Documentation for the National Estuarine Research Reserve System (NERRS) Storm Story Templates

Storm Stories: Communicating Hurricane Impacts using Monitoring Data and Visualizations
NERRS Science Collaborative Transfer Project, October 2020 - May 2022

Prepared for
Friends of the GTM Reserve and the NERRS Science Collaborative

Prepared by
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STORM STORIES

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1 Introduction

A suite of tools and templates were developed to communicate hurricanes and hurricane impacts using National Estuarine Research Reserve System (NERRS) System-wide Monitoring Program (SWMP) data. LimnoTech worked with reserves from the NERRS to develop a suite of automated tools to produce hurricane reporting templates to support Guana Tolomato Matanzas (GTM) NERR with their 2020 Science Transfer Grant from the NERRS Science Collaborative. The **Storm Story Project Team** reserves include:

- Guana Tolomato Matanzas (GTM)
- North Carolina
- North Inlet-Winyah Bay
- Delaware
- Jobos Bay
- ACE Basin

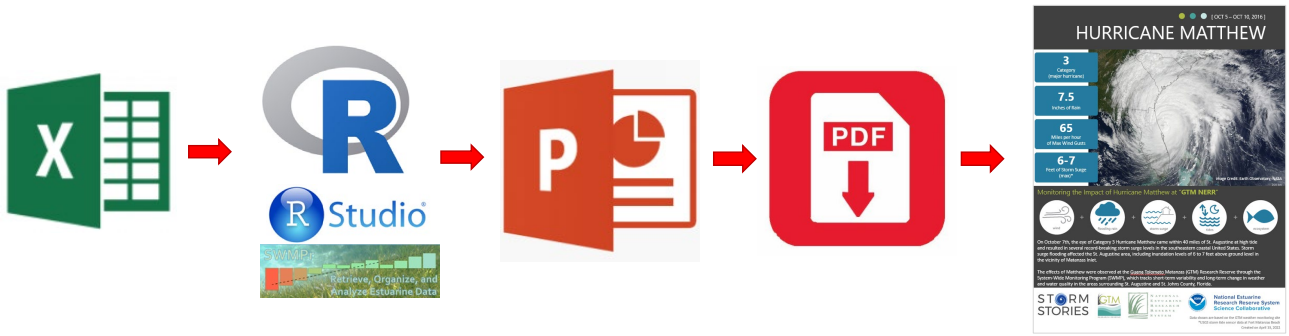
The goal of this work is to communicate the value of the SWMP and the NERR monitoring programs in a print and online product using recent storm events as examples. The tools and templates were developed to allow for flexibility and customization based on a reserve and storm. There are three potential ways the tools and templates can be used to tell a Storm Story:

- one storm – one reserve
- one storm – multiple reserves
- several storms – one reserve

Regardless of what way a story is told, each story will feature a "focus" or key reserve.

This documentation provides a guide on how to use R, Excel, and PowerPoint to generate a storm story report as a PDF that can be distributed electronically or printed (i.e., the print report). This documentation also provides a guide on how to take a storm story print report as a starting point to create a storm story **ArcGIS 'StoryMap.**'

There are two sets of automated scripts, written in R, involved in producing storm story reports. The first set of scripts uses reserve-specific System-wide Monitoring Program (SWMP) data to conduct twelve data analyses and produce plots that can then be used in the final reserve report. The analyses are intended to familiarize the user with monitoring results from the year of interest and to provide historical context that allows the user to evaluate whether or not water quality trends are changing over time. The second set of scripts is used to populate a pre-formatted, empty PowerPoint template with reserve-specific plots, text, and imagery. The plotting scripts produce many more analysis results and plots than could be reasonably included in a single report. However, by producing a large number of plots, each reserve can select parameters that are of particular interest to their stakeholders, while keeping the overarching theme of the report consistent in tone and style across reserves.



R tools and packages are used to process data, plot results, generate maps, and produce a raw storm story in a PowerPoint file. The general workflow is to use excel to define variables and parameters for plots, text, and PowerPoint files.

This document outlines all of the steps necessary to generate Storm Story data summaries, plots, and maps (i.e., the PLOT GENERATION Workflow), a storm story print report (i.e., the PRINT GENERATION Workflow), and a storm story "StoryMap" suitable for distribution.

2 System Requirements

2.1 System Requirements

To run the NERRS SWMPrStorm Scripts the user must have R and R studio as well as several additional R packages. After installing R and RStudio, the user can automatically install all necessary R packages by running the "00_initial_installation.R" script located in the R folder. The system requirements are outlined below. Detailed instructions on the installation and setup process are provided in **Section 3**.

Computer

- Windows
- Mac OSX

Microsoft Office

- 2007 and greater

Note: Microsoft Office is not required to successfully run the storm story scripts, but it is recommended.

R

- R 4.1.0 or greater
- Rstudio 1.0.153 or greater

R Packages

- lubridate
- tidyr
- dplyr
- ggplot2
- openair
- scales
- magrittr
- leaflet
- sf
- rlang
- ggridges
- mapview
- ggrepel
- smoothr
- viridis
- SWMPr

- SWMPrExtension
- SWMPrStorm
- Openxlsx
- readxl
- Officer
- htmlwidgets
- devtools

3 Quick Start Guides

The quick start guides are intended to give the user a brief introduction to an overview of the steps necessary to create a storm story report. This section includes three "quick start" guides that outline the minimum number of steps the user must take to create a report.

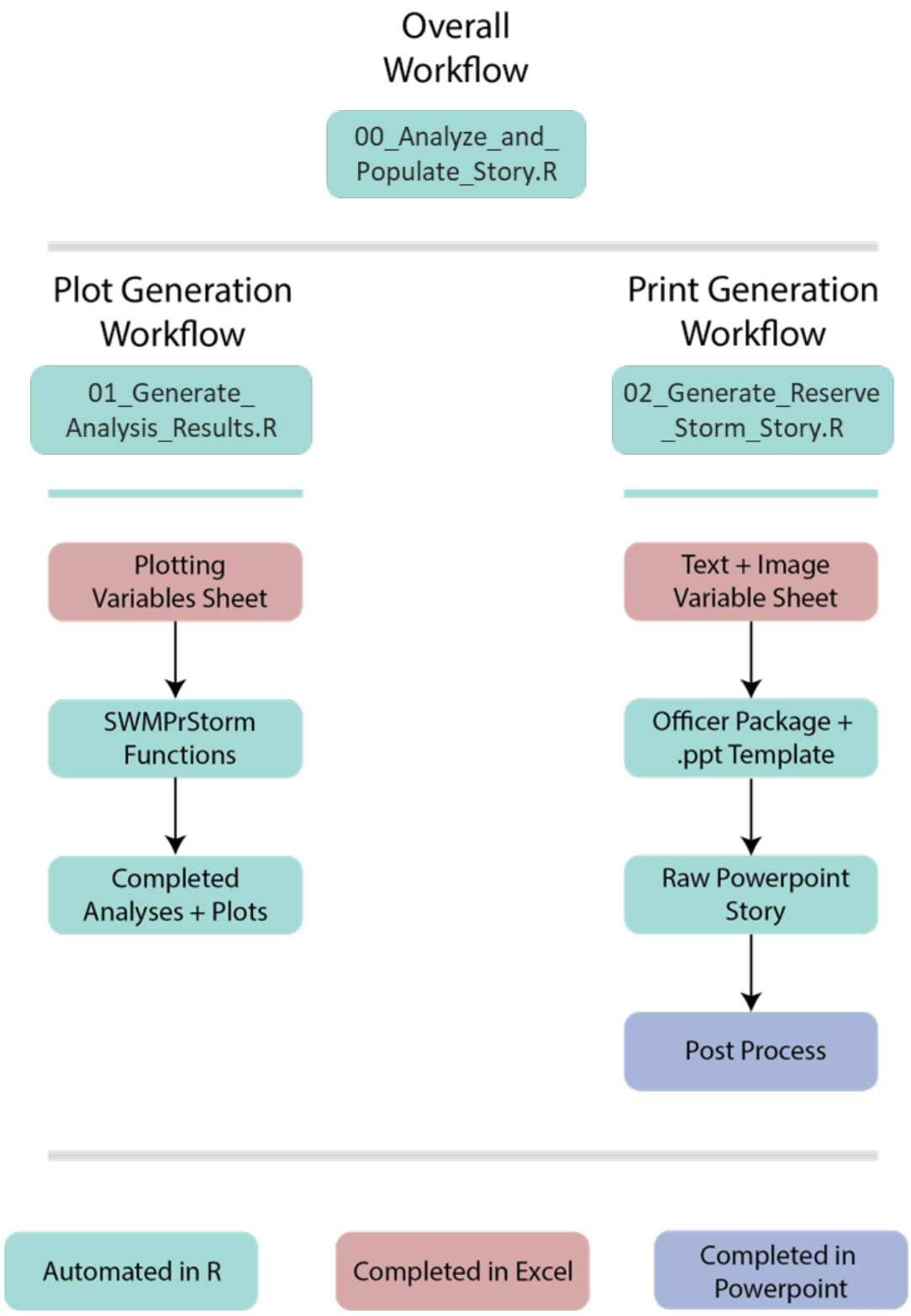
3.1 Quick Start Guides

Three quick-start guides are included in this documentation, one for installation and set up, and two for the major tasks associated with the two workflows (Plot Generation and Print Generation) associated with generating a storm story report:

1. **Installation and Set Up**
2. **Plot Generation Workflow Guide**
3. **Print Generation Workflow Guide**

The **Installation and Set Up Guide** will help the user create the working environment necessary to complete the two major workflows. The **Plot Generation Workflow Guide** describes how to execute a standardized set of analyses to produce tables, maps, and plots in accordance with a user's inputs. The **Print Generation Workflow Guide** describes how to generate a complete storm story report using the output from the Plot Generation Workflow.

The Plot Generation Workflow is executed and automated by R, while user inputs (e.g., storm start and end dates to plot) can be made in Microsoft Excel. The Print Generation Workflow requires the use of Excel (for setting initial text and graphics), R (to populate the raw template), and PowerPoint (to make final aesthetic modifications). The user's interaction with R will generally be limited to executing two individual scripts, which will perform all necessary actions to read user-defined inputs from Excel files, produce standardized tables, maps, and plots, and populate the storm story print template. The major workflow processing steps, most of which are automated by R when a user executes specific scripts, are shown below.



Overview of the Plot Generation and Print Generation Workflow Steps

3.2 Installation and Set Up Quick Guide

Set Up Software

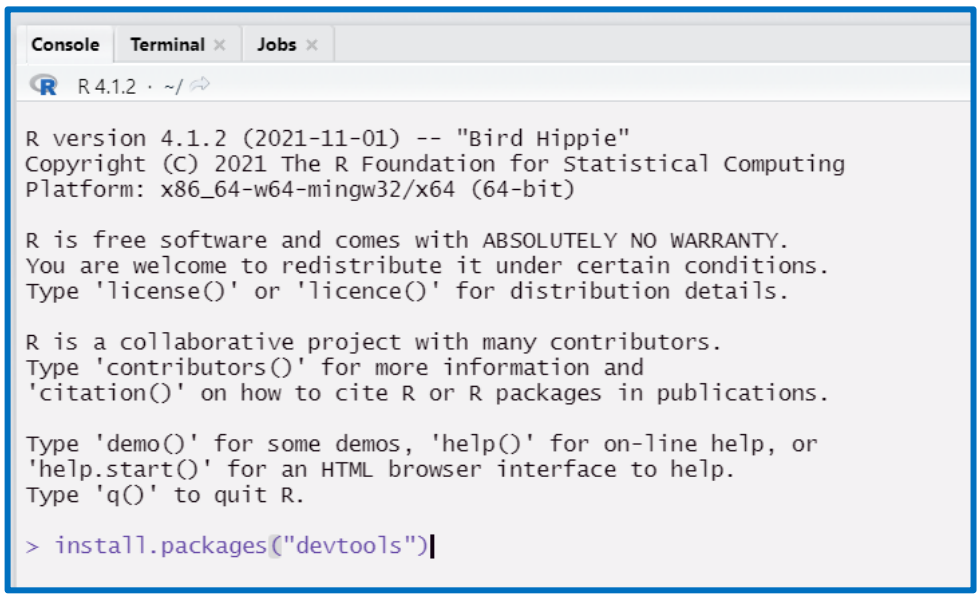
Four separate programs are needed to complete the overall workflow:

- Microsoft Excel (2007 and greater)
- Microsoft PowerPoint (2007 or greater)
- R + R Studio
- A PDF Viewer (e.g., Adobe Acrobat)

This guide assumes that the user has Microsoft products and a PDF viewer installed. A description of the required R installation steps is summarized below:

1. **Update or install R to a version 4.1 or greater** from the Comprehensive R Archive Network (CRAN) [**Windows**, **Mac**]. Follow the instructions on CRAN for a regular/standard installation.
2. **Install the latest version of R Studio** from R Studio's **website.** R Studio is a graphical user interface that uses a user-selected installation of R. Choose the version of R installed in step 1 when following the setup steps for R Studio.
3. **Launch R Studio**
4. **Install R packages.** R "packages" are sets of functions that an R user develops and shares with others. R comes pre-loaded with a standard set of packages, but the Plot Generation Workflow and Print Generation Workflow need several others. During the installation of new packages, the R Console may prompt the user to choose whether or not to install dependencies or update existing packages that have new versions. If prompted, choose to install all dependencies and update all out-of-date packages. Type the following lines into the R Studio Console and hit enter in this sequence:
    - install.packages("devtools")
    - devtools::install_github("LimnoTech/SWMPrStorm")
    - install.packages("htmlwidgets")
    - install.packages("readxl")
    - install.packages("officer")
    - webshot::install_phantomjs()

    The "devtools" package must be installed first. If not, the SWMPrStorm package will not be installed. ***It is also important that the user types these commands into the R Console*** because the quotations are misinterpreted by R when pasting from Microsoft products. If you paste the commands from this list, they will return an error unless you manually delete and retype the quotations.



Screenshot of package installation

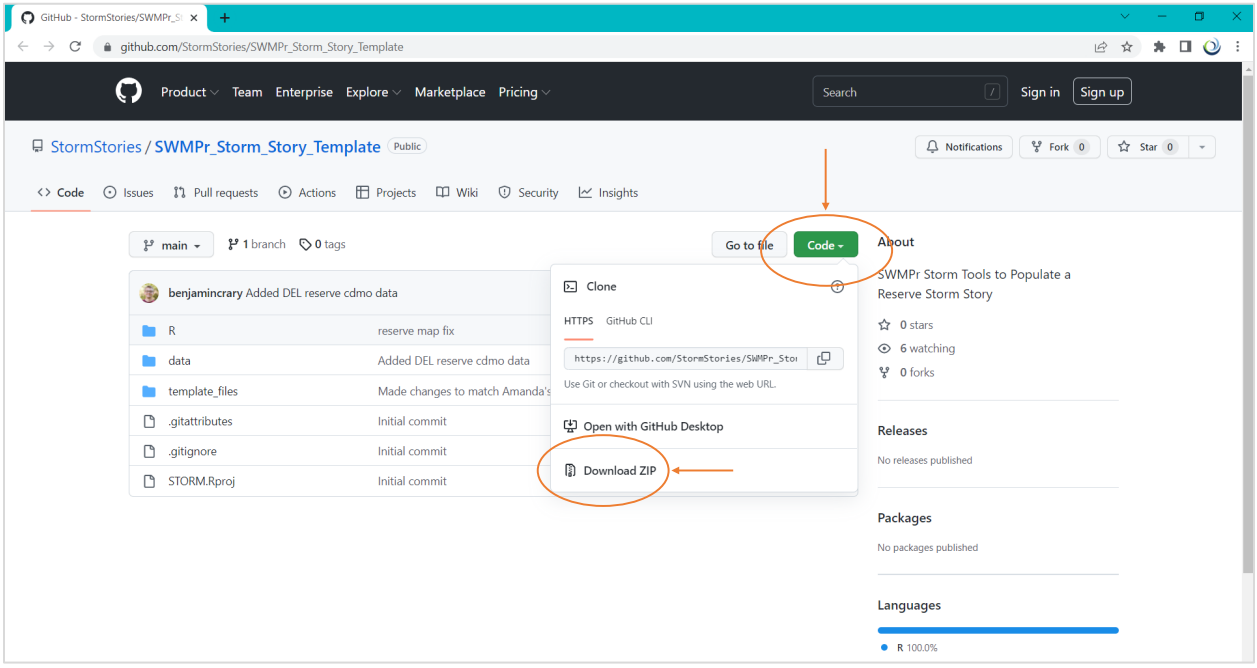
The SWMPrStorm package contains all functions needed to conduct the storm story analyses and execute the Plot Generation and Print Generation workflows.

Set Up Workspace Template

The SWMPrStorm package was developed to specifically create storm stories. The package and its functions will search for inputs and export results into predesignated locations. ***The SWMPr Storm Workspace Template must be used for this project.***

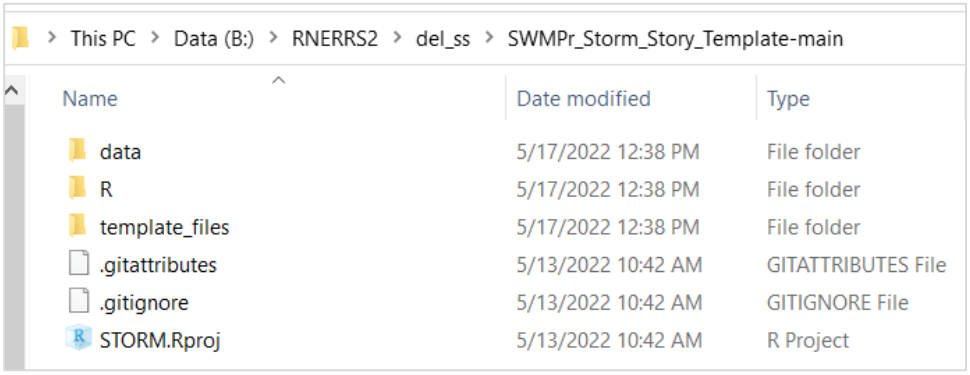
The following steps show how to set up the Workspace Template.

1. **Download the Workspace Template** from the GitHub **repository**. After clicking the repository link, the workspace can be downloaded as a zip file by clicking on the green 'code' dropdown button.



Screenshot of GitHub repository

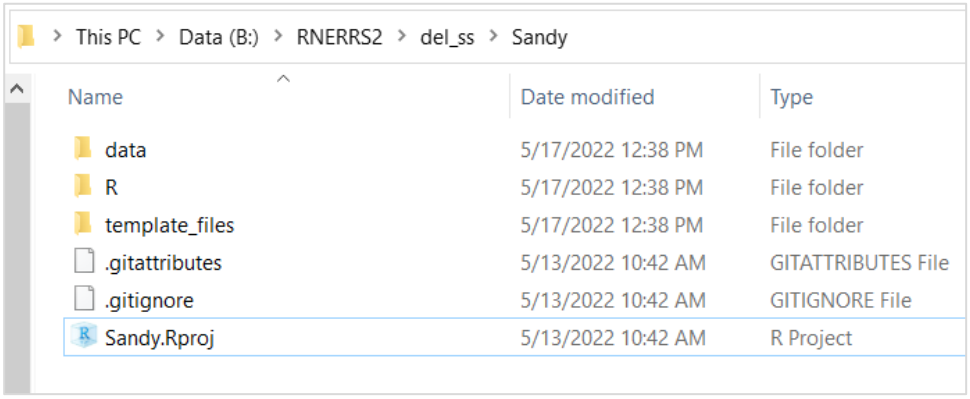
2. **Unzip the Workspace Template zip file**. Move the zip file to the desired working directory, right-click, and choose 'extract to SWMPr_Storm_Story_Template-main/'. For example, set up a directory with the reserve call code and an underscore "ss" to indicate "storm story."



Screenshot of an example workspace template directory structure

Note: Workspace Template does not include an "output" folder. This folder is created and populated as part of the Plot Generation Workflow.

3. **Rename unzipped folder and STORM.Rproj file if desired.** These could be renamed according to the storm that will be analyzed (e.g., del_ss/Sandy/Sandy.Rproj.).



Screenshot of an example workspace template directory structure using a storm as the naming convention

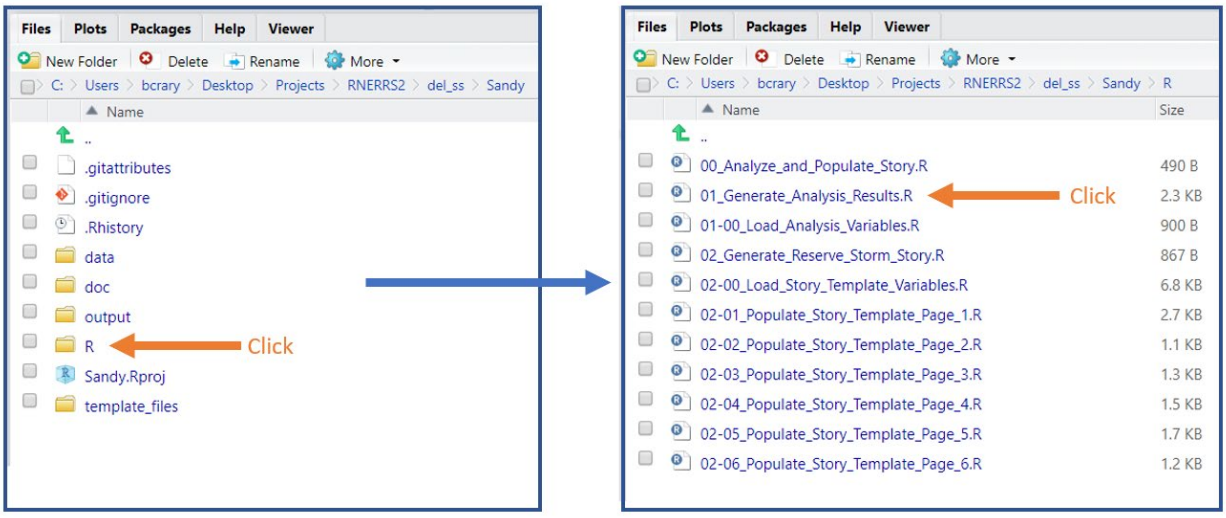
4. **Download NOAA storm track data** for the desired storm from NOAA's **National Hurricane Center**. After clicking the link, choose the appropriate year and region under Tropical Cycle Reports and hit 'Go'. Download the .shp file for the storm that will be analyzed.
5. **Place the downloaded zip file into the /data/noaa_nhc/gis/ directory** of the Workspace Template and extract it to a subdirectory.
6. **Download CDMO data (optional).** SWMP data from 2015 to 2020 comes with the Workspace Template for the project team reserves (i.e., ace, del, gtm, niw, noc, job). SWMP data post-2020 or for reserves not part of the project team will need to be downloaded from the **CDMO**. The CSV files are saved to the **/data/cdmo** folder (example: /data/cdmo/acebpmet2020.csv). The file naming convention must not be changed from the CDMO data download.

Subsequent Workflow Guides will refer to this as the 'Workspace.'

3.3 Plot Generation Workflow

The **Plot Generation Workflow** conducts all analyses that are described in **Section 5** of the Documentation. The processing is automated in R; however, the user needs to define the plotting and analysis variables for the processing to work properly. The following steps outline the process to set up and execute the Plot Generation Workflow.

1. **Populate the analysis variables in the /data/StormVariables.xlsx file** within the Workspace. There is a tab for each of the graphical and tabular analyses and a list of variables for each that must be populated. If the user does not want to execute any particular function, the user can set the "skip" parameter to "TRUE" and ignore all other variables in that tab. There are notes next to each variable entry field and an example of a completed variable spreadsheet provided in the Workspace. For reference and guidance, an example file is provided: see "EXAMPLE_StormVariables."
2. **Populate the mapping variables in the /data/StormTrackVariables.xlsx** file within the Workspace. There are two tabs for the single track map and two tabs for the multiple track map. There are notes next to each variable entry field and an example of a completed variable spreadsheet provided in the Workspace. For reference and guidance, an example file is provided: see "EXAMPLE_StormTrackVariables.xlsx."
3. **Launch the .Rproj file ("R Project") in the parent directory of the Workspace.** R Studio will launch and the files pane in the bottom right will show the Workspace. For example, you would double-click "Sandy.Rproj" to launch the R session and you would see the R files for this project listed by clicking on the "R" folder (see screenshot below).
4. **Open R/01_Generate_Analysis_Results.R** within R Studio by clicking on the file (see screenshot below).

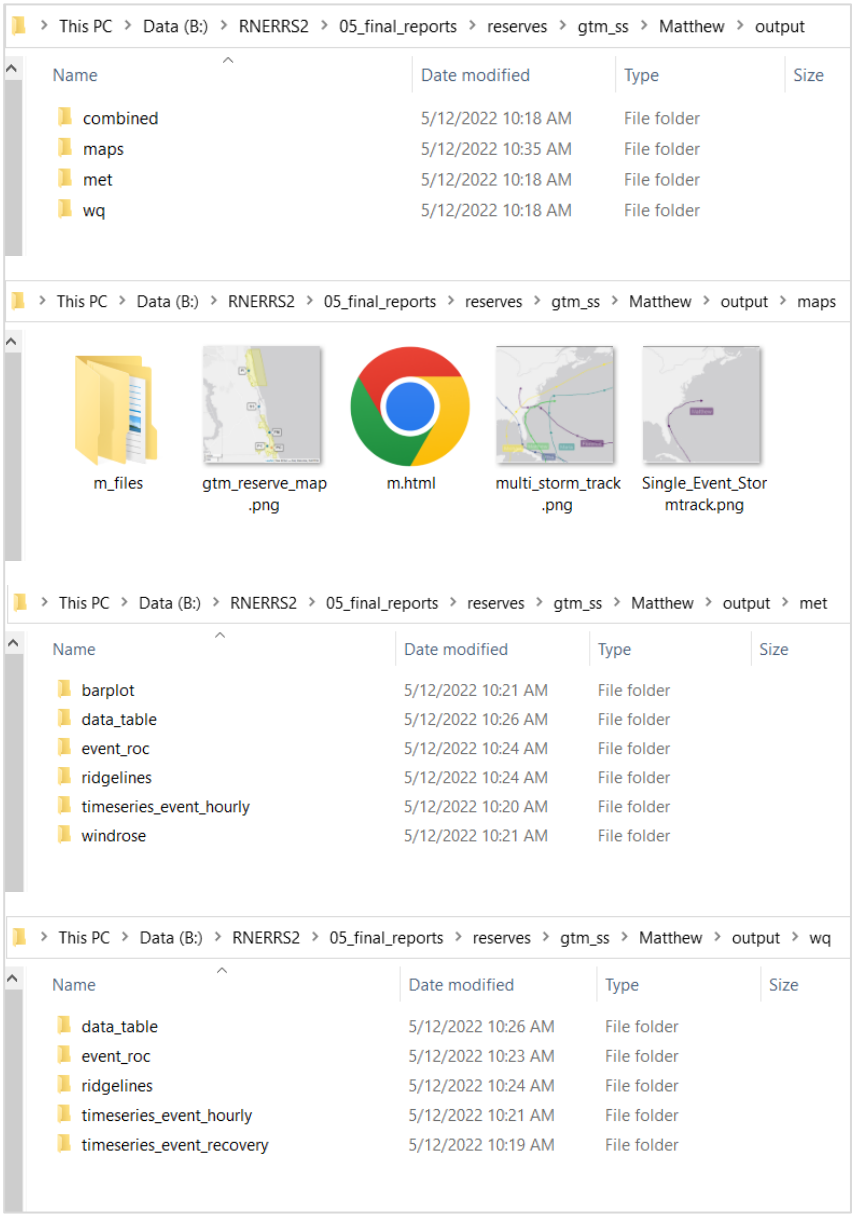


Screenshots of opening 01_Generate_Analysis_Results.R in the R project

5. **Execute the analysis script by clicking the 'Source' button in R Studio.** This script will perform all analyses described in Section 3 of the documentation.

How to execute the R analysis script

6. **Verify that plots and tables have been generated** by reviewing the **/output** directory of the Workspace. Plots and tables will be placed into various subfolders of this directory. After a review of the plots, the user may need to iterate on the periods plotted to adjust onset and recovery dates as well as how dates are displayed.



Example of /output directory and subfolders (/output, /output/maps, /output/met, and /output/wq).

3.4 Print Generation Workflow

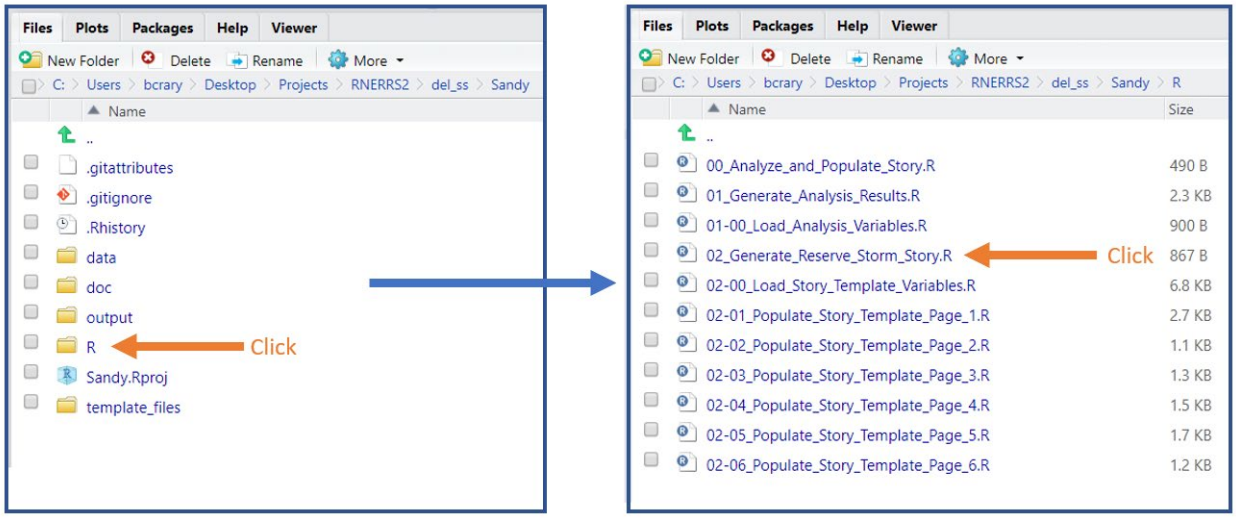
The **Print Generation Workflow** populates the storm story report template, creates a raw print storm story report, and outlines the steps to develop a final print storm story report. The Workflow requires that the user provide text inputs and figure paths within an Excel spreadsheet, which is read into R and ultimately placed into the empty print template. R automates the template population step and produces a 'raw' storm story. The user can refine this raw storm story in PowerPoint to create a final storm story. The following steps must be followed to complete this workflow.

1. **Populate the storm story content within /template-files/text/Storm_Story_Template_Text_Entry.xlsx**, which is found in the Workspace. There are tabs corresponding to each of the pages (Page 1 through Page 6) in the storm story template. The spreadsheet provides notes (i.e., blue-shaded cells) for each field that must be populated, indicated by the white cells. An example of a completed text entry spreadsheet is provided in the Workspace: see "EXAMPLE_Storm_Story_Template_Text_Entry.xlsx."

2. **Add the images outlined and named in the Storm_Story_Template_Text_Entry.xlsx to the /template/images subfolder.** You can add the images in this folder either before you work on the text entry input, in parallel, or after. The image placeholders can be found in the template_files/empty_template/Storm_Story_Template.pptx file. Places, where images are needed in the template, are noted in the Storm_Story_Template_Text_Entry.xlsx file along with dimension specifications. Note that there are three default/base images required for the template. These are "PageOneBanner.png," "RoundedRectangle.png," and "PageOneMid.png". Do not delete these files.

3. If the .Rproj is not already open, **launch the .Rproj file ("R Project") in the parent directory of the Workspace.** R Studio will launch and the files pane in the bottom right will show the Workspace. For example, you would double-click "Sandy.Rproj" to launch the R session and you would see the R files for this project listed by clicking on the "R" folder (see screenshot below).

4. **Open R/02_Generate_Reserve_Storm_Story.R** within R Studio by clicking on the file (see screenshot below).

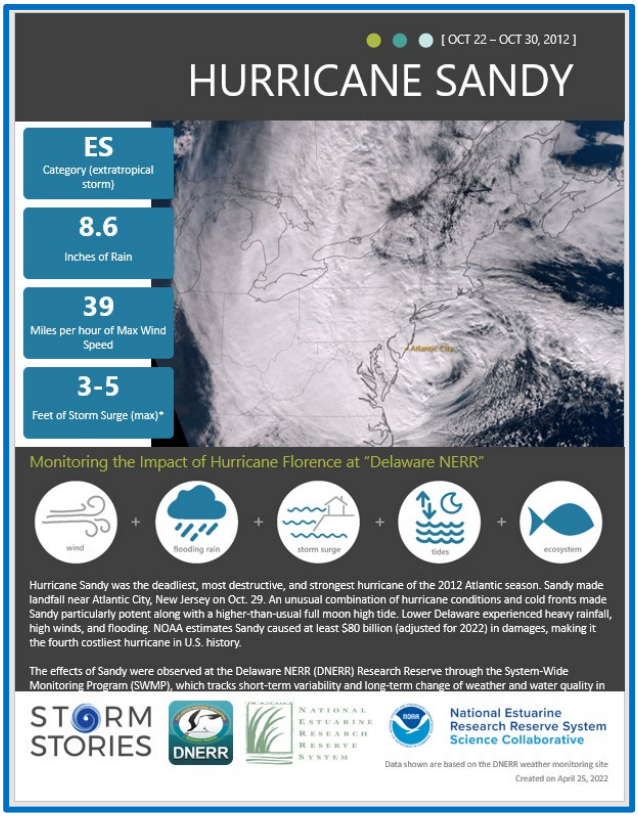


Screenshots of opening 02_Generate_Reserve_Storm_Story.R in the R project

5. **Execute the storm story generation script by clicking the 'Source' button in R Studio.** This script will read the inputs from Step 1 and populate the empty print template found in **/template-files/empty_template.**

How to execute the storm story generation script

6. **Verify that a raw populated template PowerPoint file (storm_report_raw) has been created in the /template_files/ directory.** The raw template storm story should be nearly complete but will require a final review to ensure images are rendered and the text fits within constraints.



Screenshot of an example raw storm story

7. **Make a copy of the "storm_report_raw" PowerPoint file, rename it as "storm_report_final" and make desired additions and enhancements.** Updates include adding the Weather and Water Quality data tables, refining narratives, adjusting the spacing between text or graphics, placing callout boxes overtop of figures, emphasizing text by changing to bold or italics, adding hyperlinks, etc.

8. **Go to template_files/resources/ for custom and pre-designed content elements to create the final report.**

   - **ss_print_template_resources.pptx** file provides additional content elements that can be customized for each Page (1-6).

   - **ss_Weather_and_WaterQuality_Data_Table_template.xlsx** file can be used to help process and format data for the Weather and Water Quality data generated in the **output/met/data_table** and **output/wq/data_table** csv files. Tables from this file can be copied directly into the pre-formatted tables provided in the "**ss_print_template_resources.pptx**" file (see Page 3 and Page 5). Alternatively, table data can be copied directly from the output/met/data_table and output/wq/data_table files into the

pre-formatted tables. However, some manual formatting will be needed as PowerPoint will maintain the 'parent' excel format.

- **ss-weater-water-quality-data-tables-how-to.mp4** is a tutorial video on how to use the "**ss_Weather_and_WaterQuality_Data_Table_template.xlsx"** file and the pre-formatted tables provided in the "**ss_print_template_resources.pptx**" file (see Page 3 and Page 5) to create the weather and water quality data tables.
- **ss-image_guide_size_check.pptx** file provides a copy of the placeholder images for each Page (1-6). This file can be used to check image sizes and/or modify images by resizing and cropping.
- **graphics** folder provides icons, additional NERRS maps, and NOAA/NERR logos. The icons subfolder includes a copy of all icons used in the storm story template as well as additional icons (see files that start with "0") that can be used as additional layered elements (e.g., wind icon for wind section/data plot).
- **ss-StoryMap_Image_Template.pptx** file is for the StoryMap development. This file provides a template and guidance on how to update the following images/sections in a StoryMap.
    - By the Numbers
    - Organization Logos
    - Contact Information

9. **Save the storm story as a PDF.**

4 Workflow Diagrams

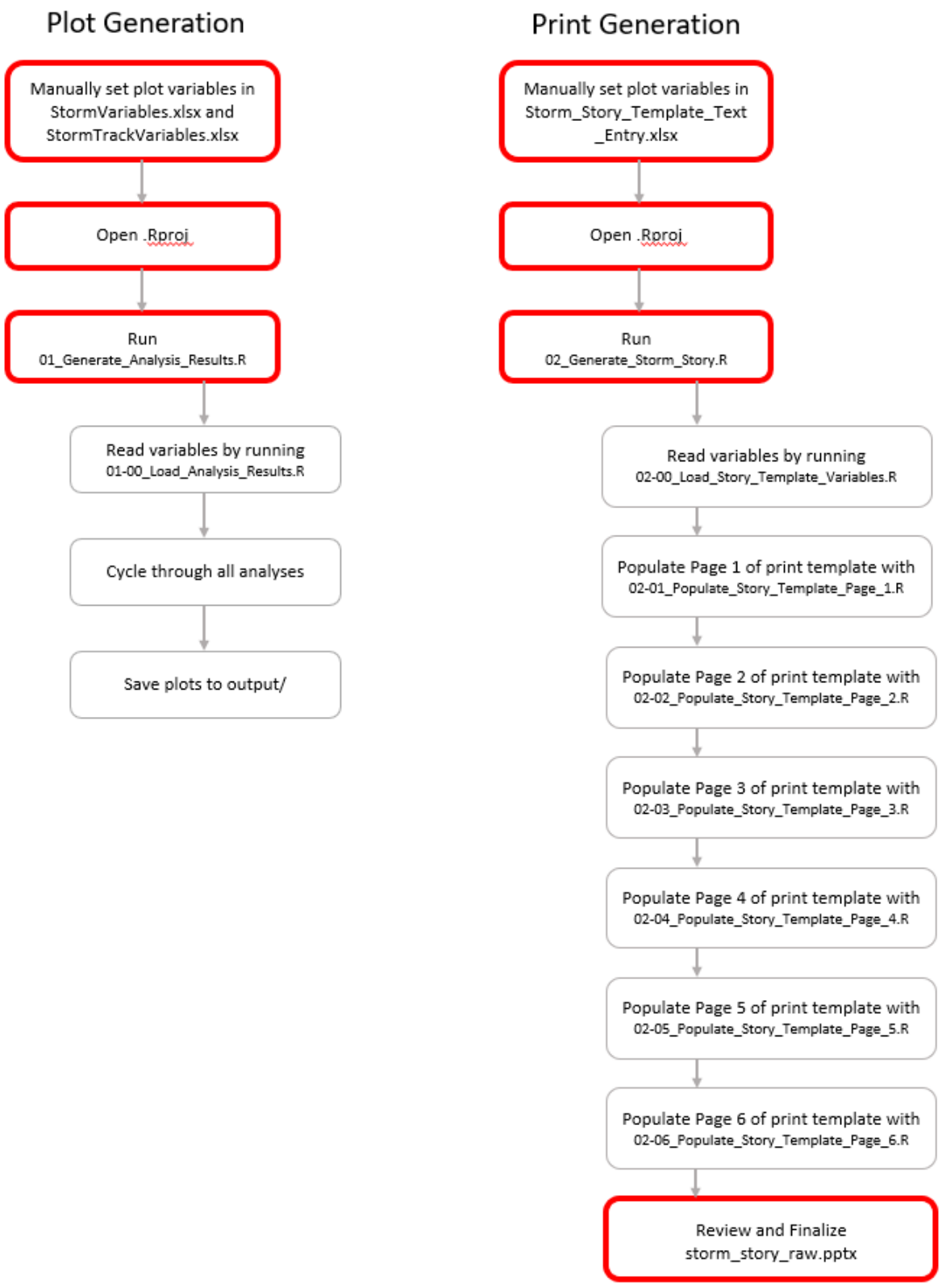
Two separate workflows must be implemented to produce a storm story: the Plot Generation Workflow and the Print Generation Workflow. The Plot Generation Workflow produces all figures and conducts all analyses outlined in **Section 5**. Due to the volume of plots that are created, producing plots can be time-consuming from a computational standpoint (> 30 min). The user can choose to skip individual analyses by setting the "skip" variable to "TRUE" in the "StormVariables.xlsx" input spreadsheet. It is anticipated that one or more of the plots generated in the Plot Generation Workflow will be inserted into the storm story; therefore, the Print Generation Workflow depends on the results from the Plot Generation Workflow.

As part of executing the Print Generation Workflow, the user must review and select plots or tables that are produced in the Plot Generation Workflow and produce narrative text based on the information in those plots. Producing the raw storm story report is much less overwhelming than producing the plots (< 1 min). After executing both workflows, the user can then refine the raw storm story report and create the final storm story report by making any desired formatting or layout modifications.

Overall, the user interaction is designed to be simple. Throughout the two workflows, the user works with three input spreadsheets (StormVariables.xlsx, StormTrackVariables.xlsx, and Storm_Story_Template_Text_Entry.xlsx), two R scripts (01_Generate_Analyses_Results.R and 02_Generate_Reserve_Storm_Story.R), and one PowerPoint file (storm_report_raw.pptx). The workflow diagrams are intended to help the user understand the relationships among these files, along with their relationships to the other scripts and files that are included in the Workspace Template. Each workflow diagram contains two different types of colored shapes as outlined in the "Process Diagram Key":

- The red rectangle – steps that require user action.
- The grey rectangle – steps that are automated in R

Process Diagram Key



Plot Generation and Print Generation Workflow Process Diagrams

5 Core Analyses

The core analyses available within the **SWMPrStorm R package** used to create the storm story reports fall into the following general categories:

a. Time Series

b. Ridgelines

c. Wind Roses

d. Precipitation Barplots

e. Rates of Change

f. Maps

g. Tabular Summaries

The analyses, methods, and maps in this section were selected and approved by the storm stories project team.

The "Core Analyses" section outlines the basic methodologies associated with each analysis. Detailed information on how to modify parameters and customize plots can be found in the documentation for **StormVariables.xlsx** and **StormTrackVariables.xslx** in **Section 7** and within the R documentation for the SWMPrStorm R package.

In general, the Plot Generation Workflow will produce plots for all applicable stations and parameters for the reserve that is specified in the "MASTER" tab of the StormVariables.xlsx sheet. The user can choose to specify otherwise to limit the scope within the tabs for individual variables, however, this would be a deviation from the primary workflow design. For example, the user could specify a single water quality station for which to produce plots, instead of producing the same plot for all stations within the reserve identified in the "MASTER" tab.

a. Time Series

Time series plots allow the user to evaluate observational data throughout an event for one to two variables at a time. These plots were developed to show the magnitude and timing of changes to the estuary caused by a storm event.

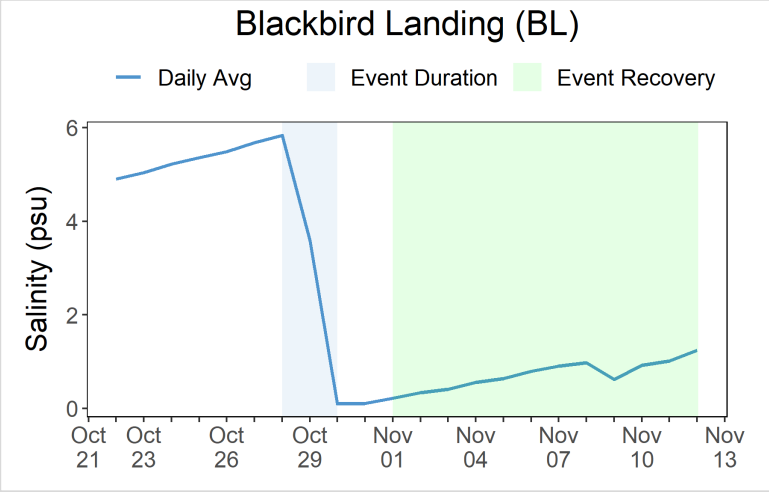
There are three time series plots that are generated in the Plot Generation Workflow:

- Daily average time series for individual water quality parameters
- Hourly average time series for individual water quality or meteorological parameters
- Incremental time series for a pair of water quality or meteorological parameters

An overview of each plot type is provided below.

Daily average time series for individual water quality parameters – SWMPrStorm function `event_timeseries()`

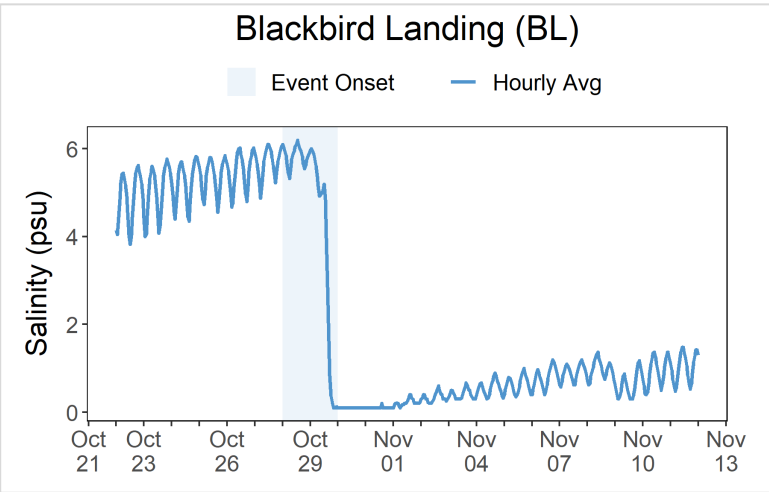
Variable input location: /data/StormVariables.xlsx – tabs 'MASTER' & 'timeseries_recovery'
Output location: /output/wq/timeseries_event_recovery/
Output naming convention: "timeseries_event_recovery_" + [station code_] + [parameter code]
Example output:



Example SWMPrStorm::event_timeseries() output

Hourly average time series for individual water quality or meteorological parameters – SWMPrStorm function `event_timeseries_hourly()`

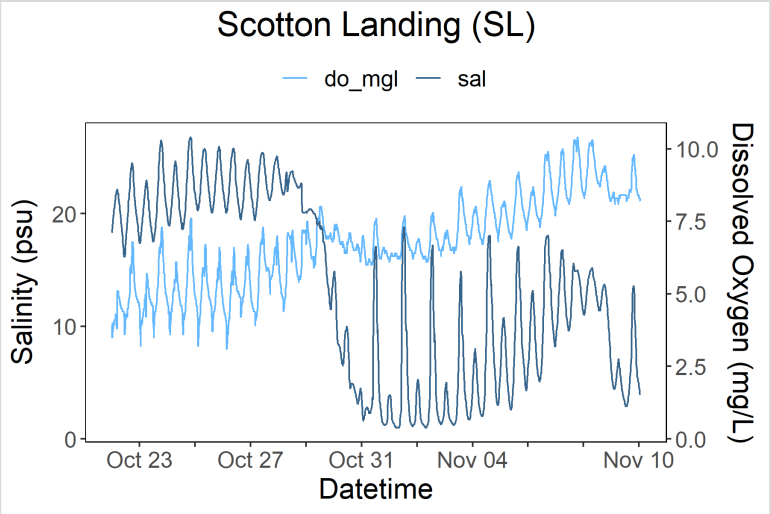
Variable input location: /data/StormVariables.xlsx – tabs 'MASTER' & 'timeseries_hourly'
Output location: /output/wq/timeseries_event_hourly/ & output/met/timeseries_event_hourly/
Output naming convention: "timeseries_event_recovery_" + [station code_] + [parameter code]+[storm name]
Example Output:



Example SWMPrStorm::event_timeseries_hourly() output

Incremental time series for a pair of water quality or meteorological parameters – SWMPrStorm function `event_timeseries_dual()`

Variable input location: /data/StormVariables.xlsx – tabs 'MASTER' & 'timeseries_dual'
Output location: /output/combined/timeseries_dual_axis/
Output naming convention: [station code_] + [primary parameter code]+ [secondary parameter code]
Example Output:



Example SWMPrStorm::event_timeseries_dual() output

b. Ridgelines

Ridgeline plots are a variation of time series plots that compare results from multiple reserves over the same period. The user must provide a list of specific station codes to compare in StormVariables.xlsx if they wish to compare across reserves. There is a single ridgeline analysis in the Plot Generation Workflow, which is described below:

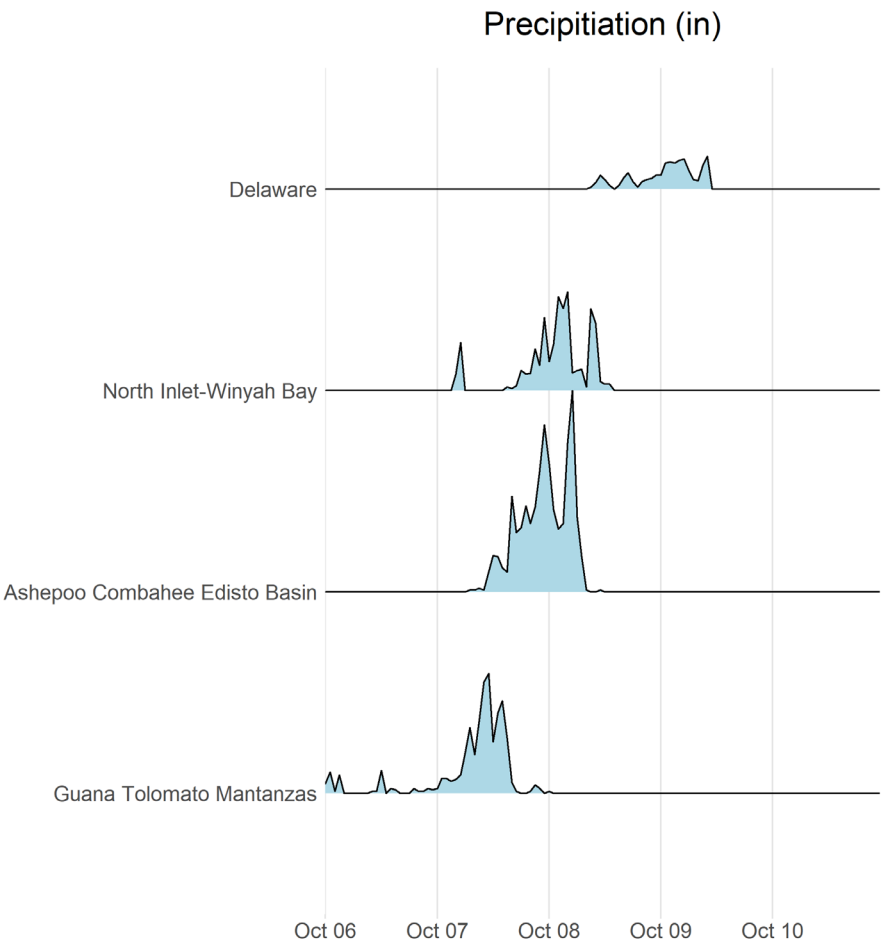
- Comparison of time series data from multiple reserves for single water quality or meteorological parameter

This analysis produces two plots, one with raw data and one with hourly average, and one with "smoothed" results.

Comparison of time series data from multiple reserves for a single water quality or meteorological parameter – SWMPrStorm function `event_ridgeline()`

Variable input location: /data/StormVariables.xlsx – tabs 'MASTER' & 'ridgeline'
Output location: /output/wq/ridgelines/ & /output/met/ridgelines/
Output naming convention: "ridgeline_" + [parameter code] & "ridgeline_" + [parameter code] + "smoothed"

Example Output:



Example SWMPrStorm::event_ridgeline() output

c. Precipitation Barplots

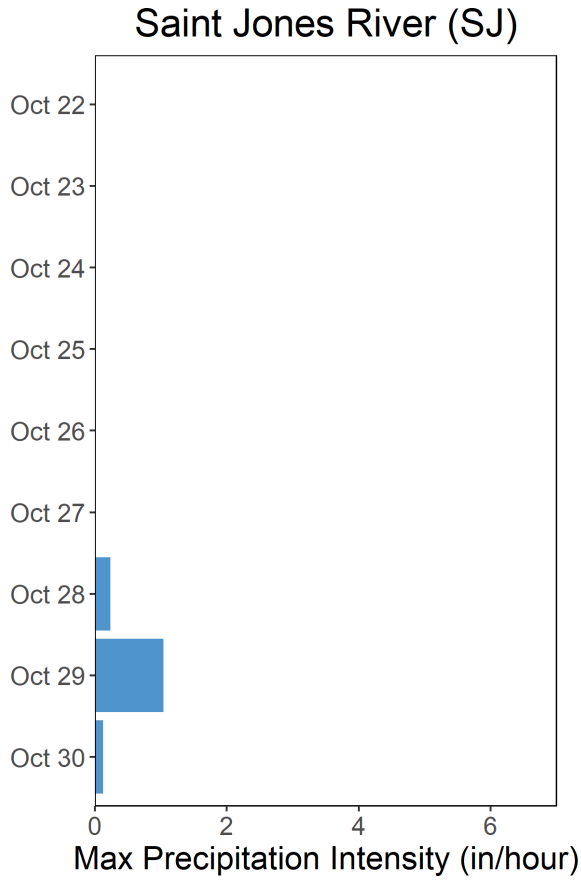
Precipitation barplots are a specific time series analysis for precipitation totals over a defined period. Individual plots are generated for any active meteorological stations within the reserve defined in the "MASTER" tab. There is a single precipitation analysis in the Plot Generation Workflow, which is described below:

- Precipitation summary barplots

This analysis produces three plots, one with total event precipitation, one with daily total precipitation, and one with daily max precipitation intensity.

Precipitation summary barplots – SWMPrStorm function `event_timeseries_precip()`

Variable input location: /data/StormVariables.xlsx – tabs 'MASTER' & 'precip_barplots'
Output location: /output/met/barplots/
Output naming convention: "barplot_cumulative" + [station code] + [parameter code] & "barplot_daily" + [station code] + [parameter code]
Example Output:



Example SWMPrStorm::event_timeseries_precip() output

d. Rates of Change

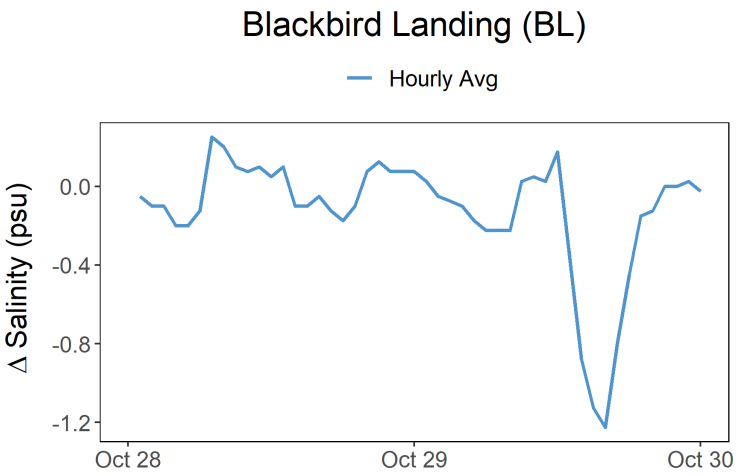
The rate of change analysis is another time series variant. Within this analysis, the stepwise and average hourly change of each parameter is plotted in the user-defined unit of measurement. Individual plots are generated for any active meteorological and water quality stations within the reserve defined in the "MASTER" tab. There is a single rate of change analysis in the Plot Generation Workflow, which is described below:

- Rate of change analysis for individual water quality or meteorological parameters

This analysis produced three plots, a raw data time series, a stepwise change time series or raw measurements, and an hourly stepwise change of hourly averaged measurements.

Rate of change analysis for individual water quality or meteorological parameters – SWMPrStorm function `event_roc()`

Variable input location: /data/StormVariables.xlsx – tabs 'MASTER' & 'rate_of_change'
Output location: /output/wq/event_roc/ & /output/met/event_roc/
Output naming convention: "roc" + [station code] + [parameter code] + "raw" **:** "roc" + [station code] + [parameter code] + "hourly" & **:** "roc" + [station code] + [parameter code] + "stepwise"
Example Output:



Example SWMPrStorm::event_roc() output

e. Wind Roses

Wind roses are a representation of wind speeds by direction on a cumulative and daily basis. There is a single wind rose analysis in the Plot Generation Workflow, described below:

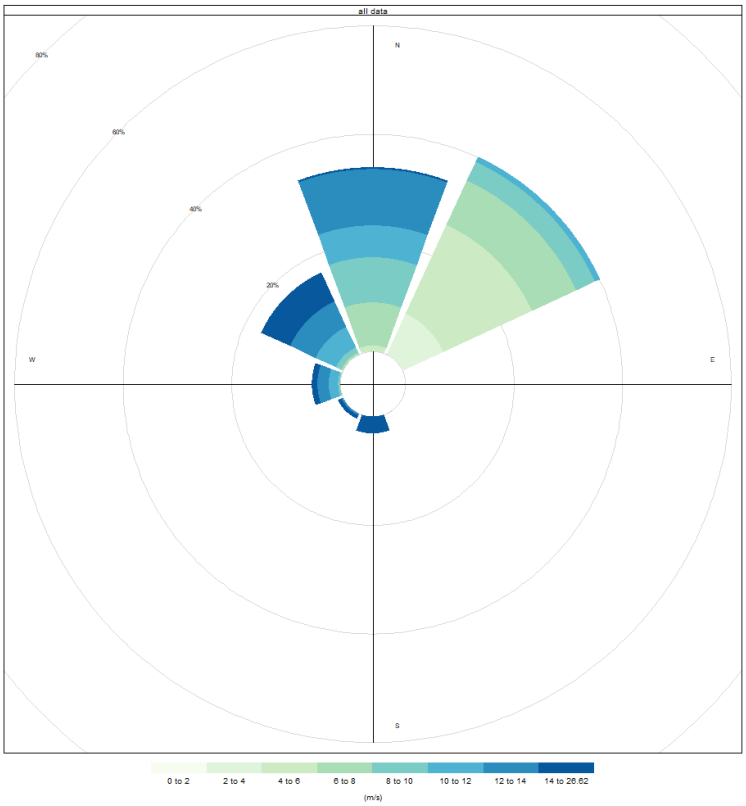
- Wind rose analysis for metrological stations

This analysis produces two plots, a summary wind rose for all selected dates and daily wind roses for the selected dates.

Wind rose analysis for meteorological stations – SWMPrStorm function `event_windrose()`

Variable input location: /data/StormVariables.xlsx – tabs 'MASTER' & 'windrose'
Output location: /output/met/windrose/
Output naming convention: [station code] + [parameter code] & [station code] + [parameter code] + "by_date"

Example Output:



Example SWMPrStorm::event_windrose() output

f. Maps

Mapping analyses are performed to characterize the location of a particular reserve concerning a specific storm event. Three specific analyses are performed in the Plot Generation Workflow, as described below:

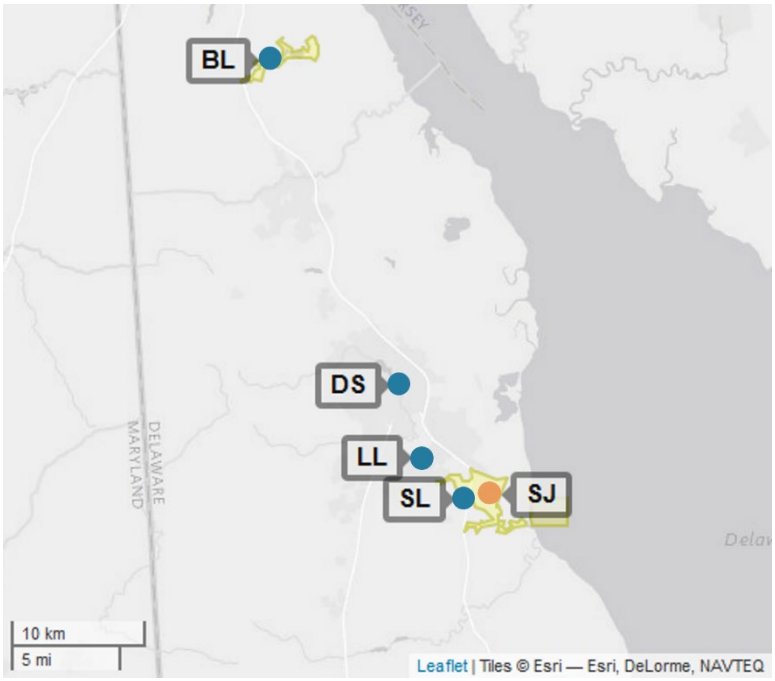
- Reserve boundary map
- Single storm track map
- Multiple storm track map

These analyses produce a total of three maps, one with the reserve boundary and station locations, one with a single storm track and the location of a selected reserve, and one with multiple storm tracks and the location of a selected reserve.

Reserve boundary map – SWMPrStorm function `res_local_map()`

Variable input location: /data/StormVariables.xlsx – tabs 'MASTER' & 'reserve_map'
Output location: /output/maps /
Output naming convention: [reserve code] + "reserve map"

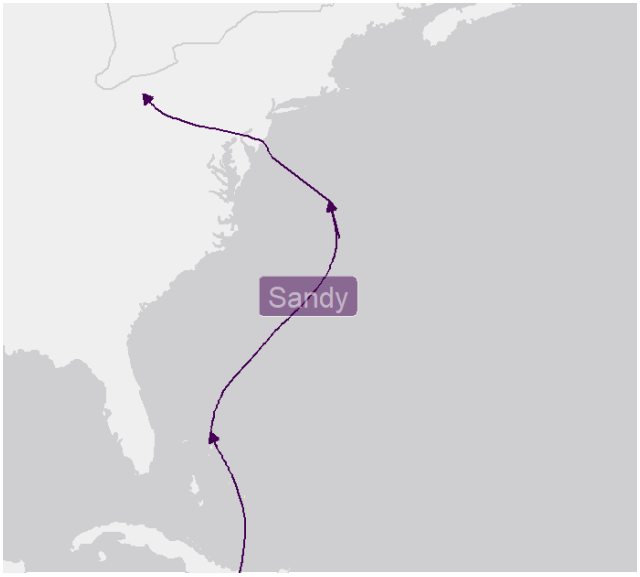
Example Output:



Example SWMPrStorm::res_local_map() output

Single storm track map – SWMPrStorm function `single_storm_track()`

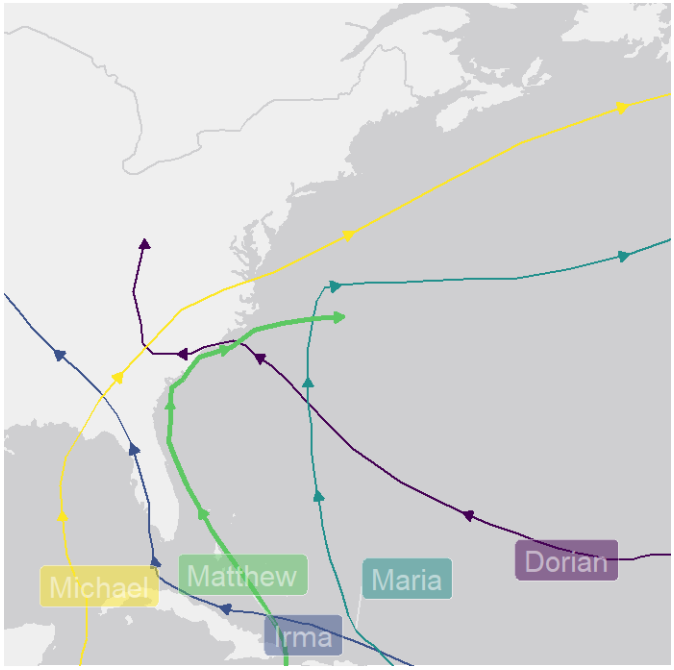
Variable input location: /data/StormTrackVariables.xlsx – tabs 'Single-storm parameters & 'Single-storm shps'
Output location: /output/maps /
Output naming convention: "Single_Event_Stormtrack"
Example Output:



Example SWMPrStorm::single_storm_track() output

Multiple storm track map – SWMPrStorm function `multi_storm_track()`

Variable input location: /data/StormTrackVariables.xlsx – tabs 'Multi-storm parameters & 'Multi-storm shps'
Output location: /output/maps /
Output naming convention: "multi_storm_track"
Example Output:



Example SWMPrStorm::mutli_storm_track()

g. Tabular Summaries

Tabular summaries are also conducted to provide specific numeric results that can be pulled into the final storm story. There are two tabular analyses in the Plot Generation Workflow:

- Daily summary statistics for multiple locations and events
- Overall summary statistics for multiple locations and events

Daily summary statistics for multiple locations and events – SWMPrStorm function `daily_data_table()`

Variable input location: /data/StormVariables.xlsx – tabs 'Multi-storm parameters & 'table_daily'
Output location: /output/wq/data_table / & /output/met/data_table/
Output naming convention: "daily_data_table_wq" + [units] + [event name(s)] + [reserve code(s)] & "daily_data_table_met" + [units] + [event name(s)] + [reserve code(s)]

Example Output:

event	parameter	station	date	min	max	mean	median	station_name
Sandy	clevel	delblwq	10/22/2012	-2.72	1.80	-0.05	0.15	Blackbird Landing (BL)
Sandy	clevel	delblwq	10/28/2012	1.90	3.18	2.64	2.72	Blackbird Landing (BL)
Sandy	clevel	delblwq	10/29/2012	1.77	3.67	2.93	3.00	Blackbird Landing (BL)
Sandy	clevel	delblwq	10/30/2012	2.20	4.56	3.62	3.76	Blackbird Landing (BL)
Sandy	clevel	delblwq	10/31/2012	0.75	2.99	2.19	2.33	Blackbird Landing (BL)
Sandy	clevel	delblwq	11/1/2012	-0.59	2.40	1.33	1.49	Blackbird Landing (BL)
Sandy	clevel	delblwq	11/2/2012	-1.71	2.10	0.77	0.98	Blackbird Landing (BL)
Sandy	clevel	delblwq	11/3/2012	-2.79	1.80	0.11	0.39	Blackbird Landing (BL)
Sandy	clevel	delblwq	11/4/2012	-2.56	2.07	0.24	0.39	Blackbird Landing (BL)
Sandy	clevel	delblwq	11/5/2012	-2.00	2.00	0.37	0.57	Blackbird Landing (BL)
Sandy	clevel	delblwq	11/6/2012	-1.54	1.57	-0.02	-0.16	Blackbird Landing (BL)

Overall summary statistics for multiple locations and events – SWMPrStorm function `summary_data_table()`

Variable input location: /data/StormVariables.xlsx – tabs 'Multi-storm parameters & 'table_summary'

Output location: /output/wq/data_table / & /output/met/data_table/

Output naming convention: "summary_data_table_wq" + [units] + [reserve code(s)] & "summary_data_table_met" + [units] + [reserve code(s)]

Example Output:

event	parameter	station	min	max	mean	median	station_name	station_fac
Sandy	clevel	delblwq	-2.8	4.6	1.3	1.4	Blackbird Landing (BL)	delblwq
Sandy	clevel	deldswq	1.6	6.9	3.2	2.5	Division Street (DS)	deldswq
Sandy	clevel	delllwq	-2.1	4.2	1.3	1.1	Lebanon Landing (LL)	delllwq
Sandy	clevel	delslwq	-2.3	4.3	1.1	1.3	Scotton Landing (SL)	delslwq
Sandy	do_mgl	delblwq	5.7	12.5	7.9	7.8	Blackbird Landing (BL)	delblwq
Sandy	do_mgl	deldswq	0.5	9.3	6.5	8.2	Division Street (DS)	deldswq
Sandy	do_mgl	delllwq	4.0	8.1	6.1	6.4	Lebanon Landing (LL)	delllwq
Sandy	do_mgl	delslwq	3.1	9.2	6.2	6.4	Scotton Landing (SL)	delslwq

6 Workspace Template Contents and File Descriptions

This section provides a reference for all of the subfolders and files within the Workspace Template directory. Each folder and its contents, within a Workspace Template folder, are described below.

data

The **data** folder contains all of the data that will be used by the R scripts to generate data tables, maps, and plots.

StormVariables.xlsx

The **StormVariables.xlsx** file is the variable input spreadsheet necessary to produce the plots, tabular summaries, and reserve maps that are described in section 3.

StormTrackVariables.xlsx

The **StormTrackVariables.xlsx** file is the variable input spreadsheet necessary to produce the single and multi storm track maps that are described in section 3

EXAMPLE_StormVariables.xlsx

Example_StormVariables.xlsx is a completed reference for the **StormVariables.xlsx** file.

EXAMPLE_StormTrackVariables.xlsx

Example_StormTrackVariables.xlsx is a completed reference for the **StormTrackVariables.xlsx** file.

cdmo

The **cdmo** folder is where all data that is downloaded from cdmo should be saved. The data should be in .csv format and should not be aggregated or otherwise modified after downloading from cdmo. The Plot Generation Workflow describes the process of downloading and extracting the cdmo data. The **cdmo** folder also contains the file, **sampling_stations.csv**, which contains metadata about stations for all reserves.

noaa_nhc

The **noaa_nhc** folder contains a **gis** subfolder where all NOAA storm track .zip files should be extracted. This folder also contains a **ReadMe** file with basic information about the data sources. The Plot Generation Workflow describes the process of downloading and extracting the correct storm track data. The Workspace Template includes tracks for several notable storms (Sandy 2012, Matthew 2016, Irma 2017, Maria 2017, Michael 2018, and Florence 2018).

Boundaries

All reserve boundary shapefiles should be placed within the **Boundaries** subfolder, **Reserve_Boundaries**. Reserve boundaries will be used in the Plot Generation Workflow to create the local reserve maps. The Workspace Template includes reserve boundaries for ACE, GTM, JOB, NIW, and NOC.

world-administrative-boundaries

The **world-administrative-boundaries** folder includes a shapefile that is used as part of the base map for the storm track map. The user does not need to interact with this directory.

doc

The **doc** folder contains user documentation for executing the two workflows and creating a storm story.

output

The **output** folder contains all of the figures and tables produced by the Plot Generation Workflow, as described in Section 3.

combined

The **combined** folder contains the results from the 'Incremental time series for a pair of water quality or meteorological parameters analysis.

maps

The **maps** folder contains the results from the ‘Reserve boundary map’, ‘Single storm track map’, and ‘Multiple storm track map’ analyses.

met

The **met** folder contains subfolders with the meteorological results from the ‘Hourly average time series for individual water quality or meteorological parameters’, ‘Comparison of time series data from multiple reserves for a single water quality or meteorological parameter’, ‘Precipitation summary barplots’, ‘Rate of change analysis for individual water quality or meteorological parameters’, ‘Wind rose analysis for meteorological stations’, ‘Daily summary statistics for multiple locations and events’, and ‘Overall summary statistics for multiple locations and events’.

wq

The **wq** folder contains subfolders with the water quality results from the ‘Daily average time series for individual water quality parameters’ ‘Hourly average time series for individual water quality or meteorological parameters’, ‘Comparison of time series data from multiple reserves for a single water quality or meteorological parameter’, ‘Rate of change analysis for individual water quality or meteorological parameters’, ‘Daily summary statistics for multiple locations and events’, and Overall summary statistics for multiple locations and events’.

R

The **R** folder contains all of the R scripts used to conduct the Plot Generation and Print Generation workflow. Scripts beginning with ‘01’ are associated with the Plot Generation Workflow, and scripts beginning with ‘02’ are associated with the Print Generation Workflow.

01_Generate_Analysis_Results.R

This script will execute the Plot Generation Workflow. The script will execute **01-00_Load_Analysis_Variables.R**, which will check the output environment and load user variable inputs from StormVariable.xlsx and StormTrackVariables.xlsx. The output of this script will be a complete set of analysis figures, tables, and maps located in the **output** folder. The user must run this script to complete the Plot Generation Workflow (see the Plot Generation Workflow Quick Guide).

01-00_Load_Analysis_Variables.R

This script will support the Plot Generation Workflow by reading the variables from StormVariables.xlsx and StormTrackVariables.xlsx. It will also ensure that the output environment is correctly structured so that plots created in the workflow are placed into the standard output locations. The user does not need to execute this script.

02_Generate_Reserve_Storm_Story.R

This script will execute the Print Generation Workflow. The script will execute scripts beginning with 02-00 through 02-06, which collectively will load text from Storm_Story_Template_Text_Entry.xlsx and populate the empty storm story template one page at a time. The output of **02_Generate_Reserve_Storm_Story.R** will be a raw storm story in the **template_files** folder titled **storm_story_raw.pptx**. The user must run this script to complete the Print Generation Workflow (see the Print Generation Workflow Quick Guide).

02-00_Load_Story_Template_Variables.R

This script will load the user inputs from Storm_Story_Template_Text_Entry.xslx and assign them to temporary variables in the R environment. The empty storm story template file, **Storm_Story_Template.pptx**, is also read into R by this script.

02-01_Populate_Story_Tempate_Page_1.R

This script will place the user inputs from Storm_Story_Template_Text_Entry.xslx into the appropriate page 1 template placeholders.

02-02_Populate_Story_Tempate_Page_2.R

This script will place the user inputs from Storm_Story_Template_Text_Entry.xslx into the appropriate page 2 template placeholders.

02-03_Populate_Story_Tempate_Page_3.R

This script will place the user inputs from Storm_Story_Template_Text_Entry.xslx into the appropriate page 3 template placeholders.

02-04_Populate_Story_Tempate_Page_4.R

This script will place the user inputs from Storm_Story_Template_Text_Entry.xslx into the appropriate page 4 template placeholders.

02-05_Populate_Story_Tempate_Page_5.R

This script will place the user inputs from Storm_Story_Template_Text_Entry.xslx into the appropriate page 5 template placeholders.

02-06_Populate_Story_Tempate_Page_6.R

This script will place the user inputs from Storm_Story_Template_Text_Entry.xslx into the appropriate page 6 template placeholders.

00_Analyze_and_Populate_Story.R

This script will execute the **01_Generate_Analysis_Resutls.R** and **02_Generate_Reserve_Storm_Story.R** scripts in sequence. This script is outside of the standard workflows because it does not give the user the ability to review plots and all print template variables must be populated before producing the plots. This script is included to allow the user to reproduce or validate the output of both the Plot Generation Workflow and Print Generation Workflow without having to execute the **01_Generate_Analysis_Resutls.R** and **02_Generate_Reserve_Storm_Story.R** scripts separately.

.gitignore

Git is a version control system that tracks changes in a folder over time. The .**gitignore** file tells git what files within a folder can be ignored when tracking changes. This file is not critical to the production of the storm story, but generally should not be modified by the user.

.gitattributes

Git is a version control system that tracks changes in a folder over time. The .**gitattributes** file is a config support file for tracking what files can be ignored. This file is not critical to the production of the storm story, but generally should not be modified by the user.

.Rhistory

The .**Rhistory** file saves the history of a previous R session. It is not critical to the production of the storm story report, but generally should not be modified by the user.

STORM.Rproj

The **STORM.Rproj** file is an R project file. This is a file format used by RStudio to make project organization easier for users. When the user double clicks on this file, RStudio will launch and the working directory will automatically be set to the folder where the R project file exists. Working with R via an R project, all file path references can be relative instead of absolute. If file references are relative, then the R project can be easily transferred between computers without having to modify any R scripts.

The user should open **STORM.Rproj** before they produce data plots or a raw storm story report. **STORM.Rproj** can be renamed in the windows explorer to reflect a particular event, however, the extension must be ".Rproj".

template_files

The **template_files** folder contains the resources necessary to complete the Print Generation Workflow.

empty_template

This folder contains the empty **Storm_Story_Template.pptx** which contains placeholders for all variables and inputs entered in the Storm_Story_Template_Text_Entry.xlsx file. This file is read into R and populated with **02_Generate_Reserve_Storm_Story.R**.

images

All of the images that will be used in the storm story should be placed in this folder. The Workspace Template includes three images (**PageOneBanner.png**, **PageOneMid.png**, **RoundedRectangle.png**) that are read into R during the Print Generation Workflow. These files should not be modified or removed. Placeholder images for photos and plots are available for temporary use to help facilitate collaboration between users working on various elements of the report. The script requires that all images are specified to generate a raw storm story report. The placeholder images can be used as needed during the development process. The placeholder images are named by page number and Variable_Name (e.g., Page1_placeholder_img_resrv_logo.png).

resources

The **resources** folder contains pre-designed content elements, a data table template, a style guide, web links to key sources, and graphics (e.g., icons) that may support the user in the creation of a storm story report. These resources are included in the Workspace Template.

text

The **text** folder contains the **Storm_Story_Template_Text_Entry.xlsx** file that must be completed by the user to execute the Print Generation Workflow. **Storm_Story_Template_Text_Entry.xlsx** contains input fields that correspond to placeholders in **Storm_Story_Template.pptx**. There is an example of a completed entry file in **EXAMPLE_Storm_Story_Tempate_Text_Entry.xlsx**.

storm_report_raw.pptx

A file with the title of **storm_report_raw.pptx** will be created after the R script 02_Generate_Reserve_Storm_Story.R is executed. This file can be modified as needed to finalize the storm story (see the Print Generation Workflow in Section 3 and Section 8).

7 Plot Generation Workflow Variables Input Guide

The Plot Generation Workflow requires users to set plotting and analysis variables for the analyses described in section 3.Users must enter variable inputs in the StormVariable.xlsx and StormTrackVariables.xlsx spreadsheet. In turn, these variables are read into R in the 01-00_Load_Analysis_Variables.R script and passed as arguments into the SWMPrStorm functions (that were developed to conduct the storm story analyses) in the 01_Generate_Analysis_Results.R script.

The user inputs must be formatted correctly to execute the SWMPrStorm functions and conduct the Plot Generation Workflow. This section describes the input requirements for each tab in the StormVariables.xlsx and StormTrackVariables.xlsx tab. These requirements are synchronous with the requirements for each SWMPrStorm function, which can be found in the SWMPrStorm package documentation.

StormVariables.xlsx – "MASTER"

param: reserve
value: [a single 3-digit reserve code]
format: text string
type: required
SWMPrStorm Function: see comment
comment: this value will be passed by default to most SWMPrStorm functions so that a list of stations can be queried.

StormVariables.xlsx – "precip_barplots"

param: storm_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_precip()
comment: this value represents the start datetime for precipitation bar plot summaries.

param: storm_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_precip()
comment: this value represents the end datetime for precipitation bar plot summaries.

param: stn_met
value: [a standard met station reserve code]
format: text string
type: optional
SWMPrStorm Function: event_timeseries_precip()
comment: if left blank, all active met stations from the reserve parameter in the MASTER tab will be analyzed.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: event_timeseries_precip()
comment: include spaces between list items.

param: filp
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: event_timeseries_precip()
comment: if TRUE, the x and y axis will be flipped from the default. By default, the date is on the y axis.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: event_timeseries_precip()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required
SWMPrStorm Function: event_timeseries_precip()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – "timeseries_recovery"

param: storm_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries()
comment: this value represents the start datetime for shading the storm duration on the plot

param: storm_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries()
comment: this value represents the end datetime for shading the storm duration on the plot

param: view_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries()

comment: this value represents the start datetime for the viewing pane on the plots

param: view_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries()
comment: this value represents the end datetime for the viewing pane on the plots

param: recovery_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries()
comment: this value represents the start datetime for shading the recovery period on the plots

param: recovery_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries()
comment: this value represents the end datetime for shading the recovery period on the plots

param: stn_wq
value: [a standard wq station reserve code]
format: text string
type: optional
SWMPrStorm Function: event_timeseries()
comment: if left blank, all active wq stations from the reserve parameter in the MASTER tab will be analyzed.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: event_timeseries()
comment: include spaces between list items.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: event_timeseries()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required
SWMPrStorm Function: event_timeseries()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – “timeseries_hourly”

param: storm_nm
value: [storm name]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: this value will be printed on the plot’s title

param: onset_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: this value represents the start datetime for shading the onset period on the plots

param: onset_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: this value represents the end datetime for shading the onset period on the plots

param: view_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: this value represents the start datetime for the viewing pane on the plots

param: view_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: this value represents the end datetime for the viewing pane on the plots

param: recovery_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: this value represents the start datetime for shading the recovery period on the plots

param: recovery_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: this value represents the end datetime for shading the recovery period on the plots

param: wq_sites
value: [comma separated list of wq station codes]
format: text string
type: optional
SWMPrStorm Function: event_timeseries_hourly()
comment: if left blank, all active wq stations from the reserve parameter in the MASTER tab will be analyzed.

param: met_sites
value: [comma separated list of met station codes]
format: text string
type: optional
SWMPrStorm Function: event_timeseries_hourly()
comment: if left blank, all active met stations from the reserve parameter in the MASTER tab will be analyzed.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: include spaces between list items.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required
SWMPrStorm Function: event_timeseries_hourly()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – "timeseries_dual"

param: view_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_dual()
comment: this value represents the start datetime for the viewing pane on the plots

param: view_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_timeseries_dual()
comment: this value represents the end datetime for the viewing pane on the plots

param: stn_wq
value: [a standard wq station reserve code]
format: text string
type: required
SWMPrStorm Function: event_timeseries_dual()
comment: a single code must be provided to execute this function.

param: stn_met
value: [a standard met station reserve code]
format: text string
type: required
SWMPrStorm Function: event_timeseries_dual()
comment: a single code must be provided to execute this function. Do not provide a met station code if no met parameters are to be analyzed.

param: param_primary
value: [parameter code]
format: text string
type: required
SWMPrStorm Function: event_timeseries_dual()
comment: a single code must be provided to execute this function. The primary parameter will be plotted on the left y axis.

param: param_secondary
value: [parameter code]
format: text string
type: required
SWMPrStorm Function: event_timeseries_dual()
comment: a single code must be provided to execute this function. The secondar parameter will be plotted on the right y axis.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: event_timeseries_dual()
comment: include spaces between list items.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: event_timeseries_dual()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required

SWMPrStorm Function: event_timeseries_dual()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – "windrose"

param: storm_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_windrose()
comment: this value represents the start datetime for the wind rose analysis.

param: storm_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_windrose()
comment: this value represents the end datetime for the wind rose analysis.

param: met_sites
value: [comma separated list of met station codes]
format: text string
type: optional
SWMPrStorm Function: event_windrose()
comment: if left blank, all active met stations from the reserve parameter in the MASTER tab will be analyzed.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: event_windrose()
comment: include spaces between list items.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: event_windrose()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required
SWMPrStorm Function: event_windrose()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – “rate_of_change”

param: storm_nm
value: [storm name]
format: text string
type: required
SWMPrStorm Function: event_roc()
comment: this value will be printed on the plot’s title

param: storm_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_roc()
comment: this value represents the start datetime for the rate of change analysis.

param: storm_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_roc()
comment: this value represents the end datetime for the rate of change analysis.

param: wq_sites
value: [comma separated list of wq station codes]
format: text string
type: optional
SWMPrStorm Function: event_roc()
comment: if left blank, all active wq stations from the reserve parameter in the MASTER tab will be analyzed.

param: met_sites
value: [comma separated list of met station codes]
format: text string
type: optional
SWMPrStorm Function: event_roc()
comment: if left blank, all active met stations from the reserve parameter in the MASTER tab will be analyzed.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: event_roc()
comment: include spaces between list items.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: event_roc()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required
SWMPrStorm Function: event_roc()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – "ridgeline"

param: storm_nm
value: [storm name]
format: text string
type: required
SWMPrStorm Function: event_ridgeline()
comment: this value will be printed on the plot's title

param: storm_start
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_ridgeline()
comment: this value represents the start datetime for the ridgeline analysis.

param: storm_end
value: [a datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: event_ridgeline()
comment: this value represents the end datetime for the ridgeline analysis.

param: wq_sites
value: [comma separated list of wq station codes]
format: text string
type: optional
SWMPrStorm Function: event_ridgeline()
comment: if left blank, all active wq stations from the reserve parameter in the MASTER tab will be analyzed.

param: met_sites
value: [comma separated list of met station codes]
format: text string
type: optional
SWMPrStorm Function: event_ridgeline()
comment: if left blank, all active met stations from the reserve parameter in the MASTER tab will be analyzed.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: event_ridgeline()

comment: include spaces between list items.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: event_ridgeline()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required
SWMPrStorm Function: event_ridgeline()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – "table_daily"

param: storm_nm
value: [comma separated list of storm names]
format: text string
type: required
SWMPrStorm Function: daily_data_table()
comment: the list order should match the order provided in storm_start and storm_end

param: storm_start
value: [a comma separated list of datetimes in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: daily_data_table()
comment: this value represents the start datetime for the daily statistics analysis. A list of storm start dates should match the order provided in storm_nm and storm_end.

param: storm_end
value: [a comma separated list of datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: daily_data_table()
comment: this value represents the start datetime for the daily statistics analysis. A list of storm start dates should match the order provided in storm_nm and storm_start.

param: reserve
value: [comma separated list of 3-digit reserve codes]
format: text string
type: optional
SWMPrStorm Function: daily_data_table()
comment: if left blank, all active stations from the reserve parameter in the MASTER tab will be analyzed. If populated with multiple reserves, all active stations in the provided reserves will be analyzed.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: daily_data_table()
comment: include spaces between list items.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: daily_data_table()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required
SWMPrStorm Function: daily_data_table()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – "table_summary"

param: storm_nm
value: [comma separated list of storm names]
format: text string
type: required
SWMPrStorm Function: summary_data_table()
comment: the list order should match the order provided in storm_start and storm_end

param: storm_start
value: [a comma separated list of datetimes in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: summary_data_table()
comment: this value represents the start datetime for the daily statistics analysis. A list of storm start dates should match the order provided in storm_nm and storm_end.

param: storm_end
value: [a comma separated list of datetime in YYYY-MM-DD HH:MM:SS format]
format: text string
type: required
SWMPrStorm Function: summary_data_table()
comment: this value represents the start datetime for the daily statistics analysis. A list of storm start dates should match the order provided in storm_nm and storm_start.

param: reserve
value: [comma separated list of 3-digit reserve codes]
format: text string
type: optional

SWMPrStorm Function: summary_data_table()
comment: if left blank, all active stations from the reserve parameter in the MASTER tab will be analyzed. If populated with multiple reserves, all active stations in the provided reserves will be analyzed.

param: keep_flags
value: [a comma separated list of CDMO QAQC flags]
format: text string
type: required
SWMPrStorm Function: summary_data_table()
comment: include spaces between list items.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: summary_data_table()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

param: user_units
value: [English or SI]
format: text string
type: required
SWMPrStorm Function: summary_data_table()
comment: setting which unit system to use for analysis.

StormVariables.xlsx – "reserve_map"

param: path_to_shp
value: [pathway to the reserve boundary file]
format: text string
type: required
SWMPrStorm Function: res_local_map()
comment: the path should be relative to the Workspace (location of the .Rproj file).

param: lab_loc
value: [a comma separated list label locations for the active stations]
format: text string
type: required
SWMPrStorm Function: res_local_map()
comment: (e.g. "R, L, L, R, R") directional orientations should be "R" or "L". The number of label directions needs to match the number of active stations. The order of stations is determined by the cdmo data structure and will be printed to the R console when executing 01-Generate_Analysis_Results.R

StormTrackVariables.xlsx – "Multi-storm parameters"

param: reserves
value: [a comma separated list of 3-digit reserve codes]
format: text string
type: required

SWMPrStorm Function: multi_storm_track()
comment: list of which reserves should be mapped along with the storm tracks

param: bbox
value: [a comma separated list of bounding parallels (W, N, E, S)]
format: text string
type: required
SWMPrStorm Function: multi_storm_track()
Comment: map extents should typically remain unchanged from [-88, 48 -55, 21] to ensure proper sizing for the Atlantic region.

param: lab_loc
value: ["bottomleft", "topleft", "bottomright", or "top right]
format: text string
type: optional
SWMPrStorm Function: multi_storm_track()
comment: if left blank, default options will be used.

param: scale_pos
value: ["bottomleft", "topleft", "bottomright", or "top right]
format: text string
type: optional
SWMPrStorm Function: multi_storm_track()
comment: if left blank, default options will be used.

param: base_path
value: [data/world-administrative-boundaries/world-administrative-boundaries.shp]
format: text string
type: optional
SWMPrStorm Function: multi_storm_track()
comment: should typically remain unchanged from the default value.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: multi_storm_track()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

StormTrackVariables.xlsx – "Multi-storm shps"

header: path
column: A
value(s): list pathways to *_lin.shp files for all desired storm tracks.
format: text string
type: minimum of two required
SWMPrStorm Function: multi_storm_track()
comment: pathways should be relative to the Workspace (the location of the .Rproj file). One pathway per row.

header: storm_nm
column: B
value(s): list of storm names in the same order as paths entered in column A
type: minimum of two required
SWMPrStorm Function: multi_storm_track()
comment: one name per row

header: storm_rank
column: C
value(s): numeric ranking of storm for aesthetic purposes (1:n)
format: integer
type: minimum of two required
SWMPrStorm Function: multi_storm_track()
comment: one per row. Storm with rank = 1 will be emphasized on the plot.

StormTrackVariables.xlsx – "Single-storm parameters"

param: reserves
value: [a comma separated list of 3-digit reserve codes]
format: text string
type: required
SWMPrStorm Function: single_storm_track()
comment: list of which reserves should be mapped along with the storm tracks

param: bbox
value: [a comma separated list of bounding parallels (W, N, E, S)]
format: text string
type: required
SWMPrStorm Function: single _storm_track()
Comment: map extents should typically remain unchanged from [-88, 48 -55, 21] to ensure proper sizing for the Atlantic region.

param: lab_loc
value: ["bottomleft", "topleft", "bottomright", or "top right]
format: text string
type: optional
SWMPrStorm Function: single _storm_track()
comment: if left blank, default options will be used.

param: scale_pos
value: ["bottomleft", "topleft", "bottomright", or "top right]
format: text string
type: optional
SWMPrStorm Function: single _storm_track()
comment: if left blank, default options will be used.

param: base_path
value: [data/world-administrative-boundaries/world-administrative-boundaries.shp]
format: text string
type: optional

SWMPrStorm Function: single _storm_track()
comment: should typically remain unchanged from the default value.

param: skip
value: [TRUE or FALSE]
format: text string
type: required
SWMPrStorm Function: single _storm_track()
comment: if TRUE, the analysis will be skipped when 01_Generate_Analysis_Results.R is executed.

StormTrackVariables.xlsx – "Single-storm shps"

header: path
column: A
value(s): pathways to *_lin.shp files for the desired storm tracks.
format: text string
type: required
SWMPrStorm Function: single_storm_track()
comment: one row allowed.

header: storm_nm
column: B
value(s): storm name associated with storm track
type: required
SWMPrStorm Function: single_storm_track()
comment: one row allowed

header: storm_rank
column: C
value(s): 1
format: integer
type: required
SWMPrStorm Function: single_storm_track()
comment: value should be set to 1.

Notes on Data Flags

Every dataset from the CDMO contains data flags. CDMO QA/QC flags can contain a numeric value or a combination of a numeric value and a three-letter code. Within each analysis, the user can specify all of the data flags that should be kept during the QA/QC process. If the user would like to include a numeric flag then including the number (e.g., "5") is sufficient. If the user would like to include a numeric flag and a three-letter code, then the user must enter the code as it is formatted in the CDMO data set (e.g., "<-4> \[SBL\]"). The backslashes are known as escape characters, and they are necessary for the R scripts to properly interpret the "[" character. Currently, the default flags are 0, 3, 5, and 4 [SBL]. Definitions for these flags can be found in Table 1. Complete definitions for QA/QC flags can be found at the following CDMO website: **http://cdmo.baruch.sc.edu/data/qaqc.cfm**. At the time of this report, data flagged with the CDMO flag of 4 (historical: pre-auto QA/QC) are excluded because of unknown data quality.

Table 1. Subset of QA/QC Flags from CDMO

CDMO QAQC Flag	Excel Formatted QAQC Entry	CDMO Definition
0	0	Passed initial QA/QC checks
3	3	Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
5	5	Corrected data
-4 [SBL]	<-4> \[SBL\]	Outside low sensor range [value below minimum limit of method detection]

External resources: CDMO Quality Assurance and Quality Control (QAQC) Website - **http://cdmo.baruch.sc.edu/data/qaqc.cfm**

8 Print Template and Text Entry Input Guide

Print Template

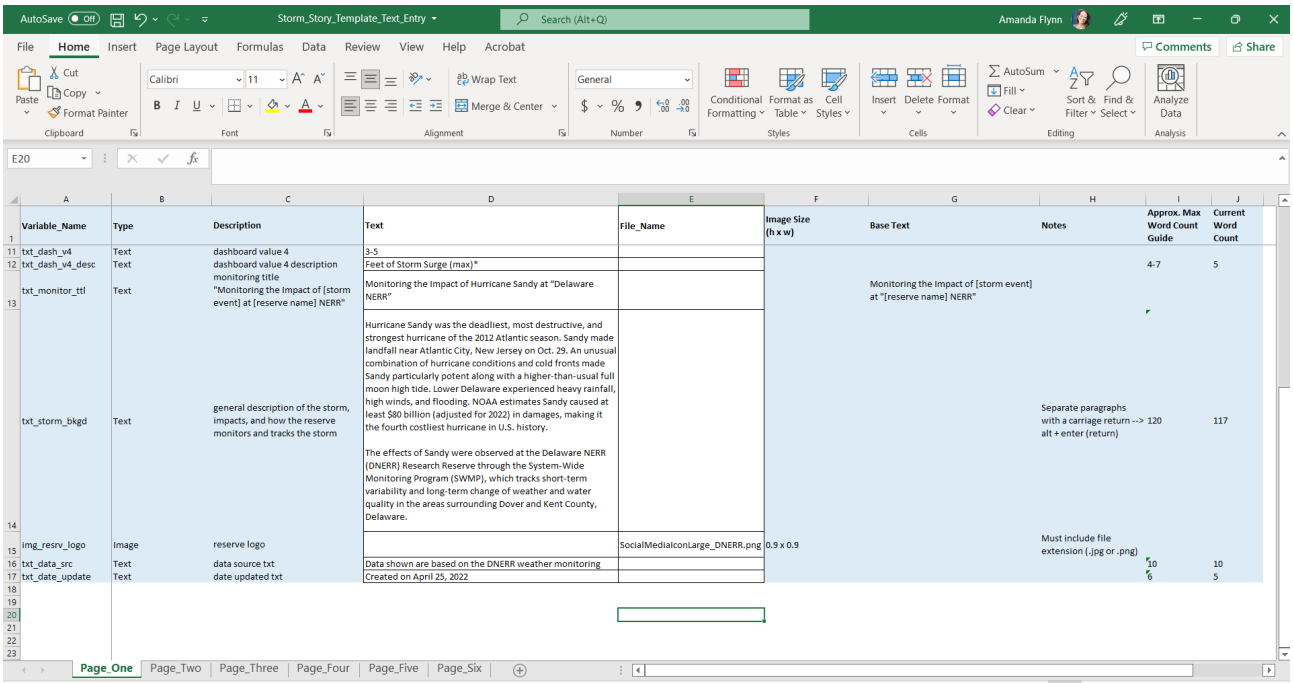
An empty and pre-designed print template that is used to create the raw storm story report is saved in the **template_files/empty_template** subfolder and is named **Storm_Story_Template.pptx**. To view the template elements and/or to make edits to the base design, the user needs to go to “View” and “Slide Master” in the PowerPoint file.

Text Entry Guide

The **Storm_Story_Template_Text_Entry.xlsx** workbook has been developed to facilitate the production of the storm story raw report and to help the user organize text, images, and plots. The workbook is also intended to minimize user interaction with the R scripts that produce the storm story raw report.

It is important to note that columns should not be inserted between the existing columns and existing columns should not be deleted.

There are six worksheets within this workbook for each page of the storm story print template (i.e., Storm_Story_Template.pptx) Page_One, Page_Two, Page_Three, Page_Four, Page_Five, and Page_Six. Within each worksheet, there are ten columns that are common to all worksheets: Variable_Name, Type, Description, Text, File_Name, Image Size, Base Text, Notes, Approx. Max Word Count Guide, and Current Word Count. The key columns that the user will interact with on each worksheet will be the “Text” (Column D) and “File_Name” (Column E) columns. The shaded blue columns (A-C and F-J) should not be modified and are either read into the R script or intended to guide the user.



Variable_Name	Type	Description	Text	File_Name	Image Size (h x w)	Base Text	Notes	Approx. Max Word Count Guide	Current Word Count
txt_dash_v4	Text	dashboard value 4	3-5						
txt_dash_v4_desc	Text	dashboard value 4 description	Feet of Storm Surge (max)*					4-7	5
txt_monitor_ttl	Text	monitoring title “Monitoring the Impact of [storm event] at [reserve name] NERR”	Monitoring the Impact of Hurricane Sandy at “Delaware NERR”			Monitoring the Impact of [storm event] at “[reserve name] NERR”			
txt_storm_bkgd	Text	general description of the storm, impacts, and how the reserve monitors and tracks the storm	Hurricane Sandy was the deadliest, most destructive, and strongest hurricane of the 2012 Atlantic season. Sandy made landfall near Atlantic City, New Jersey on Oct. 29. An unusual combination of hurricane conditions and cold fronts made Sandy particularly potent along with a higher-than-usual full moon high tide. Lower Delaware experienced heavy rainfall, high winds, and flooding. NOAA estimates Sandy caused at least $80 billion (adjusted for 2022) in damages, making it the fourth costliest hurricane in U.S. history. The effects of Sandy were observed at the Delaware NERR (DNERR) Research Reserve through the System-Wide Monitoring Program (SWMP), which tracks short-term variability and long-term change of weather and water quality in the areas surrounding Dover and Kent County, Delaware.				Separate paragraphs with a carriage return --> alt + enter (return)	120	117
img_resrv_logo	Image	reserve logo		SocialMediaIconLarge_DNERR.png	0.9 x 0.9		Must include file extension (.jpg or .png)		
txt_data_src	Text	data source txt	Data shown are based on the DNERR weather monitoring					10	10
txt_date_update	Text	date updated txt	Created on April 25, 2022					6	5

Page_One | Page_Two | Page_Three | Page_Four | Page_Five | Page_Six

Screenshot of the “Storm_Story_Template_Text_Entry.xlsx” workbook.

Variable_Name

The **Variable_Name** column contains a list of variables that are used in the R scripts for each page. This column must be correctly populated for the R scripts to successfully run. **The user should not modify this column.**

Type

The **Type** column is used to let the user know what type of variable the Variable_Name represents. There are three potential variable types: text, image, and R figure. If a Variable_Name is text then the corresponding variable is used to populate text in the template. If the type is an R figure then the variable is used to populate an R figure in the template. Finally, if the Variable_Name type is an image then the variable is used to add a photo or graphic to the template. The user should not modify this column. It is merely informative.

Description

The **Description** column provides a user-friendly text description to clarify the meaning of the variable listed in the Variable_Name column. The user should not modify this column. It is meant to help the user interpret the Variable_Name column.

Text

The **Text** column is where the user should enter the text that will be used to populate the template. The Text column should be populated by the user if *Type = Text*.

File_Name

The **File** column is where the user should enter the file name that will be used to populate images in the template. There are two possible ways to populate this field, first if *Type = Image*, and second, if *Type = R figure*. If *Type = Image* then the user can simply enter the name of the file within the **template_files/ images** subfolder. If *Type = R figure* then the user must enter the file path and the figure name for the template to populate correctly. It is important that the file name entered includes the file extension for an image or figure (e.g., .jpg or .png).

Image Size (h x w)

The **Image Size (h x w)** column provides info on the image size needed for the image variable listed.

Base Text

The **Base Text** column provides guidance on the type of information expected for the text variable listed.

Notes

The **Notes** column provides additional guidance on input entry requirements.

Approx. Max Word Count Guide

The **Approx. Max Word Count Guide** column provides guidance on the approximate maximum number of words that will fit into the text variable space allotted in the template.

Current Word Count

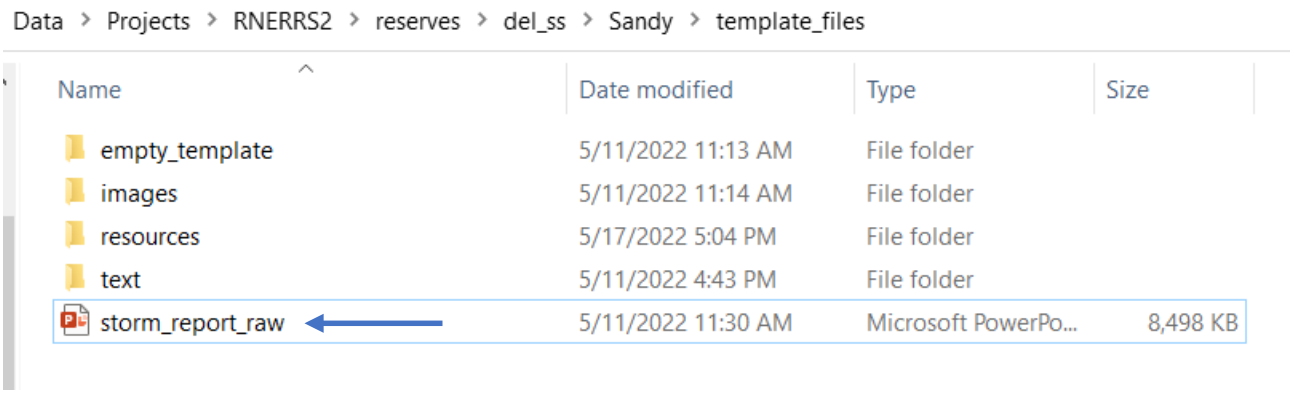
The **Current Word Count** column contains a formula that calculates the current word count as a user types text into the text variable cells to help the user stay within the max word count limit.

9 Print Template Post-Processing and Customization

This section provides a guide on how to post-process an unformatted (raw) template to create a final storm story print report. Resources for Storm Stories are provided in Appendix A. A Style Guide is provided in Appendix B.

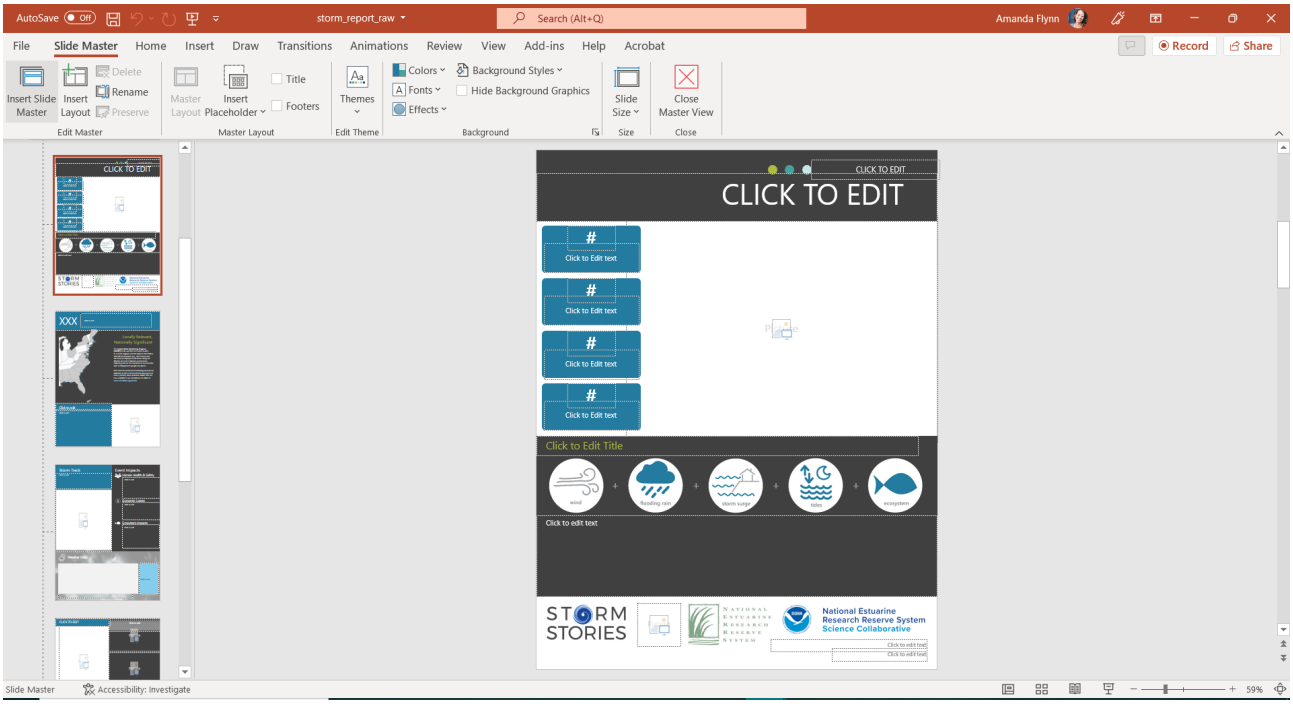
Opening the Raw Report Template File

The raw report template file will be in the “templates_files” folder and will be named “storm_report_raw.”

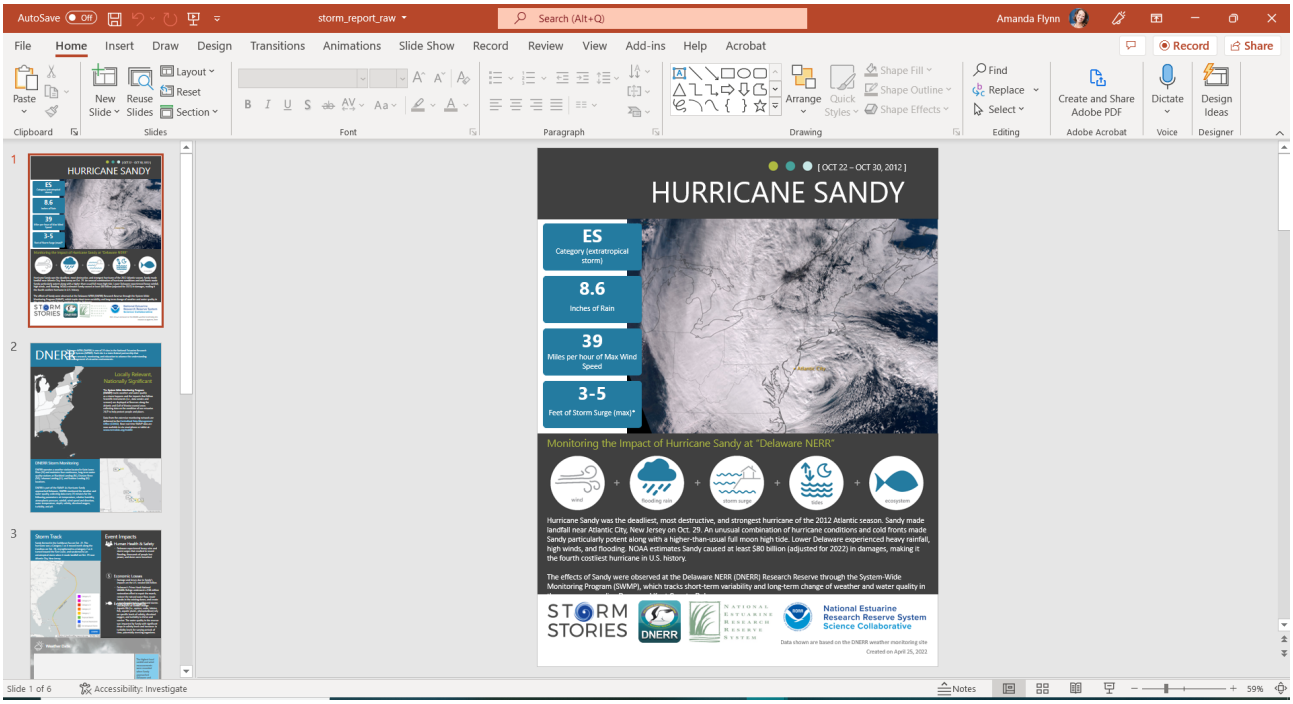


Screenshot of the Storm Story raw template file in the “template_files” folder

When the raw report template file is first opened, it may open in “Normal” view mode or “Slide Master” view mode. If the template file opens in “Slide Master” view mode, complete the following steps to switch the view mode to “Normal.” Go to the “View” section and the “Presentation Views” tab. Click on the “Normal” option to switch the view mode to “Normal.”



Example of "Slide Master" view mode



Example of "Normal" View Mode

General Post-Processing Steps

Make a copy of the "storm_report_raw" PowerPoint file, rename it as "storm_report_final" and make desired additions and enhancements. Updates include adding the Weather and Water Quality data tables, refining narratives, adjusting the spacing between text or graphics, placing callout boxes overtop of figures, emphasizing text by changing to bold or italics, adding hyperlinks, etc.

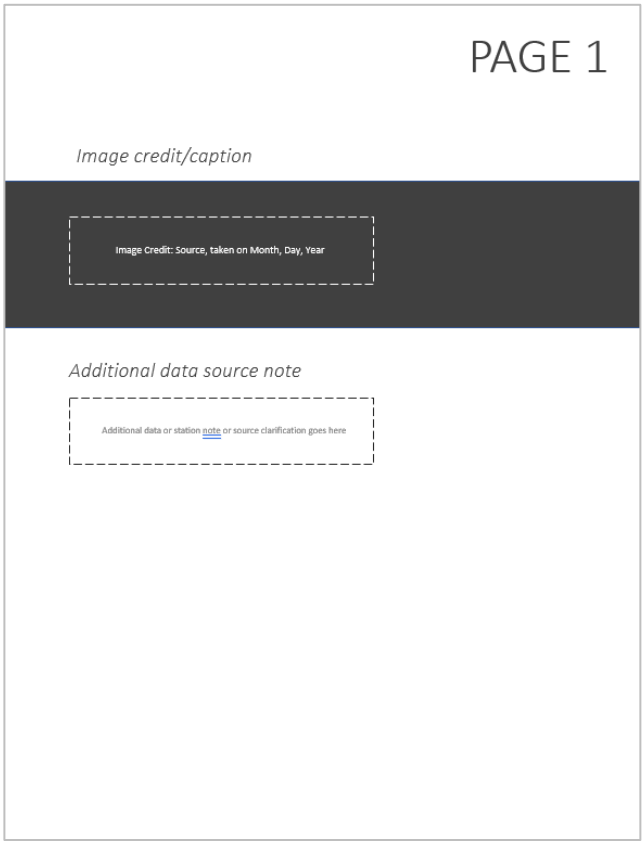
Go to **template_files/resources/** for custom and pre-designed content elements to create the final report. Here is an overview of the resources provided.

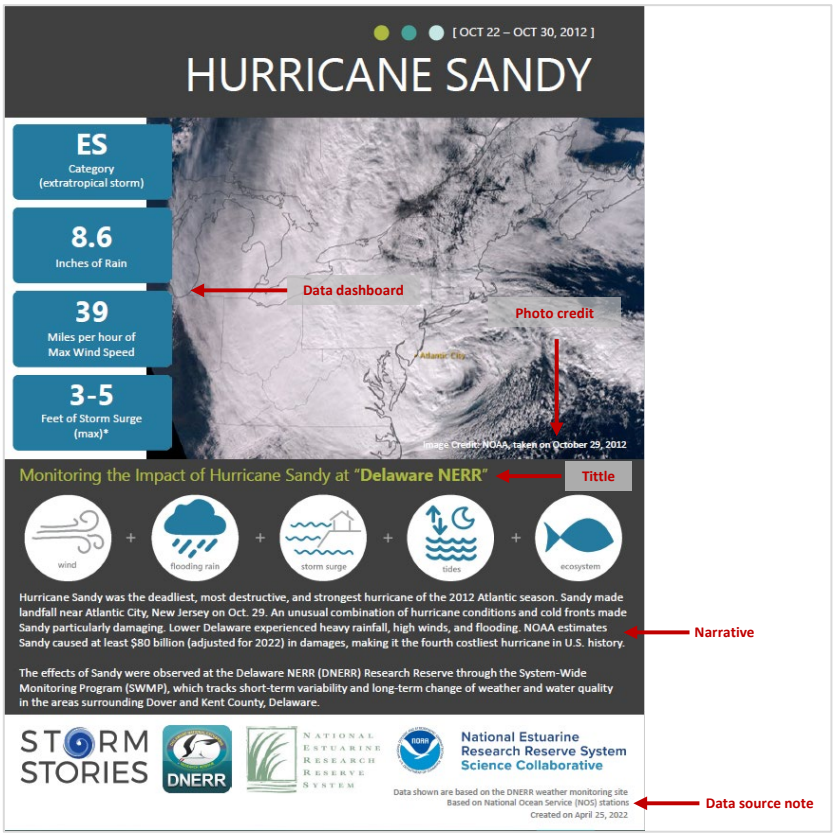
- **ss_print_template_resources.pptx** file provides additional content elements that can be customized for each Page (1-6).
- **ss_Weather_and_WaterQuality_Data_Table_template.xlsx** file can be used to help process and format data for the Weather and Water Quality data generated in the **output/met/data_table** and **output/wq/data_table** csv files. Tables from this file can be copied directly into the pre-formatted tables provided in the "**ss_print_template_resources.pptx**" file (see Page 3 and Page 5). Alternatively, table data can be copied directly from the output/met/data_table and output/wq/data_table files into the pre-formatted tables. However, some manual formatting will be needed as PowerPoint will maintain the 'parent' excel format.
- **ss-weater-water-quality-data-tables-how-to.mp4** is a tutorial video on how to use the "**ss_Weather_and_WaterQuality_Data_Table_template.xlsx**" file and the pre-formatted tables provided in the "**ss_print_template_resources.pptx**" file (see Page 3 and Page 5) to create the weather and water quality data tables.
- **ss-image_guide_size_check.pptx** file provides a copy of the placeholder images for each Page (1-6). This file can be used to check image sizes and/or modify images by resizing and cropping.
- **/graphics** folder provides icons, additional NERRS maps, and NOAA/NERR logos. The icons subfolder includes a copy of all icons used in the storm story template as well as additional icons (see files that start with "0") that can be used as additional layered elements (e.g., wind icon for wind section/data plot).

Page One Steps

Go to Page 1 of the "ss_print_template_resources.pptx" file and use the pre-designed report elements as needed.

- **Data Dashboard**: as needed, adjust the spacing to vertically align the numbers and text in the blue rectangles.
- **Cover image**: add a photo credit and/or caption.
- **Monitoring the Impact of the [storm] at "[reserve] NERR"**: Bold the "[reserve] NERR" in the title to make the text stand out more. Review narrative and edit as needed to refine the message and ensure text fits into the area allotted. Add additional bolding as desired.
- **Additional data note:** if other data sources besides the reserve met station for the data dashboard, an additional data source note can be added to the bottom right of the page along the reserve met station note and the date created info.

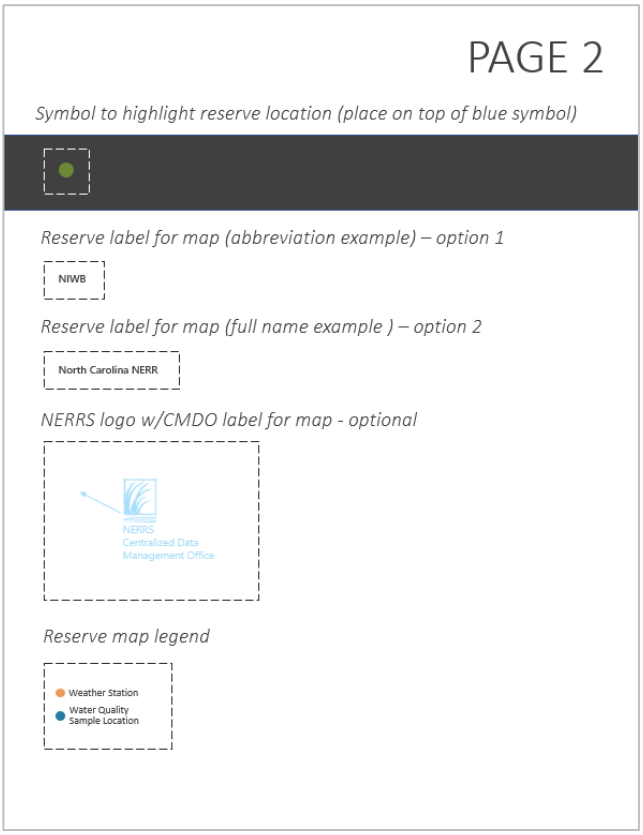


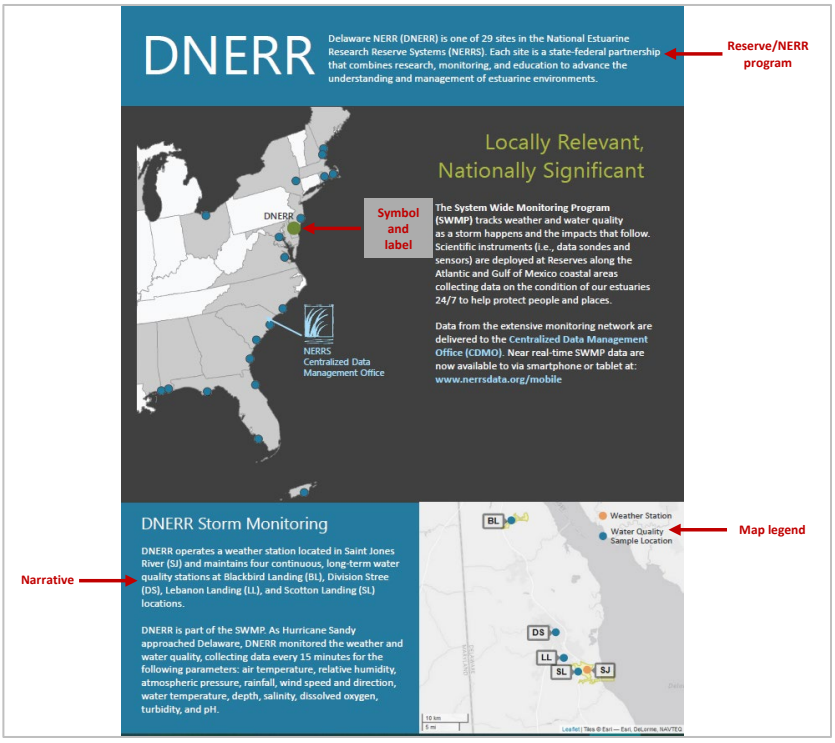


Page Two Steps

Go to Page 2 of the "ss_print_template_resources.pptx" file and use the pre-designed report elements as needed.

- **Reserve/NERR program**: Adjust the placement of the narrative box to line up vertically centered to the reserve name/abbreviation
- **Reserve location map symbol and label**: add symbol to map for reserve location and add reserve name label
- **[reserve] Storm Monitoring**: Review narrative and edit as needed to refine the message and ensure text fits into the area allotted.
- **Map Legend**: Add reserve map legend

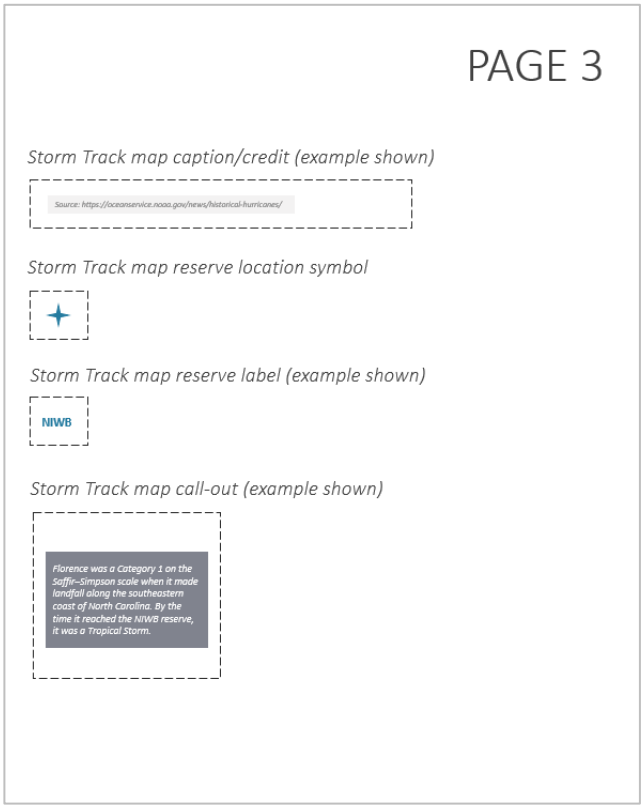


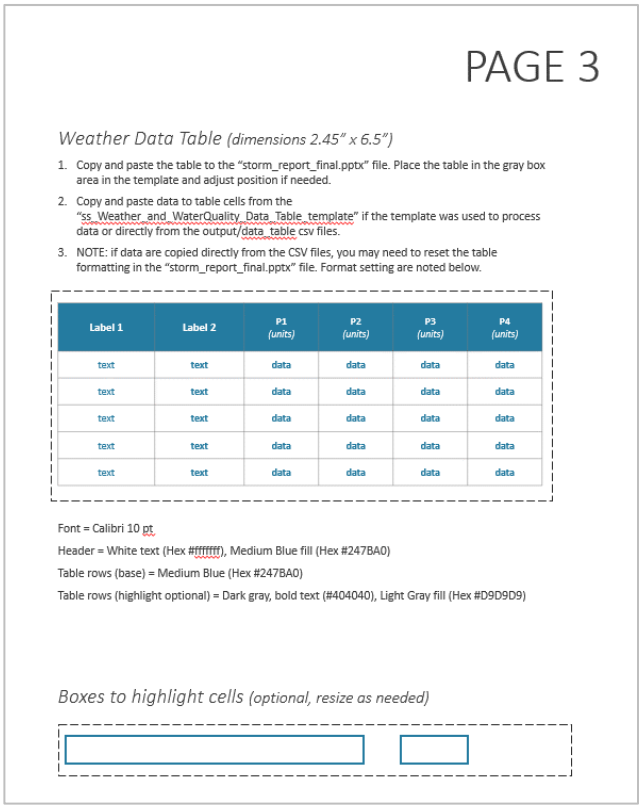


Page Three Steps

Go to Page 3 of the "ss_print_template_resources.pptx" file and use the pre-designed report elements as needed.

- **Storm Track narrative**: Review narrative and edit as needed to refine the message and ensure text fits into the area allotted.
- **Storm track image**: add image credit and/or caption.
- **Reserve location map symbol and label**: add symbol to map for reserve location and add reserve name label
- **Storm track call-out:** add call-out
- **Storm event narrative**: Review narrative and edit as needed to refine the message and ensure text fits into the area allotted. If needed, move the "Economic Losses" and "Ecosystem Impacts" titles and icons up or down to accommodate the number of bullets for each section. It is expected that the number of bullets and length of text will vary for each report. To move the titles and icons, go to "View" then the "Master Views" tab and select "Slide Master." Click on the icon and title (these elements should be grouped) and move up or down as needed. After the change has been made, go to "Presentation Views" and select "Normal" to return to the normal view mode.
- **Weather data table call-out:** Review narrative and edit as needed to refine message and ensure text fits into the area allotted.



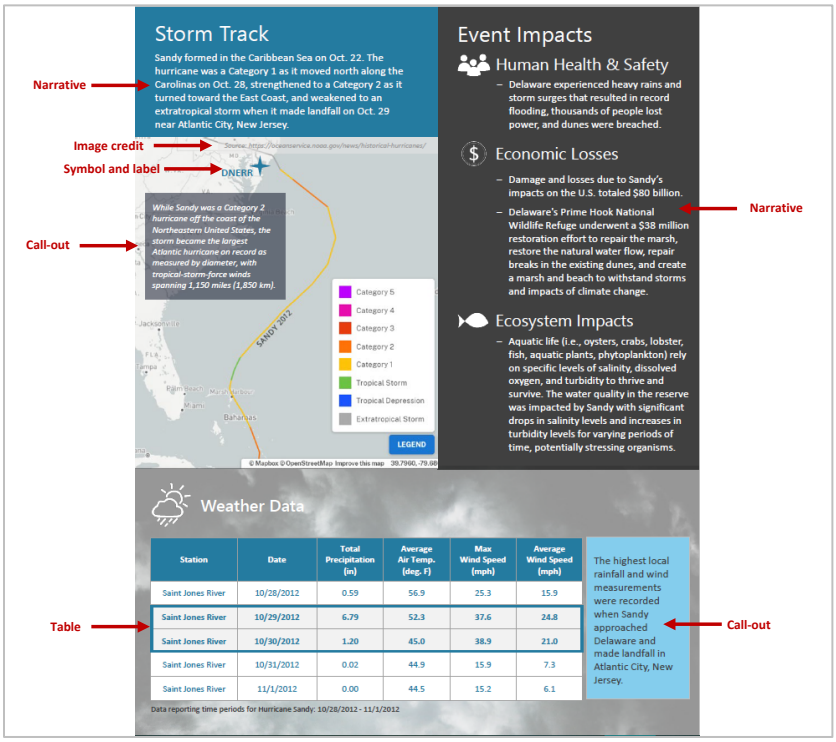


- **Weather data table:** Go to the "**ss_print_template_resources.pptx**" file (Page 3) to copy and paste the pre-formatted and designed PowerPoint table to the "storm_report_final.pptx" file. Place the table over the "gray" box and adjust placement as needed to line up the table to cover the "gray" box area.

  There are a few ways to copy data to the table. For a "one reserve, one event," the user can use the "**ss_Weather_and_WaterQuality_Data_Table_template.xlsx**" file to process and format data. Tables from this file can be copied directly into the pre-formatted tables provided in the "ss_print_template_resources.pptx" file. See the "**ss-weater-water-quality-data-tables-how-to.mp4**" video tutorial for more detailed "how-to" instructions.

  Alternatively, table data can be copied directly from the output/met/data_table csv files into the pre-formatted tables. However, some manual formatting will be needed as PowerPoint will maintain the 'parent' excel format. Guidance on the font type, size, and color settings for the table is provided in the "ss_print_template_resources.pptx" file. To highlight data, use bold text, different color font, and shaded highlight boxes.

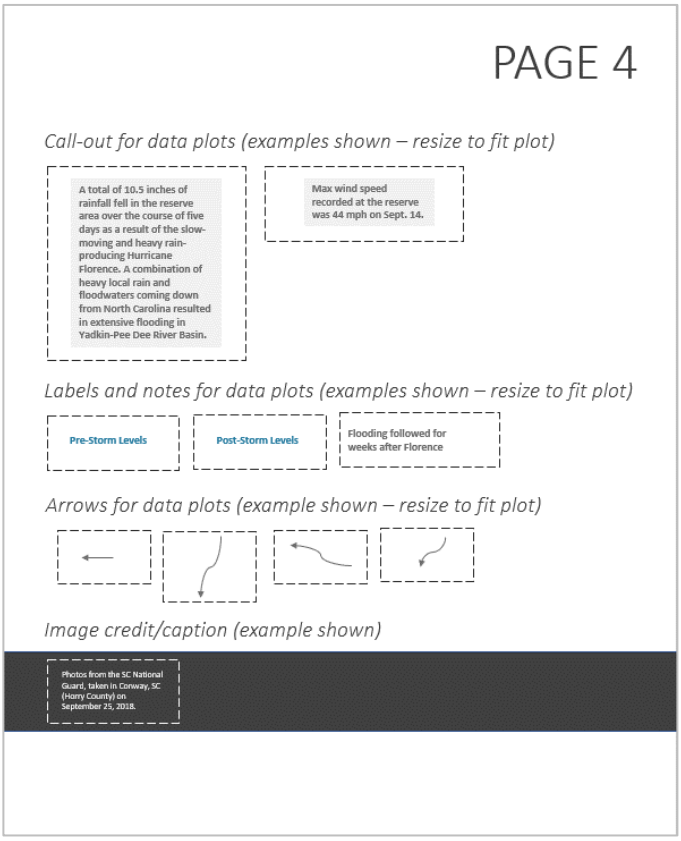
  For other storm story types (e.g., one reserve, multiple storms, and multiple reserves, one storm), a more manual data compilation and formatting approach will be needed. Depending on how the user generates output, the user may need to compile data from several csv files (e.g., if the output is generated for a single reserve or a single storm rather than generating output summaries for multiple reserves.

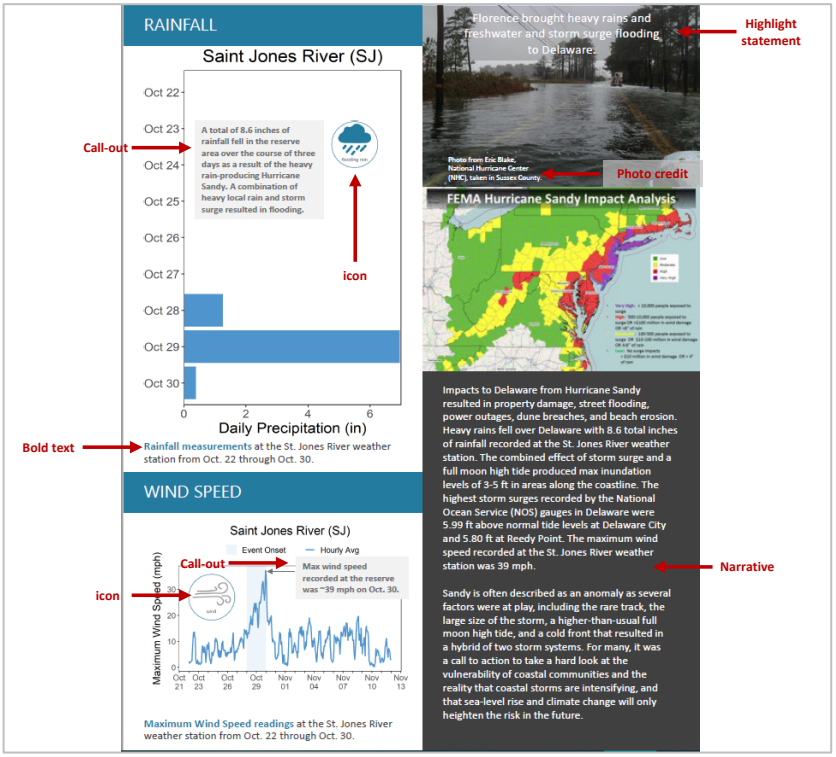


Page Four Steps

Go to Page 4 of the "ss_print_template_resources.pptx" file and use the pre-designed report elements as needed.

- **Data plots call-outs**: Add call-outs
- **Data plots icons**: The **template_files/resources/graphics/icons** subfolder includes a copy of all icons used in the storm story template as well as additional icons. The files that start with "0" can be used as additional layered elements of the data plots (e.g., wind icon for wind section/data plot).
- **Data plots caption text:** Add bolded text to highlight the data plot type.
- **Weather data narrative**: Review narrative and edit as needed to refine the message and ensure text fits into the area allotted.
- **Highlight statement**: Adjust spacing if needed. Add a shading fill to the box to add more contrast between the text and the images if needed. To do this, click on the box, go to the "Shape Format" tab and the "Shape Styles" section. Click on "Shape Fill" and the down arrow. Select "More Fill Colors" and adjust the gray background color to lighter or darker and also adjust the transparency (0-100%) as needed.





Page Five Steps

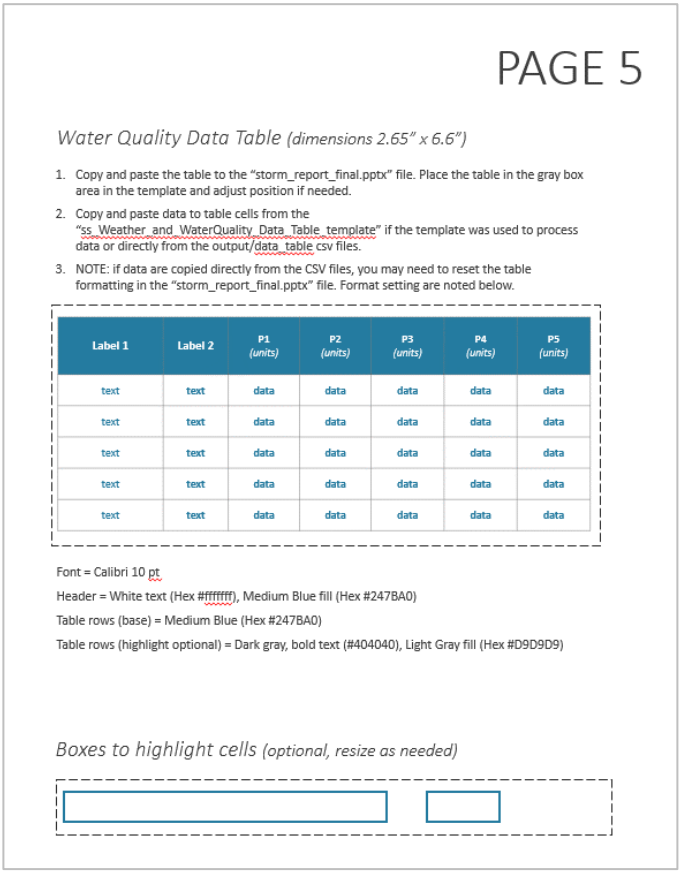
Go to Page 5 of the "ss_print_template_resources.pptx" file and use the pre-designed report elements as needed.

- **Water Quality data table:** Go to the "**ss_print_template_resources.pptx**" file (Page 5) to copy and paste the pre-formatted and designed PowerPoint table to the "storm_report_final.pptx" file. Place the table over the "gray" box and adjust placement as needed to line up the table to cover the "gray" box area.

  There are a few ways to copy data to the table. For a "one reserve, one event," the user can use the "**ss_Weather_and_WaterQuality_Data_Table_template.xlsx**" file to process and format data. Tables from this file can be copied directly into the pre-formatted tables provided in the "ss_print_template_resources.pptx" file. See the "ss-weater-water-quality-data-tables-how-to.mp4" video tutorial for more detailed "how-to" instructions.

  Alternatively, table data can be copied directly from the output/wq/data_table csv files into the pre-formatted tables. However, some manual formatting will be needed as PowerPoint will maintain the 'parent' excel format. Guidance on the font type, size, and color settings for the table is provided in the "ss_print_template_resources.pptx" file. To highlight data, use bold text, different color font, and shaded highlight boxes.

  For other storm story types (e.g., one reserve, multiple storms, and multiple reserves, one storm), a more manual data compilation and formatting approach will be needed. Depending on how the user generates output, the user may need to compile data from several csv files (e.g., if the output is generated for a single reserve or a single storm rather than generating output summaries for multiple reserves


PAGE 5

Water Quality Data Table (dimensions 2.65" x 6.6")

1. Copy and paste the table to the "storm_report_final.pptx" file. Place the table in the gray box area in the template and adjust position if needed.
2. Copy and paste data to table cells from the "ss_Weather_and_WaterQuality_Data_Table_template" if the template was used to process data or directly from the output/data_table csv files.
3. NOTE: if data are copied directly from the CSV files, you may need to reset the table formatting in the "storm_report_final.pptx" file. Format setting are noted below.

Label 1	Label 2	P1 (units)	P2 (units)	P3 (units)	P4 (units)	P5 (units)
text	text	data	data	data	data	data
text	text	data	data	data	data	data
text	text	data	data	data	data	data
text	text	data	data	data	data	data
text	text	data	data	data	data	data

Font = Calibri 10 pt

Header = White text (Hex #ffffff), Medium Blue fill (Hex #247BA0)

Table rows (base) = Medium Blue (Hex #247BA0)

Table rows (highlight optional) = Dark gray, bold text (#404040), Light Gray fill (Hex #D9D9D9)

Boxes to highlight cells (optional, resize as needed)

- **Water Quality data table call-out:** Review narrative and edit as needed to refine the message and ensure text fits into the area allotted.
- **Data plots call-outs**: Add call-outs
- **Data plots caption text:** Add bolded text to highlight the data plot type.
- **Ecosystem impact narrative**: Review narrative and edit as needed to refine the message and ensure text fits into the area allotted.
- **Highlight statement**: Adjust spacing and revise the text to fit if needed.

PAGE 5

Call-out for data plots (examples shown – resize to fit plot)

Note about water quality data here

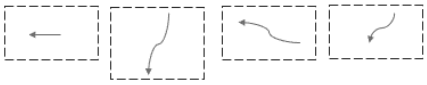
Labels and notes for data plots (examples shown – resize to fit plot)

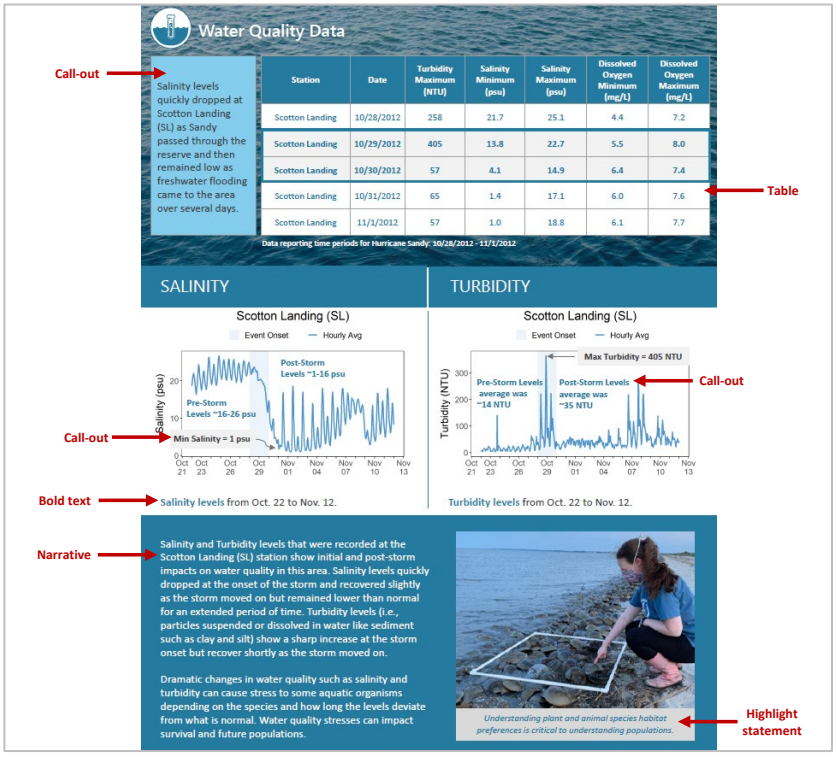
Pre-Storm Levels ~X-X

Post-Storm Levels ~X-X

A big and fast drop in salinity occurred as flooding followed for weeks after Florence

Arrows for data plots (example shown – resize to fit plot)





Page Six Steps

Page 6 does not have any custom elements that are needed from the "ss_print_template_resources.pptx" file.

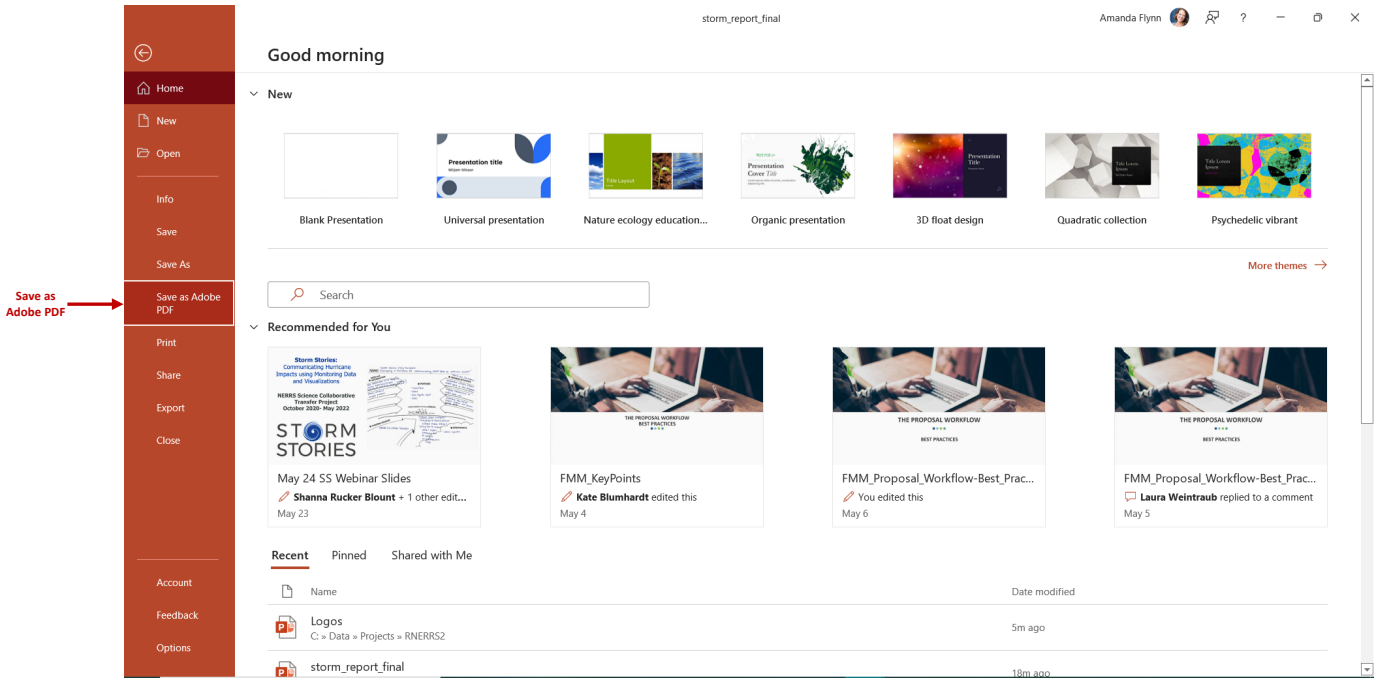
- **Web links**: Format web links and check for active hyperlinks. If a link is not active, add the hyperlink by selecting the hyperlink text, right-click, select "Link" and add the URL. Update web link styling to "green" font, bold, and an underline.
- Make text spacing adjustments as needed in the various sections.

PAGE 6

No custom elements required

Create Final PDF

After the post-processing steps have been completed, the user is ready to create the final storm story report as a PDF. Go to “File” and “Save as Adobe PDF.” Specify the location where you want to save the PDF. A PDF version of the storm story report should now be created and available for distribution.



Screenshot of PowerPoint File and “Save As” Option Page

10 StoryMap Template

ArcGIS StoryMaps is an interactive, web-based application that allows narrative text to be shared alongside maps, images, and other multimedia (e.g., video, interactive tools, etc.) content in a streamlined and intuitive format. The storm stories StoryMaps template builds off the storm story print template. Since StoryMaps are scalable and are not limited to the same page constraints as the print template, the story can be expanded and more details can be added within the StoryMaps. The StoryMap template provides a framework for getting started and can easily be adapted to meet the needs of a particular storm story or reserve.

This section provides an overview of how to access and use the StoryMaps template to create a webpage tool to accompany the print template. It is important to note that the ArcGIS StoryMaps platform is constantly evolving. ESRI is continually making updates to enhance existing tools and add new capabilities. Over time, some features and functionalities may not be exactly as described in the documentation due to changes to the StoryMaps platform.

Before getting started with the ArcGIS StoryMap platform, it may be helpful to first compile the content that you want to use to for your storm story. A new StoryMap can be created from the template. Edits can then be made to each section until the new StoryMap is complete and ready to be reviewed and published.

An outline of the StoryMap Workflow steps is listed below and described in more detail in the subsequent sections.

1. Compile StoryMap content and media
2. Set up StoryMap
    a. Access “NERRS Storm Stories” group in ArcGIS Online (may require admin support)
    b. Duplicate StoryMap template
3. Edit StoryMap and related content
    a. Copy in text from print template
    b. Expand on text narrative
    c. Replace and add maps and figures
    d. Add additional content (videos, interactive tool links, etc.)
4. Review and publish StoryMap (may require admin support)

Compile StoryMap Content and Media

ArcGIS StoryMaps provides the flexibility to incorporate a range of media types. The StoryMap template includes placeholders for various types of content. Below is a list of some items that can be compiled to assist with the creation of the StoryMap.

- Print Template
- Photos
- Data plots
- Videos
- Links to tools and webpages
- Timeline dates and details

For a detailed list of the websites and tools that can be incorporated into StoryMaps see **Appendix A**.

Set Up StoryMap

The StoryMap template is accessed through an ArcGIS Online (AGOL) account. Once accessed, it is **important that the template first be duplicated** so that other users can utilize the original, unedited version as a resource for their StoryMaps.

Access NERRS Storm Stories Group and Template

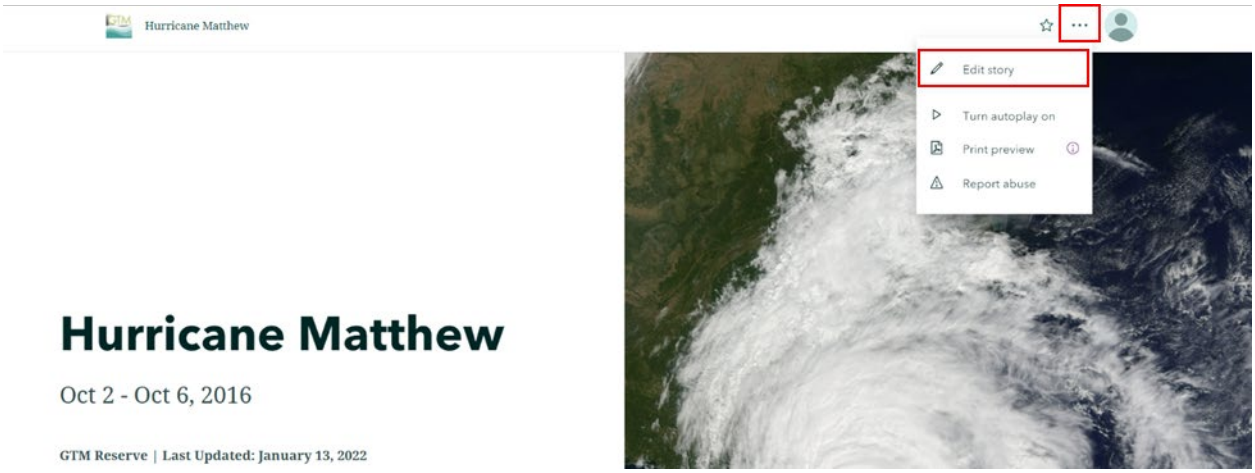
- Sign into an ArcGIS Online (AGOL) account at **https://www.arcgis.com/**
- Click 'Groups' in the top navigation bar

- Find and select the group called 'NERRS Storm Stories.' If you do not see this group listed, contact your IT support. An account administrator may need to grant access to this group.

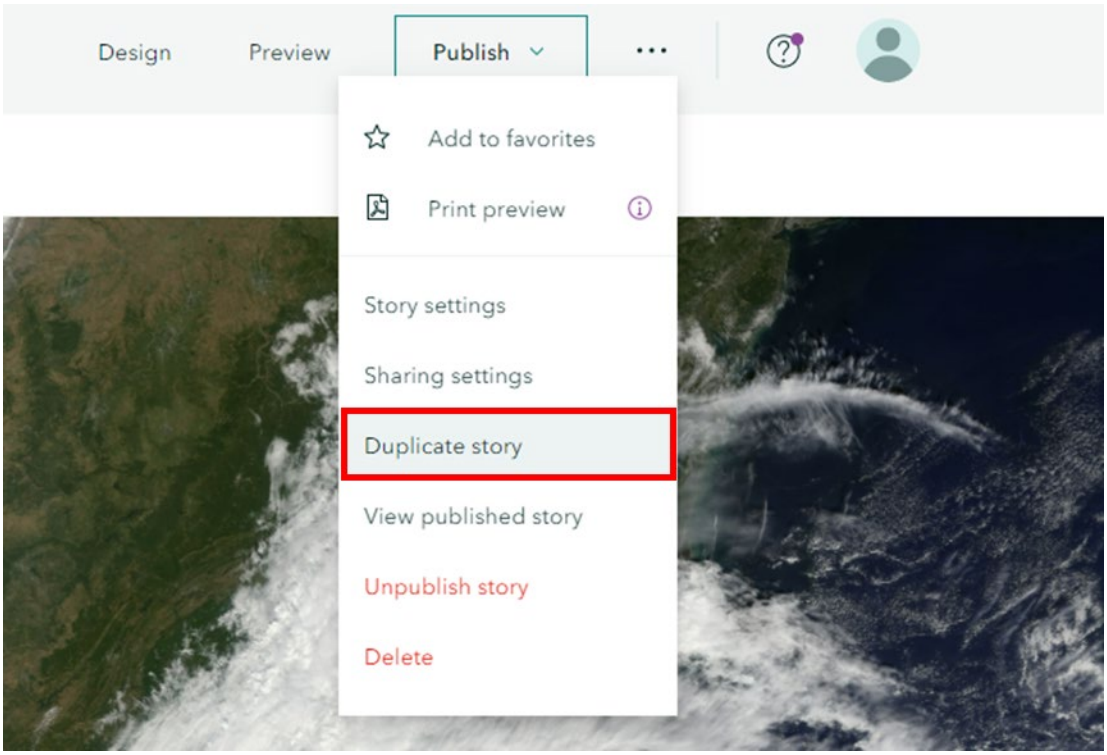
Duplicate StoryMap Template

- Find the StoryMap template within the NERRS Storm Stories group. The StoryMap is called "**Template StoryMap – Hurricane Matthew**". Alternatively, open the template using this link: **https://storymaps.arcgis.com/stories/bef8f533a48445538f4d7971c0413aef**

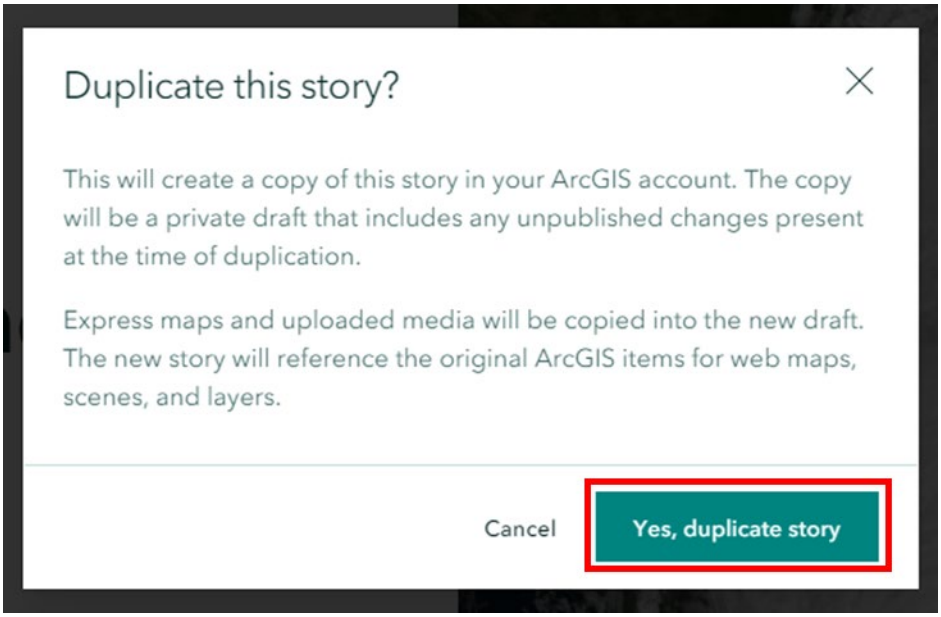
- Click on the three dots – Click 'Edit story'



- Click on the three dots – Click 'Duplicate story'

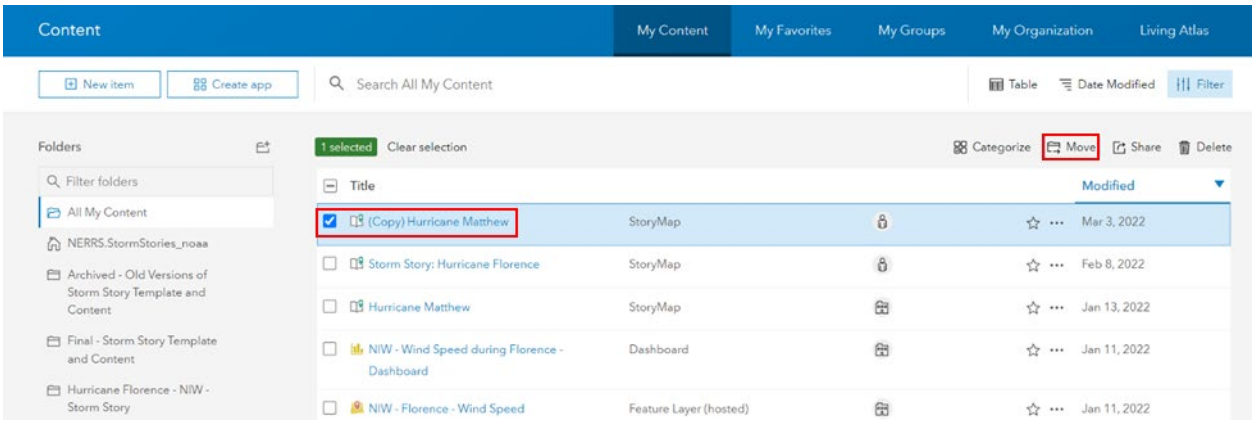


- A warning will pop-up. Click ‘Yes, duplicate story’



- A copy of the new StoryMap will open automatically.

- The location of the newly created StoryMap may need to be moved.
  Go to the Content page – select the copied StoryMap – click ‘Move’ – choose the desired folder destination



Edit StoryMaps and Related Content

Basic Navigation

Reorder Sections and Content

StoryMap content – such as paragraphs, section headers, maps, and images – is organized in blocks. To move and reorder these blocks, hover over the content, then click and drag the icon with six dots (⠿) to move the block to the desired location.

Replace Text

StoryMaps work similarly to other text editors, such as Microsoft Word. Delete placeholder text and add the narrative for the new StoryMap. Copy in text or type directly within the paragraph blocks.

Add Media

To add a new content block, hover over the blank space between existing blocks. A button with a plus-sign (⊕) will appear. Once the button is clicked, a list of various block types will appear. Select the desired option.

Replace Images

To replace an image, hover over the image –click the More Options button (⋯) – click 'Replace Image' – browse for the desired image.

Go to the Workspace Template and **/template_files/resources** for the **ss-StoryMap_Image_Template.pptx** file, which provides a template and guidance on how to update the following images/sections in a StoryMap.

- By the Numbers
- Organization Logos
- Contact Information

Replace Web Maps

To replace a web map, the existing template map first needs to be deleted:

- Hover over the map – click the Delete button ( )

Once the template map is deleted, a new map can be added:

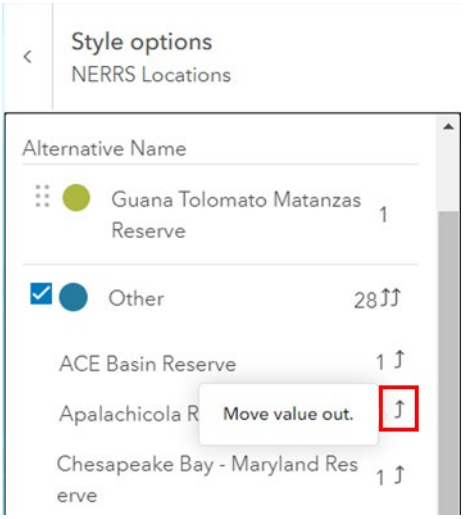
- Click 'Add media' – click 'Add map'
- Select a map that already exists in your account or add a new express map
- Adjust the map extents (if needed) – click 'Place map'

Edit Web Maps

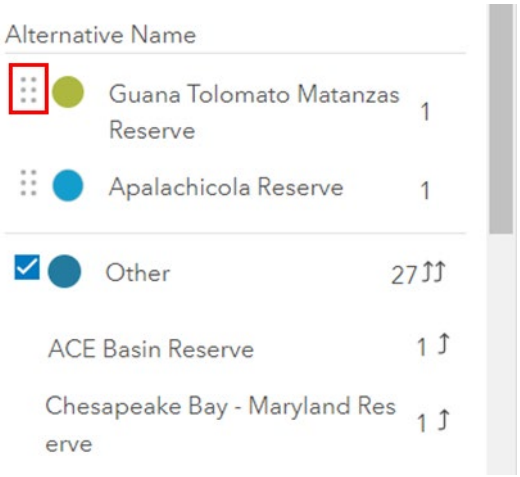
Three maps are included in the StoryMap template. The steps below describe how to copy the template maps and update them for a particular reserve.

Regional Map

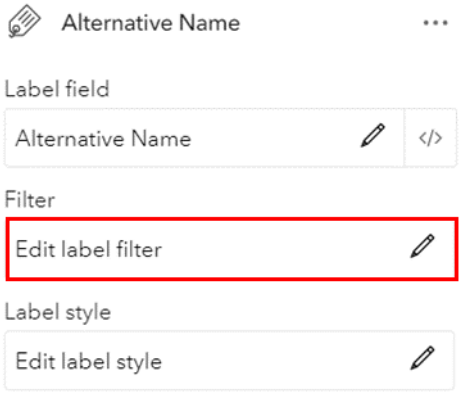
- Find the web map called "NERRS Reserves - Regional Map for Storm Stories" in the NERRS Storm Stories group – open in Map Viewer
- Click on the Save and Open button on the left side panel – click 'Save as' – modify the name and save in location with the rest of the StoryMap content being created
- Click on the Layers button on the left side panel – click 'NERRS Locations' layer
- On the right panel, click the Styles button ( ) – click 'Style options'
- Find the reserve(s) that is being highlighted in the StoryMap – click the up arrow to move the reserve to the 'Alternative Name' section



- Remove reserves out of the 'Alternative Name' section if they are not a focus for the map: Drag (by clicking on the six dots) and move below the 'Other' section.



- Change the symbology: Click on symbol you want changed – select size – choose fill color – click 'Done'
  - *Standard color for focus reserve: hex #aeb840*
  - *Standard color for 'Other' reserves: hex #247ba0*
- Change label: Click the Labels button  – click 'Edit label filter'– change expression to identify reserve that should be highlighted



- Adjust map extents to focus on the desired region
- Save Map
- Replace template web map with newly saved map (as described in the previous section)

Reserve Level Map

- Find the web map called "NERRS Reserves - Reserve Level Map for Storm Stories" in the NERRS Storm Stories group – Open in Map Viewer
-  Click on the Save and Open button on the left side panel – click 'Save as' – modify the name and save in location with the rest of the StoryMap content being created
-  Click on the Layers button on the left side panel – click the 'CDMO Stations' layer
- On the right panel, click the Filter button ( ) on the right-side panel
- Filter by Station Code or NERR Site ID (Add or delete expressions as needed
- On the right panel, click the Styles button ( ) – click 'Style options'
- Change the symbology (as needed): Click on the symbol that needs to be modified – Select size – Choose fill color – click 'Done'
  Standard style for Water Quality Station: symbol = circle, size = 10, custom color = hex #247ba0
  Standard style for Weather Station: symbol = triangle, size = 11, custom color = hex # 7a29b
- Adjust map extents to focus on the desired region
- Save Map
- Replace template web map with newly saved map (as described in the previous section)

National Map

This National map is designed to be used by all reserves without any editing. New StoryMaps should not be linked to template content within the NERRS Storm Stories Group, so a copy of the template map needs to be made.

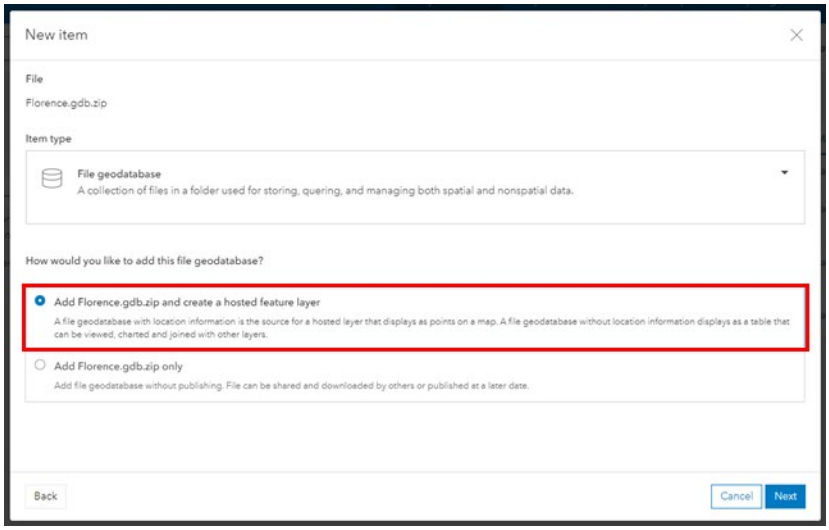
- Find the web map called "NERRS Reserves – National Map for Storm Stories" in the NERRS Storm Stories group – Open in Map Viewer
  
- Click on the Save and Open button on the left side panel – click 'Save as' – modify the name and save in location with the rest of the StoryMap content being created
- Replace template web map with newly saved map (as described in the previous section)

Create Interactive Data Plot

Upload Data to AGOL

- Download data from CDMO website or extract data from the Workspace Template **/data/cdmo** or the R 'daily_data_table_*.csv met or wq output from the Workspace Template **/output/met/data_table**, **/output/wq/data table** subfolders
- Process and reformat the data as needed. Examples of data processing include:
  - Change units
  - Add latitude and longitude coordinates
  - Add additional fields
  - Change date/time format to UTC time zone
- Save data to an ArcGIS geodatabase

- Upload geodatabase layers to AGOL. There are multiple ways to do this. One option is to add the geodatabase as a zip file:
    - In AGOL, go to the Content page – click ‘New Item’
    - Select the zip file containing the geodatabase
    - Choose the Item type ‘File geodatabase’ – Choose the option ‘Add .zip and create a hosted feature layer or import directly to AGOL’
    - Click ‘Next’



Modify Template Dashboards

- In the NERRS Storm Stories group, find a dashboard template to serve as a starting point. Two are included in the group:
    - Hurricane Matthew - Rainfall Dashboard and Map
    - Hurricane Matthew - Wind Speed Dashboard
- Click ‘Edit Dashboard’
-  Click on the Save button on the left side panel – Click ‘Save As’ – Enter a new title and change the folder location
- Hover mouse over the dashboard section that needs to be updated – Hover over the three dots in the top left corner of the panel – Click ‘Configure’

- In the ‘Data’ tab, change the layer to an existing layer in the AGOL account
- Go through the remaining tabs to select chart preferences. (When the data layer gets changed, the chart options also change. To use the same preferences as the dashboard template, repeat Steps 1 to 4 and create an extra copy of the dashboard to reference the settings.)

Review and Publish StoryMaps

Preview in Desktop, Mobile, and Tablet Views

- At the top of the page, click ‘Preview’

- In the bottom right corner, select the preview type (phone, tablet, desktop, or fullscreen)

- Scroll through the StoryMap to see how things will appear on the different device types

Publish StoryMaps

- Leave Preview mode (click the X in the bottom right-hand corner) and return to Edit mode
- At the top of the page, click ‘Publish’

- Select the Sharing Level that is desired or type in the group name to give access – click ‘Publish’ (If you are not able to select the desired sharing level, your account may not have the privileges to share at that level. Contact an ArcGIS administrator for assistance.)

Appendix A: Storm Stories Resources

Appendix B: Print Report Style Guide