10/12/2012.
RG257	12-OCT-12	.81	UE	HAIL	.2	14	3	UE	HAIL	ImpHYD. 30Max 0.2 began 13:25 on 10/12/2012.
RG262.4	12-OCT-12	.38	UE	HAIL	.19	30	2	UE	HAIL	ImpHYD. 30Max 0.19 began 13:50 on 10/12/2012.
RG265	12-OCT-12	.16	UE	HAIL	.09	32	1	UE	HAIL	ImpHYD. 30Max 0.09 began 14:05 on 10/12/2012.
RG267.4	12-OCT-12	.32	UE	HAIL	.18	30	1	UE	HAIL	ImpHYD. 30Max 0.18 began 14:00 on 10/12/2012.
RG340	12-OCT-12	.12	UE	HAIL	.07	30	1	UE	HAIL	ImpHYD. 30Max 0.07 began 14:05 on 10/12/2012.

Jackie Carr

Digitally signed by Jackie Carr
DN: cn=Jackie Carr,
o=Environmental
Investigations, ou=ET-EI,
email=carr_j@lanl.gov,
c=US
Date: 2012.10.15 10:21:53
-06'00'

ATTACHMENT 1

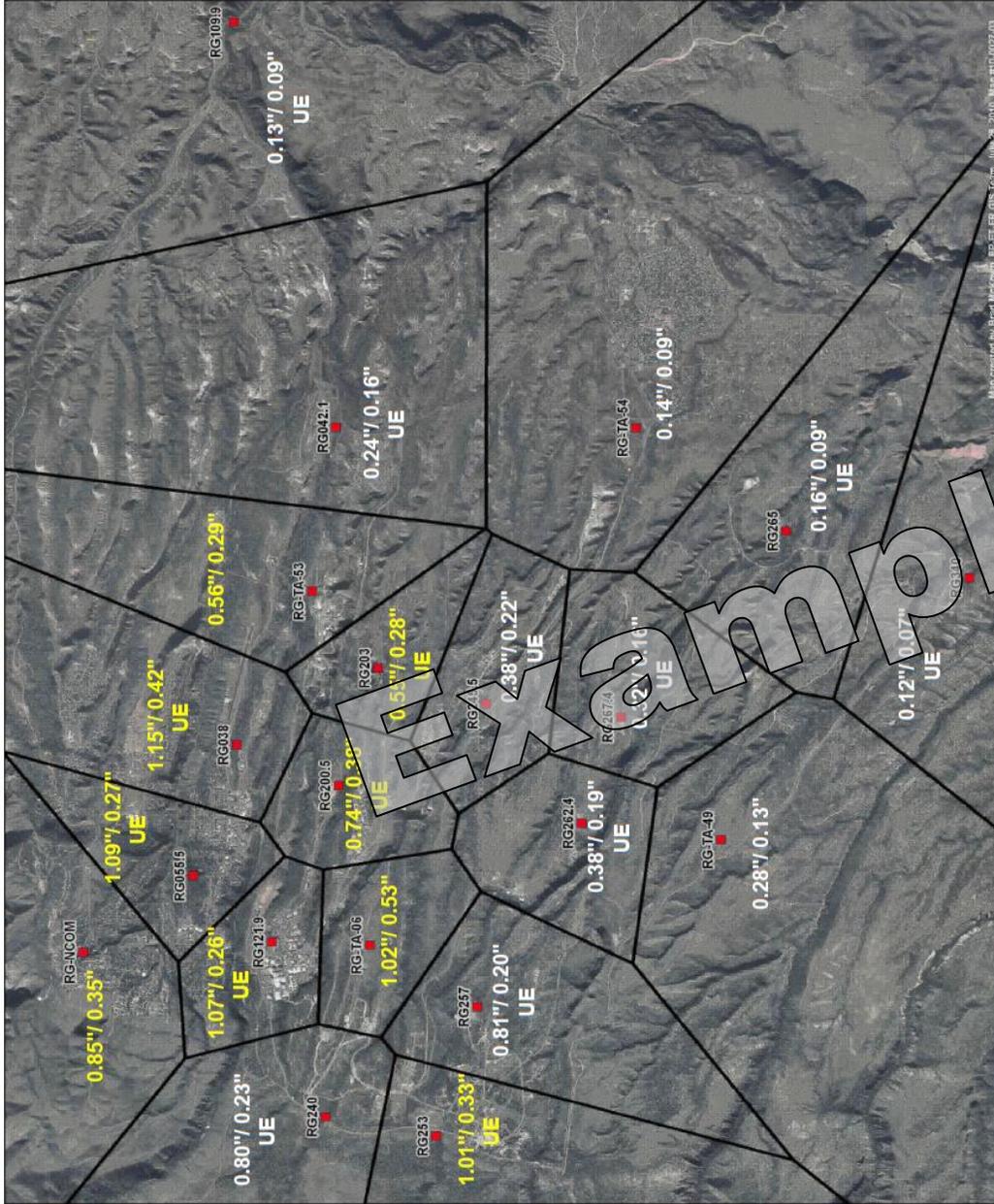
Storm Water Tracking System 24-Hour Precipitation Report

sw_precip_rpt.rtf

Water Quality Database
Storm Water Tracking System
Precipitation Report

LOS ALAMOS
NATIONAL LABORATORY

October 12, 2012
[Oct 12, 06:05 to Oct 13, 06:00]



Map created by: Jairo MacCam, EP-EE-615, Oct 12, 2012. Map #10-0027-03

Report Date: OCT-15-12 10:07 AM

Report created by: Z238075

This is a graphic representation of the Water Quality Database Storm Water Tracking System Precipitation Report. Refer to the official tabular report on page 1 for full details.