



Introduction

Michelle Simon, Ph.D., P.E.

United States Environmental Protection Agency

Cincinnati, OH

Simon.michelle@epa.gov

EPA Point of Contact for SWMM

Worked on Green Infrastructure since 2010





Disclaimer

The U.S. EPA, through its Office of Research and Development, funded and collaborated in the research described in this presentation. It has been subjected to the agency's administrative review and has been approved for external publication. Opinions expressed in this presentation are those of the author and do not necessarily reflect the views of the agency; therefore, no official endorsement should be inferred.

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Recent Updates to SWMM 5.1

Michelle Simon, Ph.D., P.E.

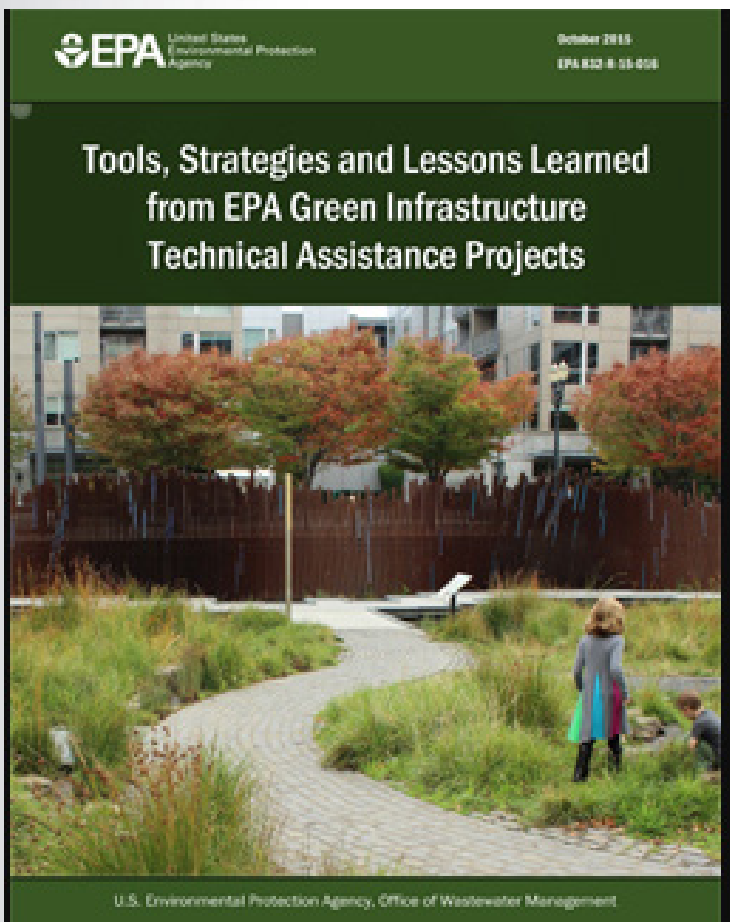
United States Environmental Protection Agency

Villanova University Seminar

March 23, 2021



Talk Outline – kudos to Lew Rossman



Introduction

EPA's Stormwater Management Model (SWMM)

SWMM 5.1.013

SWMM 5.1.014

SWMM 5.1.015

SWMM 5.1.016 - beta version

Summary



What is SWMM?

<https://www.epa.gov/water-research/storm-water-management-model-swmm>

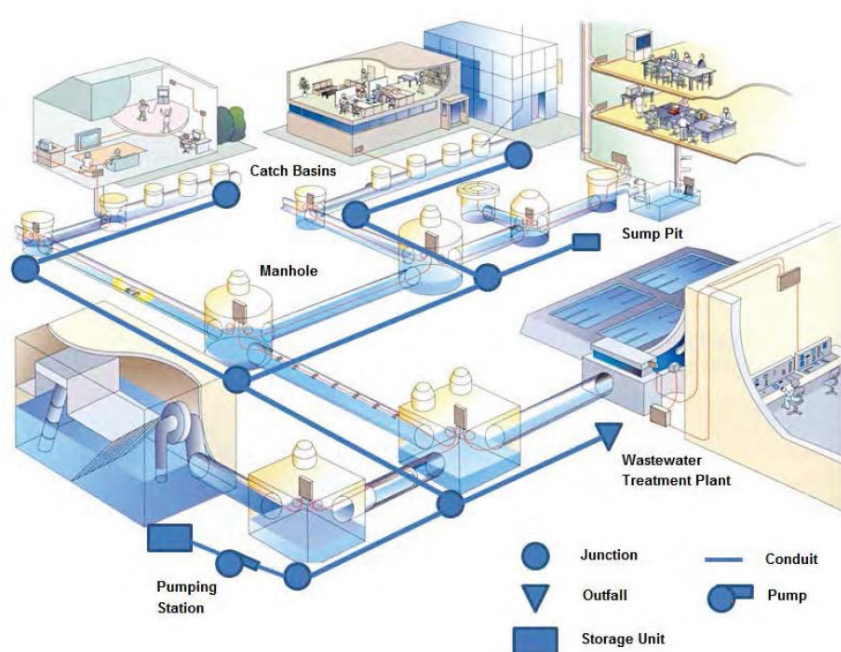


SWMM is a public domain, distributed, dynamic hydrologic - hydraulic - water quality model used for simulation of runoff quantity and quality from primarily urban areas.



EPA Stormwater Management Model

<https://www.epa.gov/water-research/storm-water-management-model-swmm>





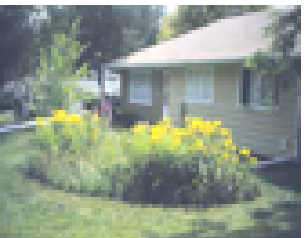
Why EPA needs SWMM (CSO, MS4, TMDL, NPDES)



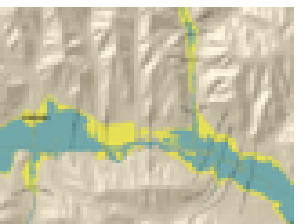
Design and sizing of drainage system.



Control of combined and sanitary sewer overflows.



Modeling Inflow & Infiltration in sanitary sewer systems.



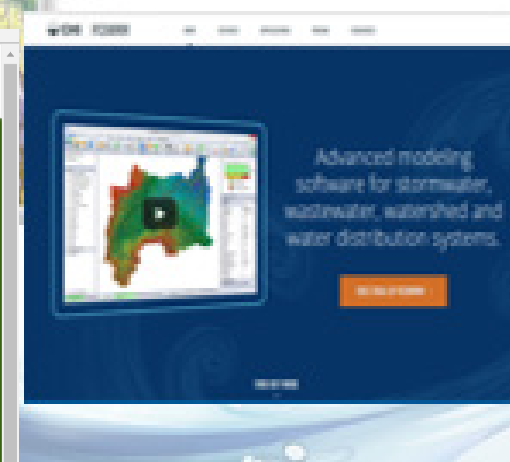
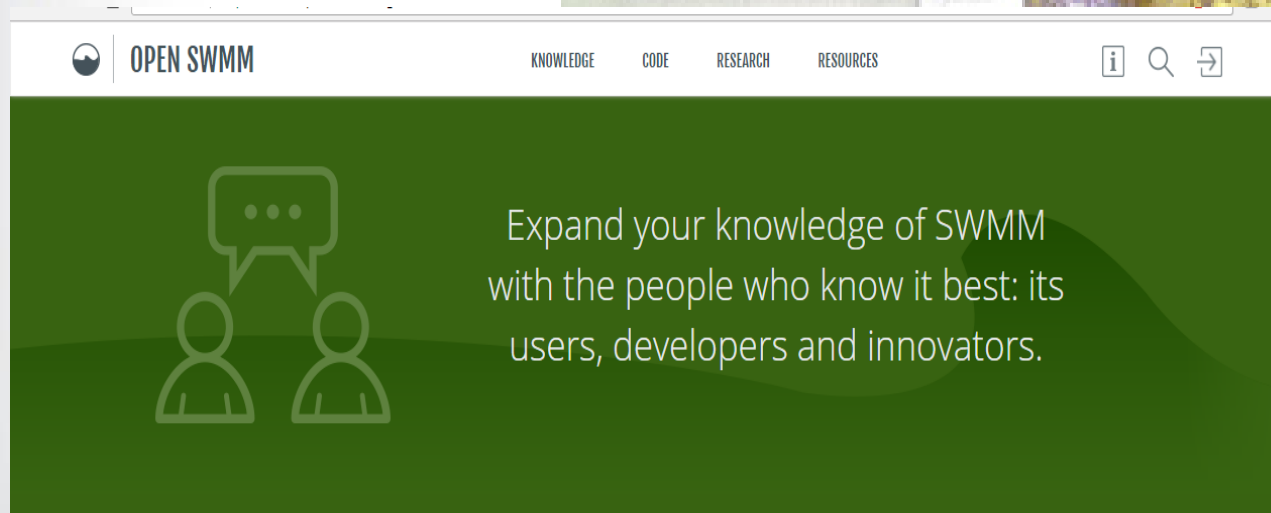
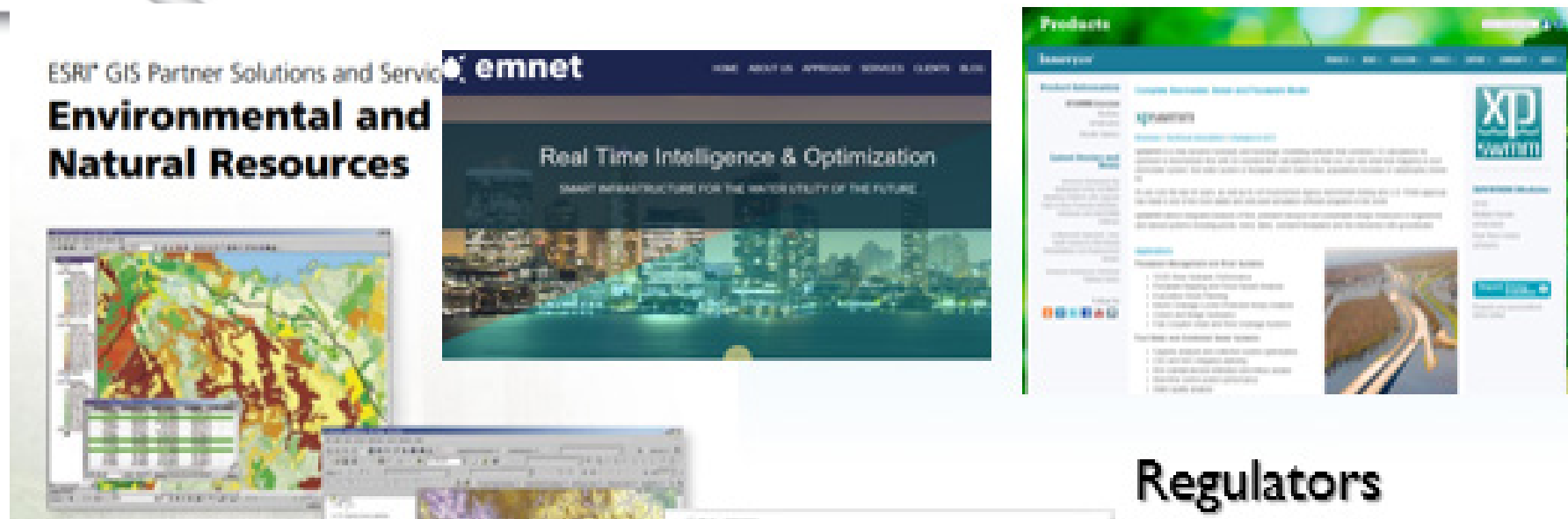
Generating non-point source pollutant loadings for waste load allocation studies.

Evaluating green infrastructure.



SWMM – Many stakeholders

Downloaded >30,000 annually



Regulators
Communities,
Utilities,
Private industry,
Consultants,
Academia

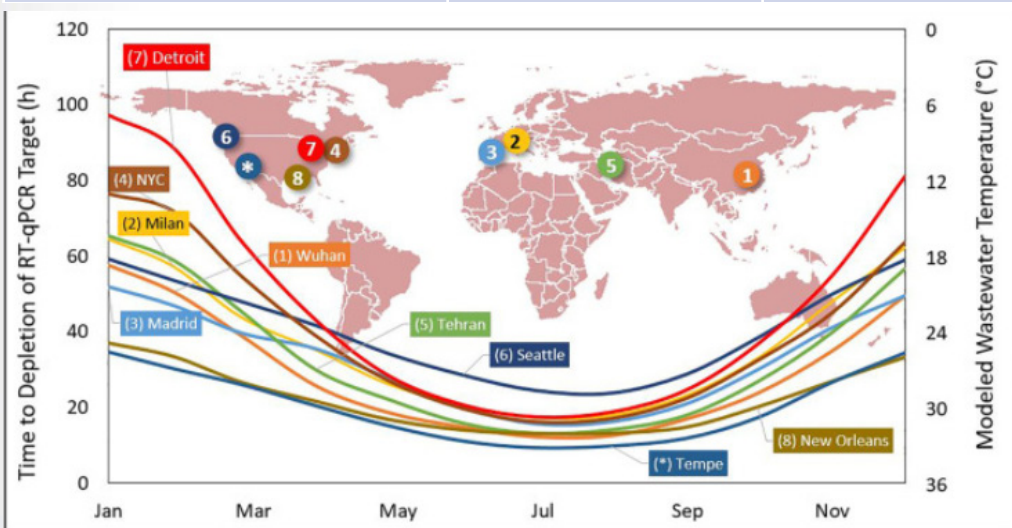


Jay Garland, Nichole Brinkman, Greater Cincinnati Water Works

Using SWMM to calculate COVID detection

Estimated kinetic parameters of SARS-CoV-2 attenuation in wastewater at ambient temperature

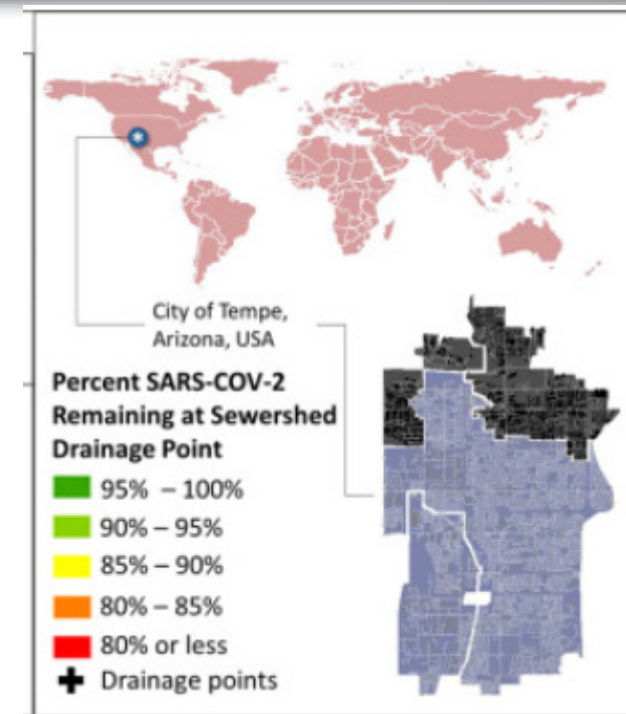
Time to 99.9% reduction (hours)	Half-Life, $t_{1/2}$ (hours)	Mean Lifetime, τ (hours)	Decay constant, λ
48	4.82	6.95	0.143
72	7.22	10.4	0.096



Brinkman.Nichole@epa.gov

<https://www.epa.gov/water-research/water-research-webinar-series>

<https://www.epa.gov/healthresearch/research-covid-19-environment>



Olga E. Hart, Rolf U. Halden, 2020 Computational analysis of SARS-CoV-2/COVID-19 surveillance by wastewater-based epidemiology locally and globally: Feasibility, economy, opportunities and challenges, Science of The Total Environment, Volume 730, 2020

<https://doi.org/10.1016/j.scitotenv.2020.138875>



Community Development

<https://github.com/USEPA/Stormwater-Management-Model>

SWMM 5.1.015 July 2020

Browser address bar: <https://github.com/USEPA/Stormwater-Management-Model>

USEPA / Stormwater-Management-Model

Watch 32 Star 74 Fork 100

Code Issues 23 Pull requests Actions Projects Wiki Security Insights

develop 5 branches 16 tags

michaeltryby Merge

.github/workflows

bindings

extern

src

tests

.gitignore

Build.md

CMakeLists.txt

README.md

ReleaseNotes.txt

OpenWaterAnalytics / Stormwater-Management-Model
forked from USEPA/Stormwater-Management-Model

<https://github.com/OpenWaterAnalytics/Stormwater-Management-Model>

Code Issues 46 Pull requests 4 Actions Projects 4 Wiki Security Insights

develop 15 branches 17 tags

Go to file

Add file

Code

This branch is 1000 commits ahead, 171 commits behind USEPA:develop.

Pull request Compare



michaeltryby Merge pull request #317 from OpenWaterAnalytics/master

84f2994 28 days ago 1,053 commits

.github/workflows	Update build-test.yml	last month
ci-tools @ a3d6d55	Updating ci-tools	last month
docs	Work in progress	last month
extern	Refactoring build system	7 months ago
src	swmm-output rolling back void * pointer to handle	2 months ago
tests	Updating header notes	29 days ago

About

Open Water Analytics Stormwater
Management Model repository

toolkit modeling hydrology
hydraulics stormwater swmm5

Readme

View license

Releases 17

OWA SWMM v5.1.13 Latest
7 days ago

+ 16 releases



EPA_updates.txt 2018-2021

Preissmann Slot

Individual Subcatchment Infiltration

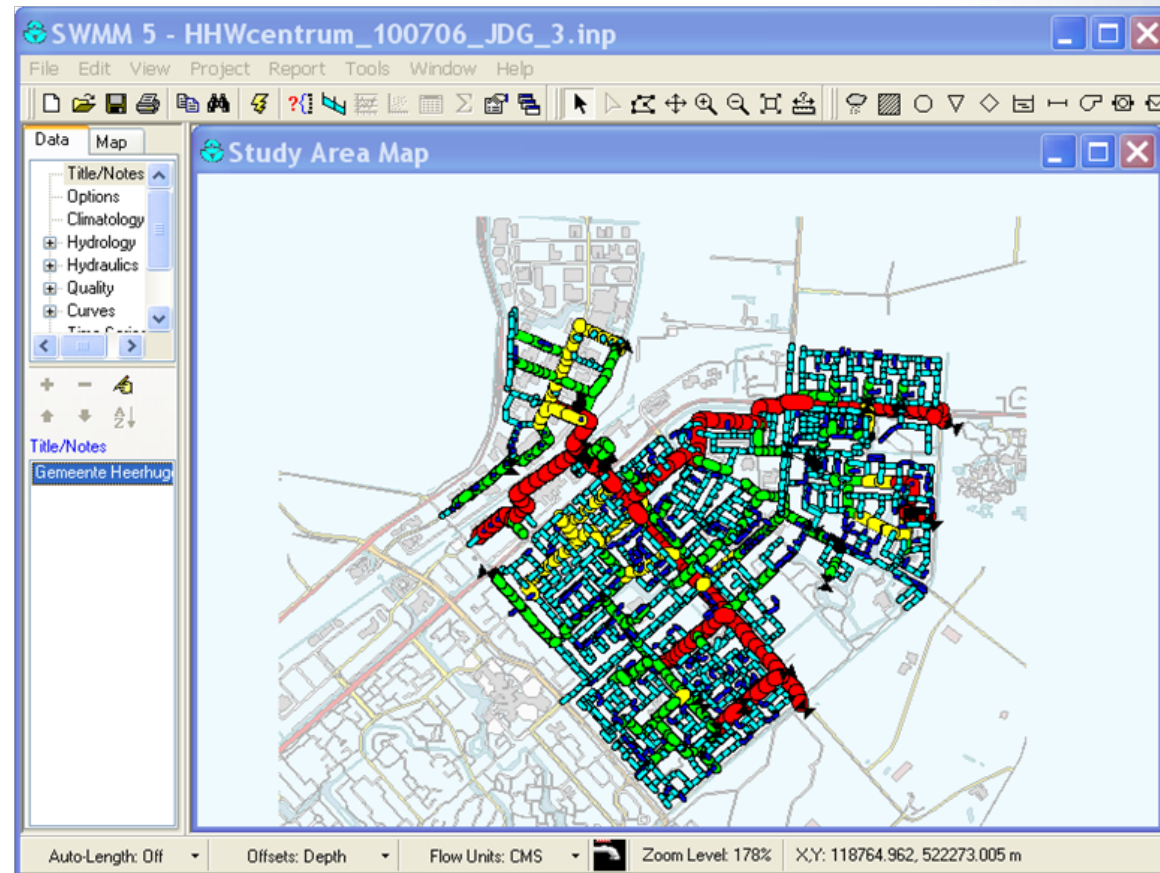
Dual Drainage

Storage Unit Shapes

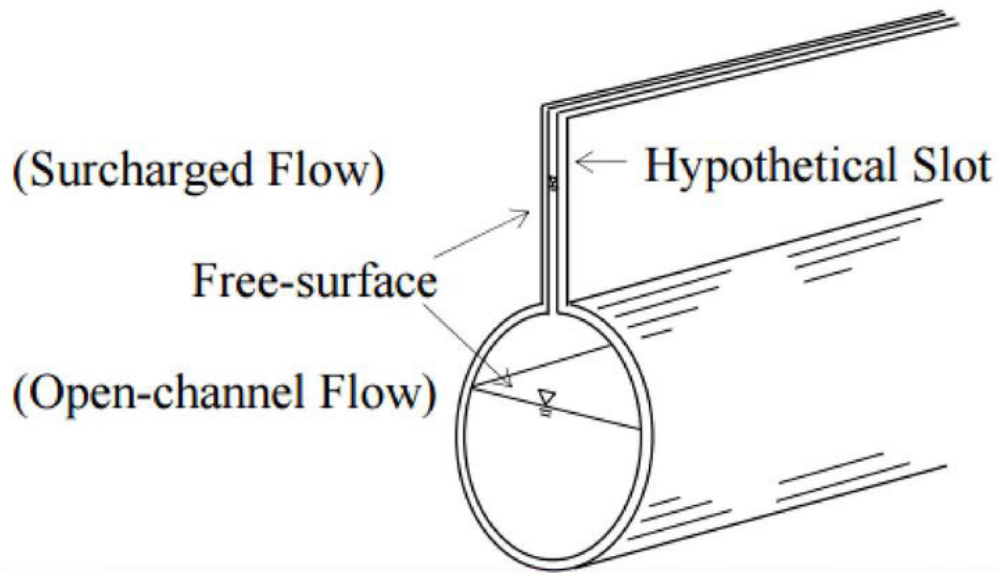
Variable Speed Pumps

New Control Rule Features

GIS Import - World Coordinates



Preissmann Slot Concept



$$w_{slot} = gA/c^2$$

$$w_{slot}/W_{max} = 0.5423 \exp\left(-\left(Y/Y_{full}\right)^{2.4}\right)$$

EPA SWMM 5.1.013

getSlotWidth

```

//// New function added to release 5.1.013. //// // (5.1.013)

double getSlotWidth(TXsect* xsect, double y)
{
    double yNorm = y / xsect->yFull;

    // --- return 0.0 if slot surcharge method not used
    if (SurchargeMethod != SLOT || xsect_isOpen(xsect->type) ||
        yNorm < CrownCutoff) return 0.0;

    // --- for depth > 1.78 * pipe depth, slot width = 1% of max. width
    if (yNorm > 1.78) return 0.01 * xsect->wMax;

    // --- otherwise use the Sjöberg formula
    return xsect->wMax * 0.5423 * exp(-pow(yNorm, 2.4));
}
    
```

Original reference (Cunge and Wegner, 1964)
modified version of a formula proposed by Sjöberg (1982))

Photo credit

https://www.google.com/search?rlz=1C1SQJL_enUS938US938&source=univ&tbm=isch&q=images+for+the+preissman+slot&sa=X&ved=2ahUKEwij5bHizKbvAhVrGVkFHYUWDOsQ7Al6BAgFEBA&biw=2000&bih=986#imgrc=N_6wsL9eiqeztM



Mix of Infiltration Methods

SWMM 5.1 - pipe2020408.inp

File Edit View Project Report Tools Window Help

Project Map

- Title/Notes
- Options
- Climatology
- Hydrology
 - Rain Gages
 - Subcatchments
 - Aquifers
 - Snow Packs
 - Unit Hydrographs
 - LID Controls
- Hydraulics
- Quality
- Curves
- Time Series
- Time Patterns
- Map Labels

Study Subcatchment 1

Property	Value
Name	1
X-Coordinate	527851.684
Y-Coordinate	3902393.730
Description	
Tag	
Rain Gage	Weir-Fourplex
Outlet	196
Area	0.71
Width	82.79
% Slope	5.300
% Imperv	15.1
N-Imperv	0.011
N-Perv	0.24
Dstore-Imperv	0.05
Dstore-Perv	0.05
%Zero-Imperv	25.0
Subarea Routing	OUTLET
Percent Routed	100
Infiltration Data	GREEN_AMPT ...
Groundwater	NO

Bluebell

04/08/2020

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	110
Conductivity	6.200
Initial Deficit	0.412

Soil capillary suction head (inches or mm)

OK Cancel Help

Inlets convey runoff from street pavements into below ground storm sewers.

Inlet type, sizing and spacing chosen to meet limits on spread & depth of water on pavement.

FHWA “Urban Drainage Design Manual” (HEC-22) is the de facto standard for inlet analysis.



Factors Affecting Inlet Flow Capture

On-Grade Grates:

- Approach flow rate, velocity & spread
- Street cross slope & curb depression
- Grate width & length



On-Grade Curb Openings:

- Approach flow rate
- Street slope, cross slope, roughness & curb depression
- Opening length



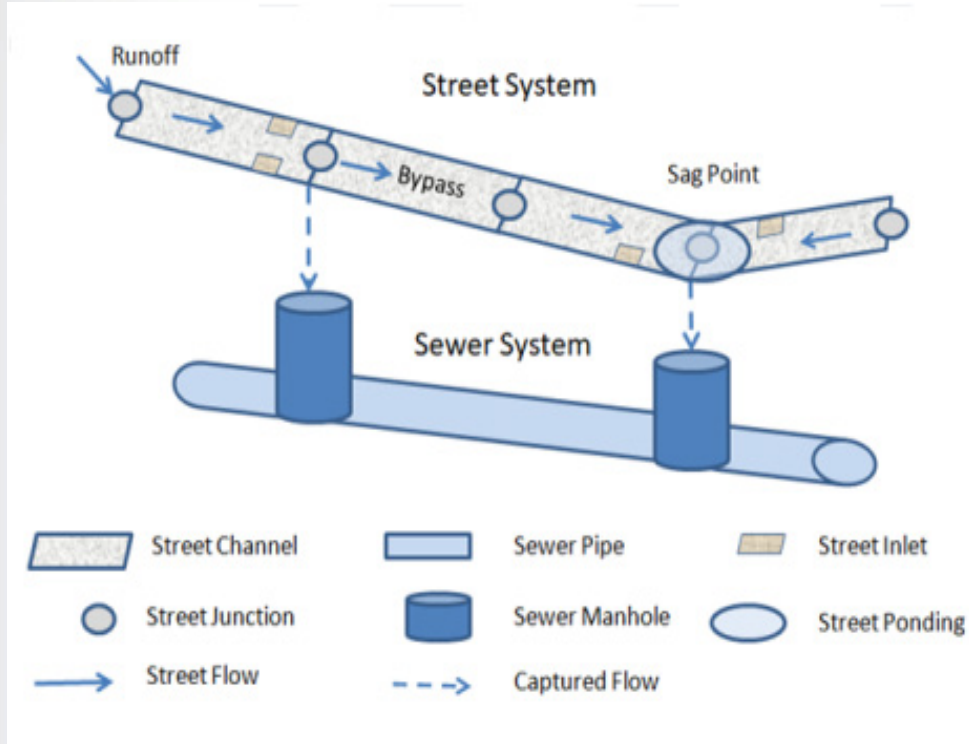
On-Sag Inlets:

- Depth of water at curb
- Grate width, length & area of openings
- Curb opening length & height





Modeling a Dual Drainage System



Methods for Modeling Dual Drainage Systems

Flow divider nodes

Shared nodes with offset

Orifice or outlet links

Lateral Flow Adjustment

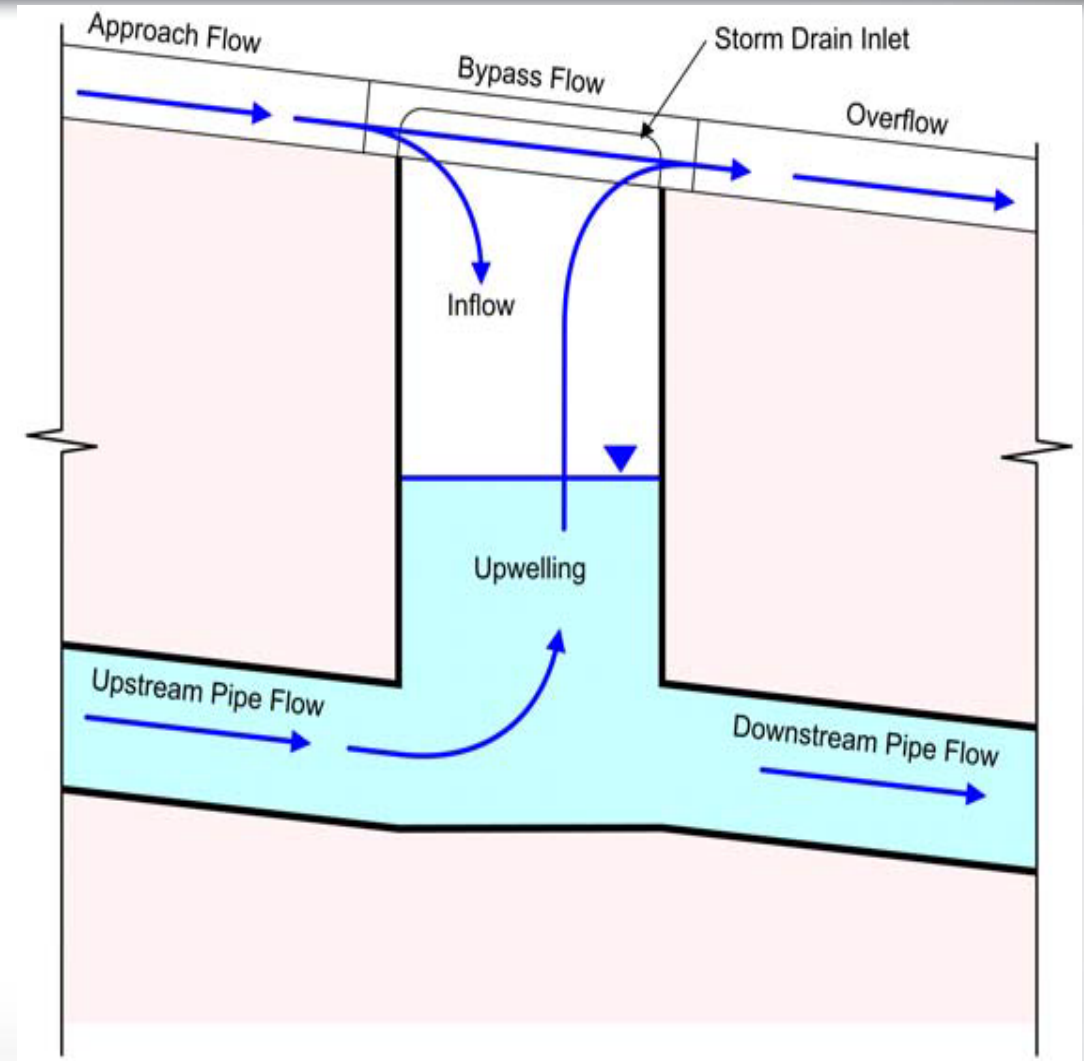
Original Source: FHWA "Urban Drainage Design Manual" (HEC-22)



Inlet Analysis Using Lateral Flow Adjustment

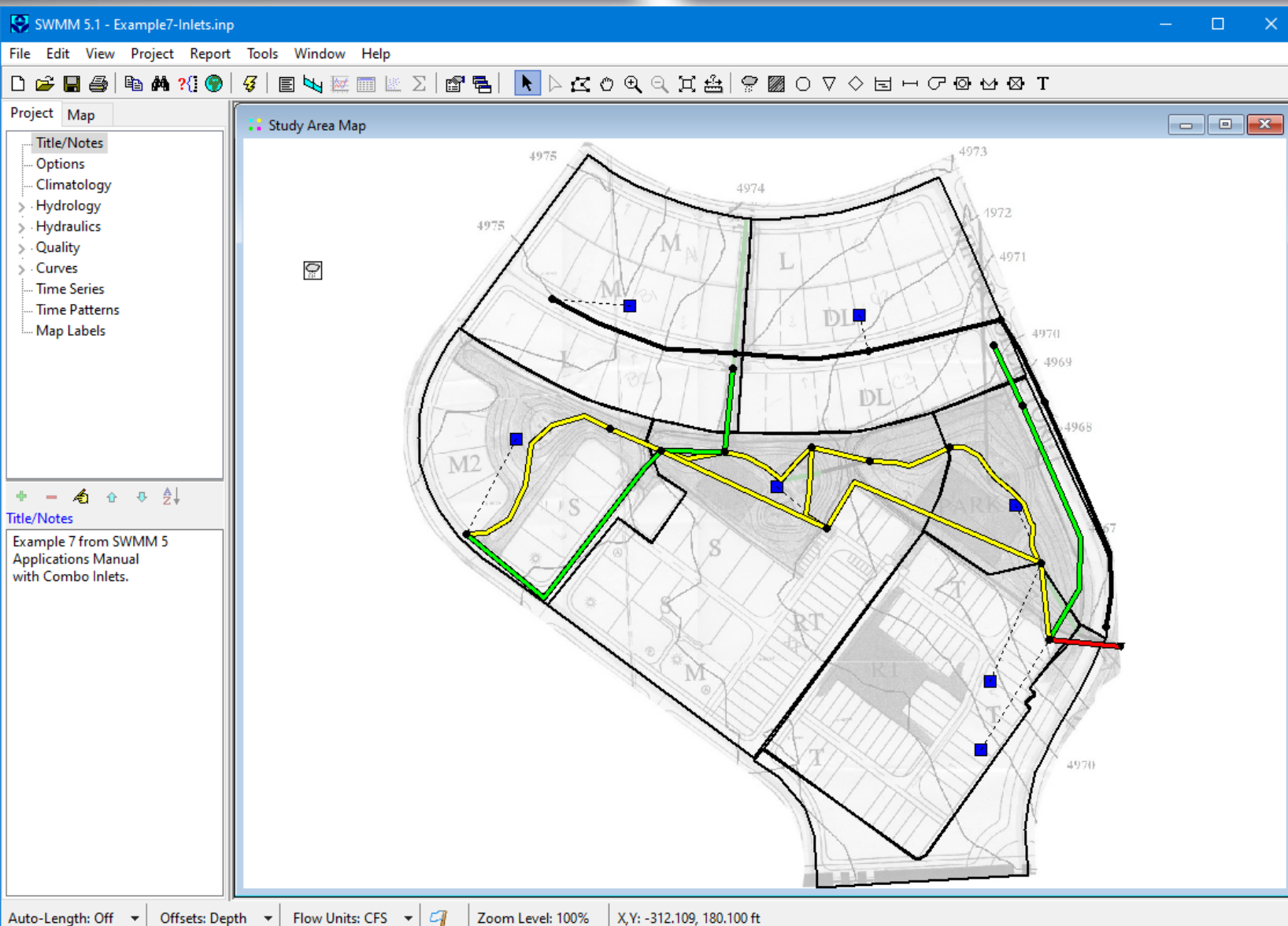
At each flow routing time step:

- Compute each inlet's flow capture (Q_c) using HEC-22 methods
- Add Q_c to sewer node's lateral inflow
- Subtract Q_c from lateral inflow to inlet's street node
- Add any sewer node overflow to street node's lateral inflow
- Apply usual flow routing procedure





Step I - Layout the street and sewer networks





Step 2 - Create a collection of Street cross-sections

SWMM 5.1 - Example7-Inlets.inp

File Edit View Project Report Tools Window Help

Project Map

Study Area Map

Streets

- HalfStreet
- FullStreet

Street Section Editor

Street Section Name: HalfStreet

Required

Road Width (Tcrown)	20	ft
Curb Height (Hcurb)	0.5	ft
Cross Slope (Sx)	4	%
Road Roughness	0.016	

☒ One Sided ☐ Two Sided

Optional

Gutter Depression (a)	0	ft
Gutter Width (W)	0	ft
Backing Width (Tback)	20	ft
Backing Slope (Sback)	4	%
Backing Roughness	0.016	

OK Cancel Help

Auto-Length: Off Offsets: Depth Flow Units: CFS Zoom Level: 100% X,Y: 76



Step 3 - Assign Street cross-sections to street conduits

SWMM 5.1 - Example7-Inlets.inp

File Edit View Project Report Tools Window Help

Project Map

- Title/Notes
- Options
- Climatology
- Hydrology
- Hydraulics
 - Nodes
 - Links
 - Conduits
 - Pumps
 - Orifices
 - Weirs
 - Outlets
 - Streets
 - Inlets
 - Transects
 - Controls

Conduits

- Street1
- Street2
- Street3
- Street4
- Street5
- C3
- C4
- C5
- C6
- C7
- C8
- C9
- C10
- C11
- C_Aux3
- P1
- P2

Study Area Map

4972

49

Street3

DL

DL

DL

C3

Cross-Section Editor

Rectangular

Trapezoidal

Triangular

Parabolic

Power

Street

Irregular

Circular

Force Main

Street Section Name

FullStreet

Dimensions are feet unless otherwise stated.

OK Cancel Help

Open street cross section, either one or two sided

Auto-Length: Off Offsets: Depth Flow Units: CFS Zoom Level: 252% X,Y: 789.660, 932.093 ft



Step 4 - Create a collection of Inlet designs

SWMM 5.1 - Example7-Inlets.inp

File Edit View Project Report Tools Window Help

Project Map

Study Area Map

Inlet Structure Editor

Inlet Name:

Inlet Type:

Grate ☒ Curb Opening

Type:

Length: ft

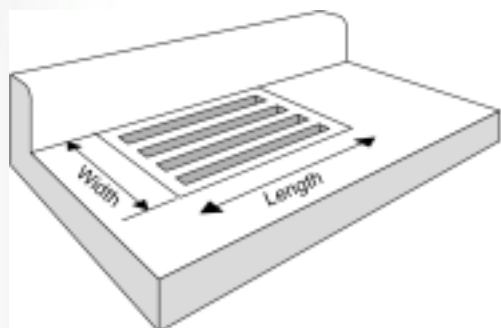
Width: ft

OK Cancel Help

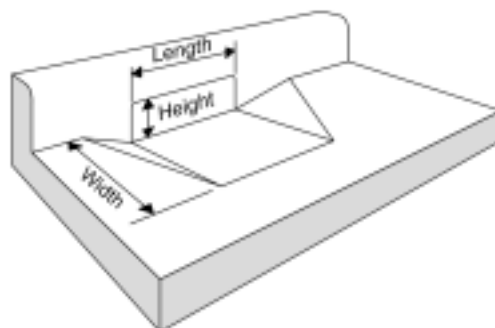
Auto-Length: Off Offsets: Depth Flow Units: CFS Zoom Level: 100% X,Y: -275,633, 18,238 ft

Supported Inlet Types

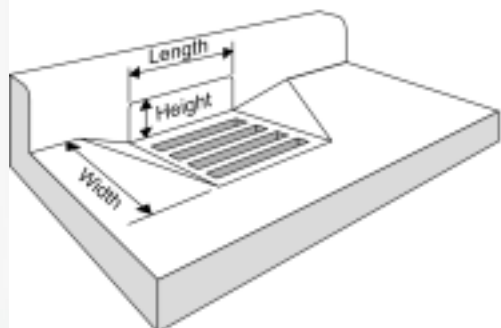
Curb & Gutter Inlets



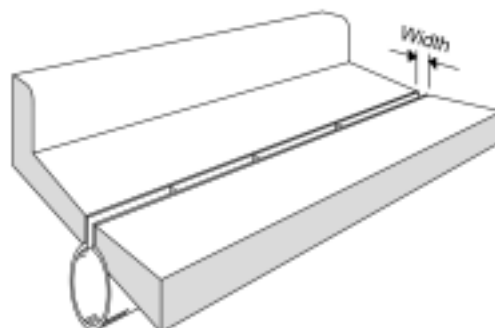
Grated Inlet



Curb-Opening Inlet

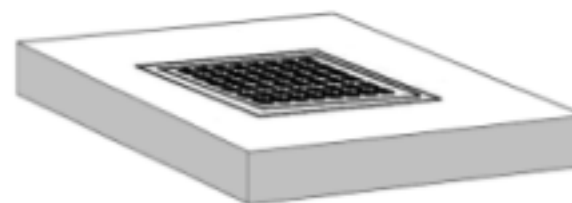


Combination Inlet



Slotted Drain Inlet

Drop Inlets

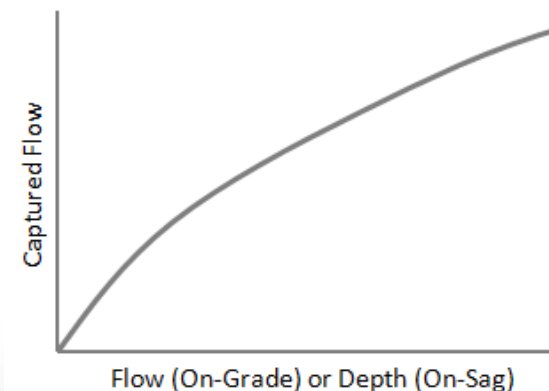


Drop Grate Inlet



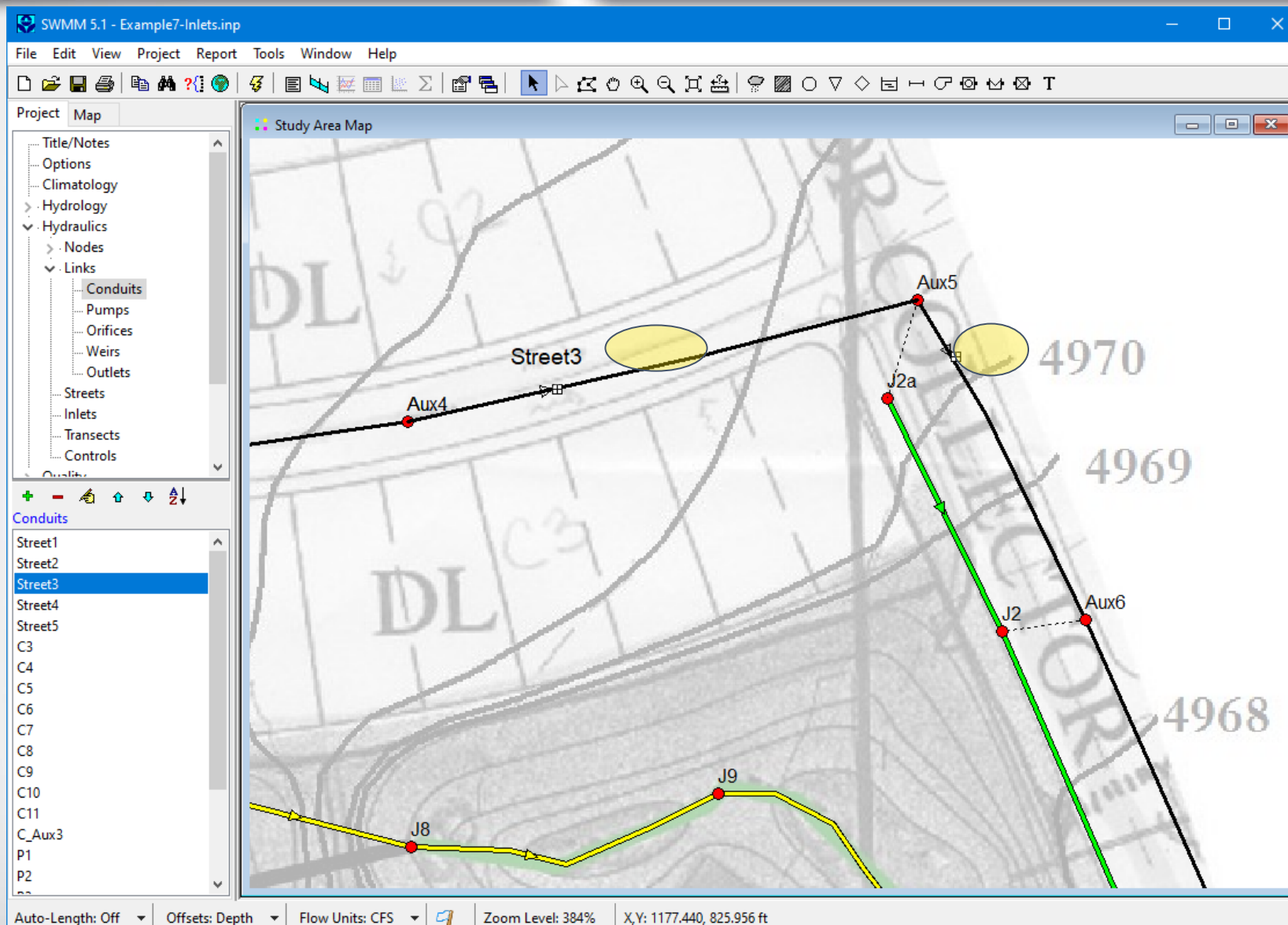
Drop Curb Inlet

Custom Inlet





Step 5 - Assign Inlet designs to streets



Inlet for Conduit Street3

Property	Value
Inlet Structure	CombInlet
Capture Node	J2a
Number of Inlets	1
Percent Clogged	0
Flow Restriction	0
Depression Height	0
Depression Width	0
Inlet Placement	AUTOMATIC

Name of inlet structure to use.
Select blank entry to remove inlet.

OK Cancel Help



Step 6 - Run an analysis and view the Street Flow Summary Report

SWMM 5.1 - Example7-Inlets.inp

File Edit View Project Report Tools Window Help

Project Map

Title/Notes

- Options
- Climatology
- > Hydrology
- > Hydraulics
- > Quality
- > Curves
- Time Series
- Time Patterns
- Map Labels

Study Area Map

Summary Results

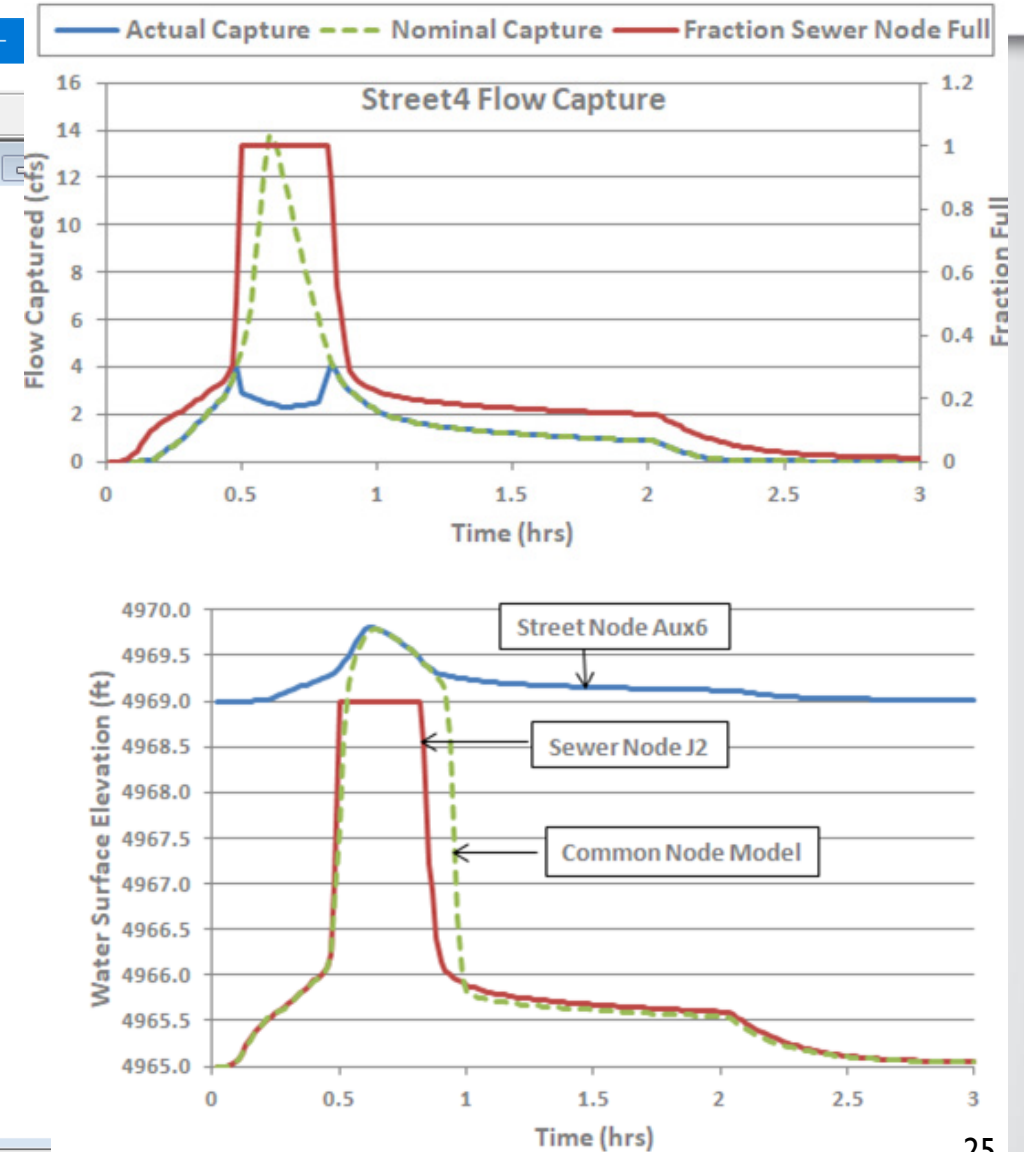
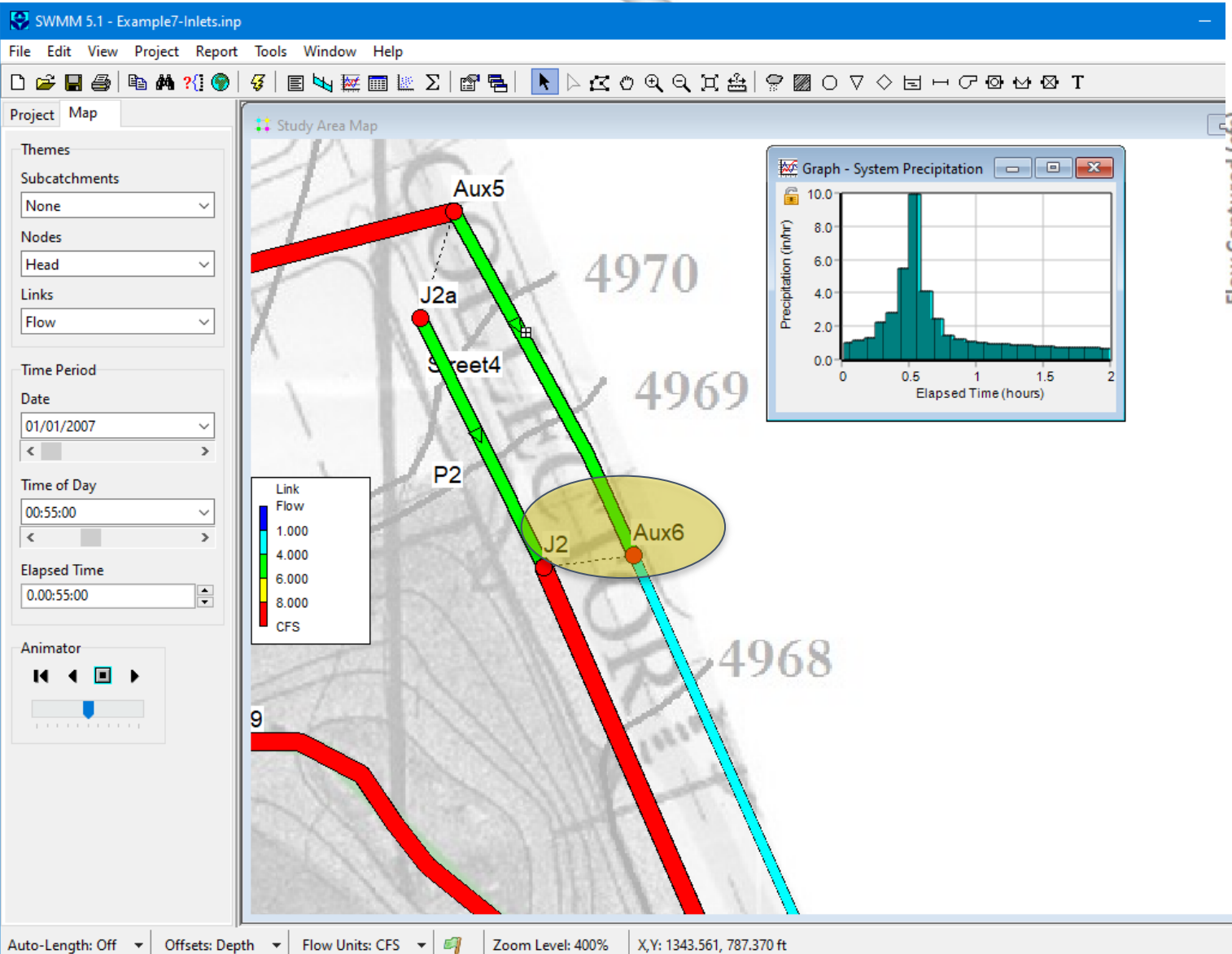
Topic: Street Flow Click a column header to sort the column.

Street Conduit	Peak Flow CFS	Maximum Spread ft	Maximum Depth ft	Inlet Structure	Peak Flow Capture %	Average Capture %	Bypass Frequency %	Backflow Frequency %
Street1	37.33	19.99	0.65	ComboInlet	17.06	67.86	88.77	0.00
Street2	25.79	23.32	0.72					
Street3	59.91	28.22	0.83	ComboInlet	14.85	62.93	90.10	0.00
Street4	49.36	28.11	0.82	ComboInlet	4.94	64.30	86.82	0.00
Street5	45.02	30.73	0.93	ComboInlet	70.65	92.04	22.96	0.00

Auto-Length: Off Offsets: Depth Flow Units: CFS Zoom Level: 100% X,Y: -312.109, 180.100 ft



Reduced Capture Due to Full Manhole





Control Rule Enhancements

**Control rule premise clauses expanded to include:
additional control parameters**

- rain gage current rainfall & next rainfall
- node full depth, volume, head
- conduit length, slope, full depth, full flow, velocity



named variables as aliases for Object - ID - Property

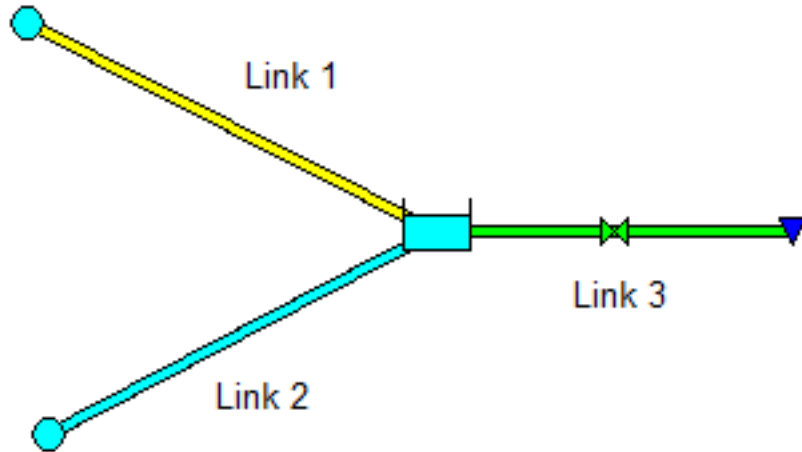
Variable N23 = Node 23 Depth

math expressions containing named variables

Expression $HGL = \text{abs}(H23.1 - H23.2) / L23$

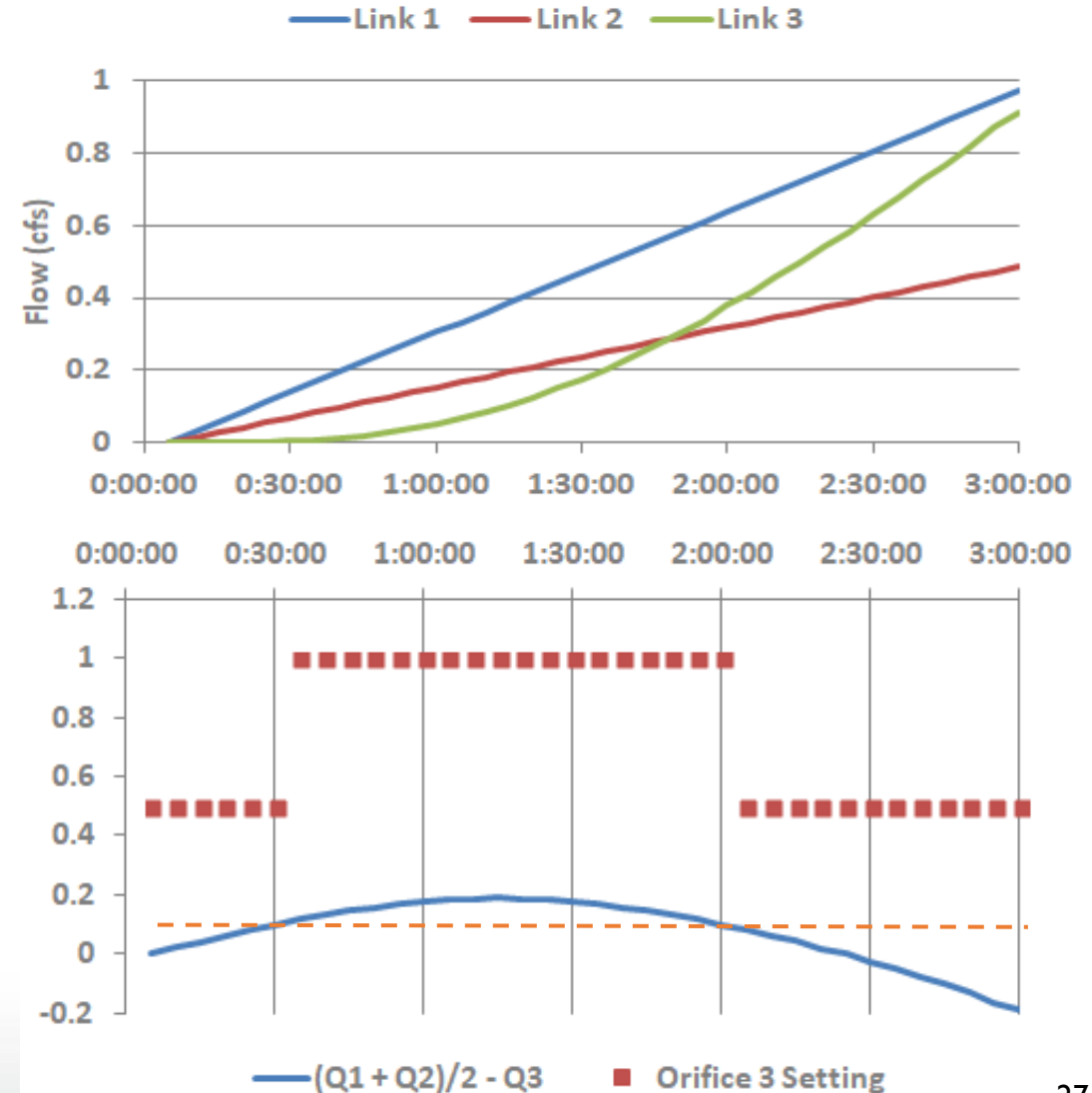


Example of Enhanced Control Rule



```
[RULES]
variable  Q1 = LINK 1 FLOW
variable  Q2 = LINK 2 FLOW
variable  Q3 = LINK 3 FLOW
expression Net_Inflow = (Q1 + Q2)/2 - Q3

rule 1
if Net_Inflow > 0.1
then ORIFICE 3 Setting = 1
else ORIFICE 3 Setting = 0.5
```





Variable Pump Speeds

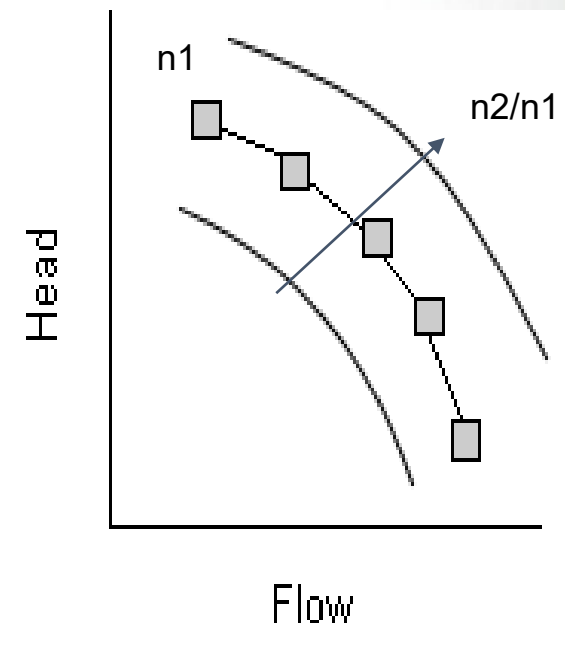
Requires a Head (H) v. Flow (Q) performance curve that obeys the pump affinity laws:

$$Q2 / Q1 = n2 / n1 \quad H2 / H1 = (n2 / n1)^2$$

These determine how the curve shifts as impeller speed changes from a nominal value $n1$ to $n2$.

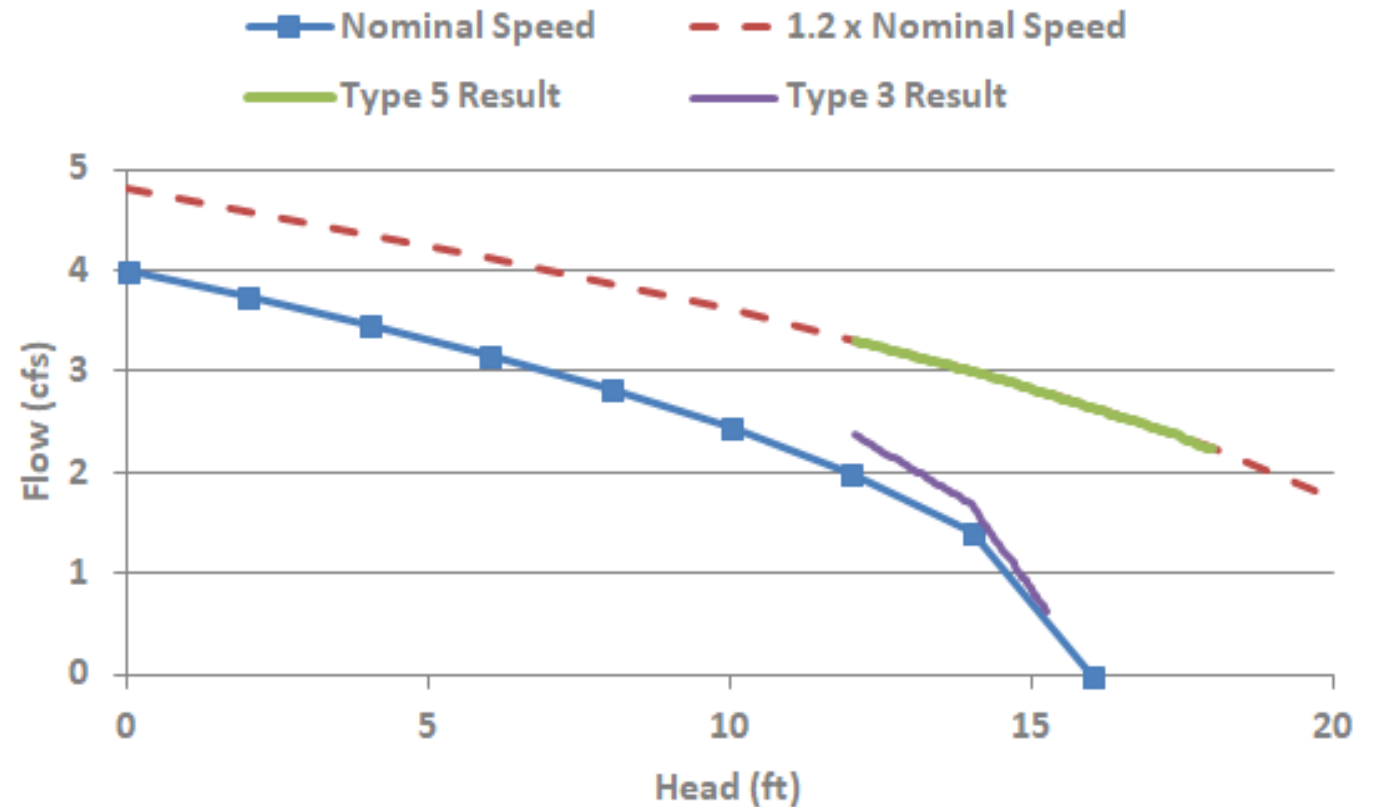
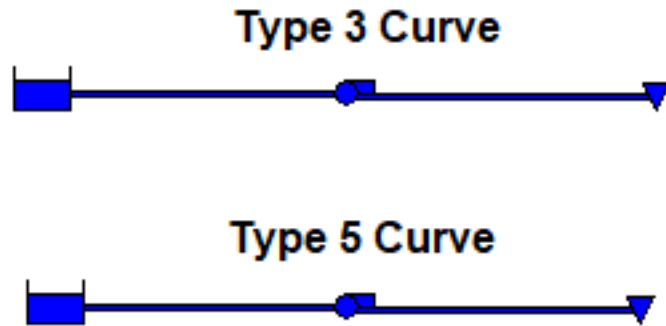
SWMM's Type 3 Pump uses a H-Q curve that only follows the flow affinity law as its speed setting is changed.

A new Type 5 pump has been introduced that obeys both affinity laws.





New Type 5 Pump Curve v. Existing Type 3 Curve



If Simulation Time = 0

Then Pump Type3 Setting = 1.2

And Pump Type5 Setting = 1.2



Storage Unit Curves

SWMM represents storage unit shapes with a surface area v. depth curve.

Either a tabular listing of area & depth points or a functional formula:

$$\text{Area} = A0 + A1 * \text{Depth}^{A2}$$

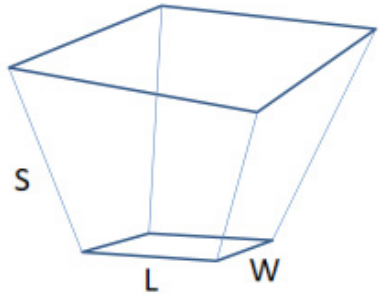
can be used.

The functional option cannot represent common regular shapes where all sides are sloping (e.g., truncated pyramids).



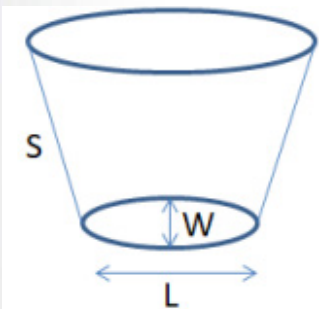


New Functional Storage Curves Added



Truncated Rectangular Pyramid:

$$\text{Area} = L*W + 2*(L+W) * S*\text{Depth} + 4*(S*\text{Depth})^2$$



Truncated Elliptical Cone:

$$\text{Area} = \text{PI} * (L*W + 2*W*S*\text{Depth} + (W/L)(S*\text{Depth})^2)$$

Storage Shape Editor

Select a type of storage unit shape and provide its parameters:



Functional



Conical



Pyramidal



Tabular

Truncated Rectangular Pyramid

Base Length

Base Width

Side Slope (Run / Rise)

OK

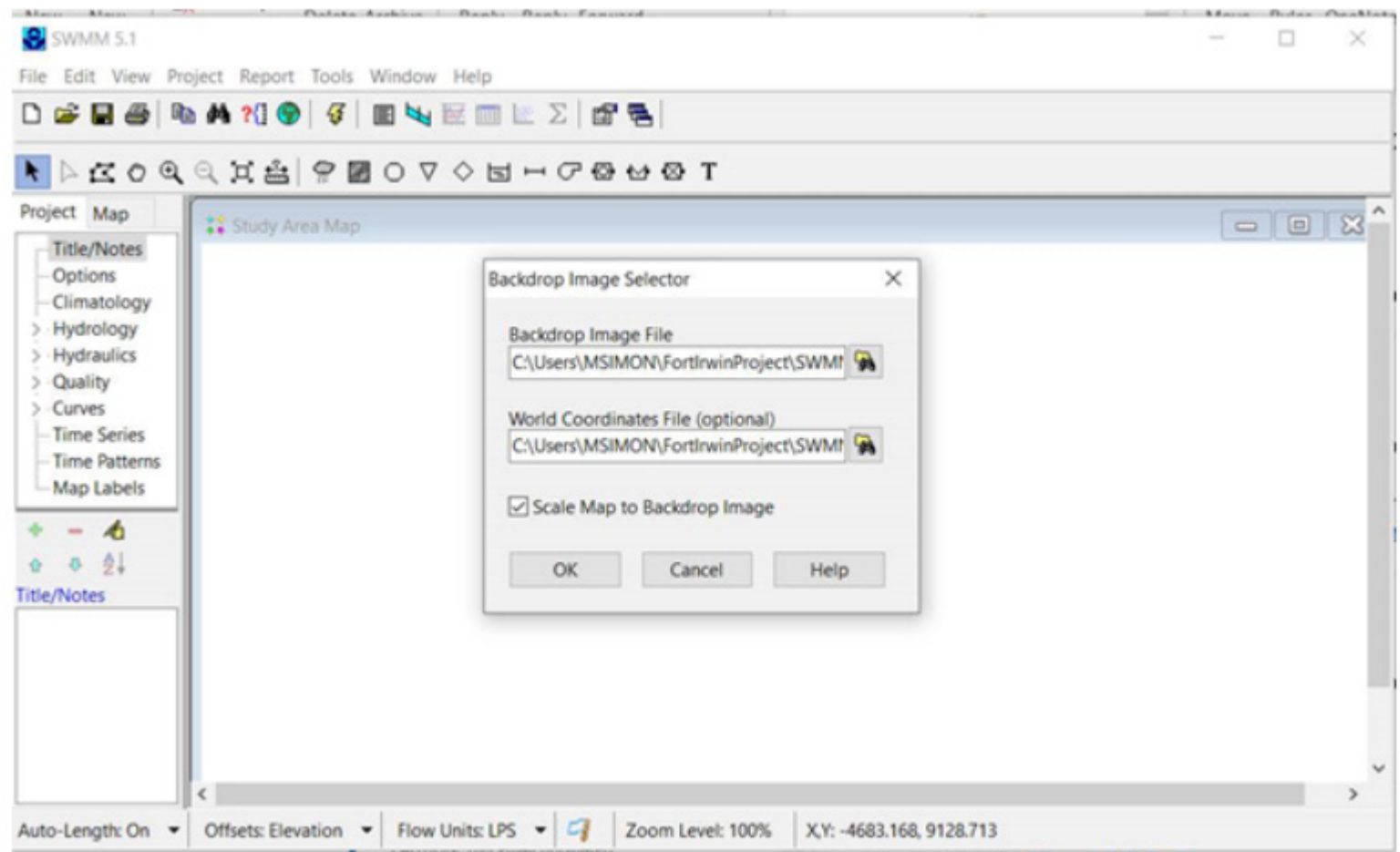
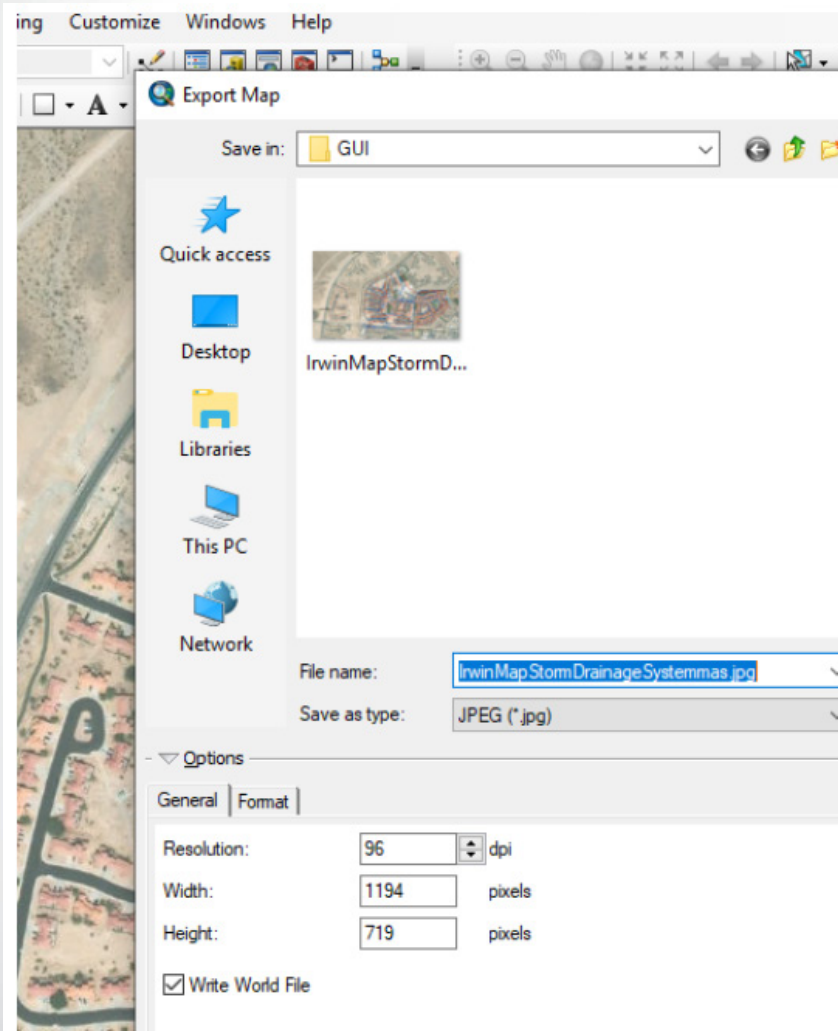
Cancel

Help



Import Geo Referenced Map

<https://www.openswmm.org/Topic/27275/how-to-import-a-georeferenced-swmm-backdrop-with-world-coordinates-from-an-arcgis-map-into-swmm>





SWMM Reference Manuals

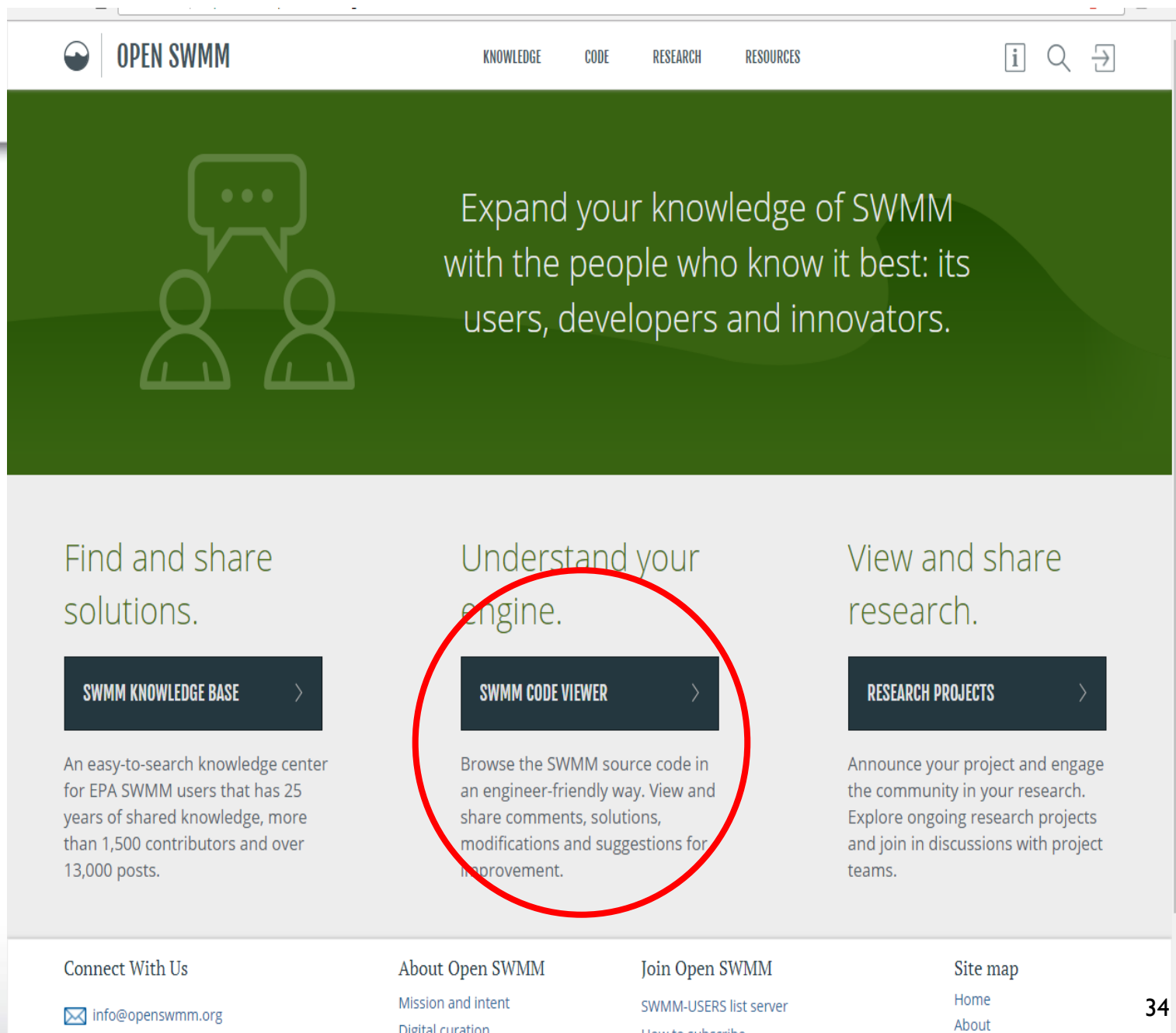
<https://www.epa.gov/water-research/storm-water-management-model-swmm>

Manuals and Guides

Date	Title
09/30/2015	SWMM 5.1 User's Manual
09/01/2014	SWMM-CAT User's Guide
09/07/2016	SWMM Applications Manual (ZIP) (7 MB)
01/18/2018	SWMM Modeling Methods for Simulating Green Infrastructure at a Suburban Headwatershed: User's Guide
03/19/2019	SWMM Reference Manuals Errata (Volumes I and II)
01/29/2016	SWMM Reference Manual Volume I—Hydrology
08/07/2017	SWMM Reference Manual Volume II—Hydraulics
09/08/2016	SWMM Reference Manual Volume III—Water Quality (Includes the LID Module references)



<https://www.openswmm.org/>



The screenshot shows the Open SWMM website. The header includes the 'OPEN SWMM' logo and navigation links for KNOWLEDGE, CODE, RESEARCH, and RESOURCES. A green banner at the top features an icon of two people talking and the text: 'Expand your knowledge of SWMM with the people who know it best: its users, developers and innovators.' Below this, three main sections are displayed: 'Find and share solutions.' with a 'SWMM KNOWLEDGE BASE' button, 'Understand your engine.' with a 'SWMM CODE VIEWER' button (circled in red), and 'View and share research.' with a 'RESEARCH PROJECTS' button. Each section has a brief description of its content. The footer contains contact information, about pages, and a site map.

OPEN SWMM KNOWLEDGE CODE RESEARCH RESOURCES

Expand your knowledge of SWMM with the people who know it best: its users, developers and innovators.

Find and share solutions.

SWMM KNOWLEDGE BASE >

An easy-to-search knowledge center for EPA SWMM users that has 25 years of shared knowledge, more than 1,500 contributors and over 13,000 posts.

Understand your engine.

SWMM CODE VIEWER >

Browse the SWMM source code in an engineer-friendly way. View and share comments, solutions, modifications and suggestions for improvement.

View and share research.

RESEARCH PROJECTS >

Announce your project and engage the community in your research. Explore ongoing research projects and join in discussions with project teams.

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Digital curation

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SWMM Code Viewer

Understand your engine.

EPA SWMM 5.1.015 vs EPA SWMM 5.1.013



Code comparison summary

[Collapse all](#)

— ADDED (2)

1. grnampt_getParams +
2. report_RouteStepFreq +

— EDITED (96)

1. adjustSubareaParams ○
2. conduit_getLossRate ○
3. conduit_initState ○
4. consts.h ○
5. createObjects ○
6. datetime.h ○
7. dwflow.c ○
8. dwflow_findConduitFlow ○
9. dynwave.c ○
10. enums.h ○
11. error.c ○
12. error.h ○
13. execRouting ○
14. exfil.h ○

EPA SWMM 5.1.015 ▾

vs. EPA SWMM 5.1.013

[About this Engine](#)[Code Roadmap](#)[Visual Code Explorer](#)

Search



headers.h

▸ hotstart.c ○

▸ iface.c

▾ infil.c ○

curvenum_getInfil

curvenum_getState

curvenum_initState

curvenum_setParams

curvenum_setState

grnampt_getF2

grnampt_getInfil

grnampt_getParams +


grnampt_getSatInfil

grnampt_getState




grnampt_getUnsatInfil




<https://www.openswmm.org/>

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An easy-to-search knowledge center for EPA SWMM users that has 25 years of shared knowledge, more than 1,500 contributors and over 13,000 posts.

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DISCUSSIONS

LID controls
15 Mar 2021 | Mariana de Lara

Permeable Pavers Infiltration: conductivity of joints
12 Mar 2021 | Jasmin Eggert, Lew Rossman

Modeling of SWALE on highway in SWMM
12 Mar 2021 | Rikin Patel

What shapefile layer do cross sections belong in
11 Mar 2021 | Elizabeth Fernandez

LID - no evaporation during times of surface infiltration

REFERENCE DOCUMENTATION

DISCUSSIONS

HOT TOPICS

DOCUMENTED BUGS

FEATURE REQUESTS

EXAMPLE MODELS

BE PART OF THE CONVERSATION:
To ask, add or contribute to the Knowledge Base, please join the SWMM-USERS email discussion group.

EPA SWC – Storm Water Calculator

Precipitation/Evaporation

Directions >

Select a rain gage location to use as a source of hourly rainfall data and a weather station to use as a source for evaporation rates.

Select the checkbox if you would like the...

Rain Gage:

TUCSON CAMP AVE EXP FM ▼

Weather Station:

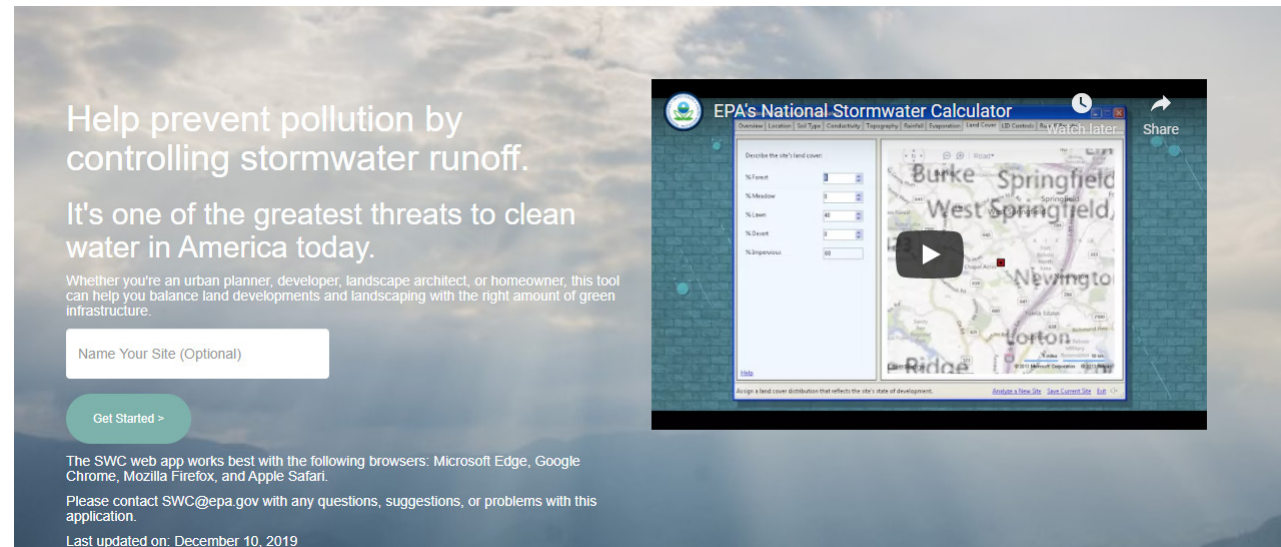
TUCSON CAMP AVE EXP FM ▼

Rainfall and Evaporation Information:

Record Start Date: 1970/01/01
Record End Date: 2005/12/31
Annual Rainfall: 11.99

[Download rainfall/evaporation data](#)

[Help](#)





BASINS Flat Files
1970-2006




SWMM is the engine for SWC

<https://www.epa.gov/water-research/national-stormwater-calculator>

EPA\ORISE Updated Historical Data – COOP and ISD 2006-2019 append 2020 later



 barrc Add network to Station and other small changes Latest commit 1be74d0 on Nov 24, 2020  History

1 contributor COOP: https://github.com/barrc/get_ncei/blob/master/src/coop_stations_to_use.csv




1860 lines (1860 sloc) 185 KB Raw Blame   

Search this file...

	station_id	station_name	state	start_date	end_date	latitude	longitude	in_basins	break_with_basins	network
1	USC00010008	ABBEVILLE	AL	1948-06-01 00:00:00	2018-04-18 00:00:00	31.5702	-85.2482	True	False	coop
2	USC00010063	ADDISON	AL	1948-06-01 00:00:00	2020-08-06 00:00:00	34.2553	-87.1814	True	False	coop
3	USC00010140	ALBERTA	AL	1963-09-26 00:00:00	2020-08-01 00:00:00	32.2322	-87.4104	True	False	coop
4	USC00010252	ANDALUSIA 3 W	AL	1980-03-01 00:00:00	2018-02-05 00:00:00	31.3071	-86.5226	True	False	coop
5	USC00010369	ASHLAND 3 ENE	AL	1948-06-01 00:00:00	2013-08-04 00:00:00	33.2941	-85.7788	True	False	coop

 barrc Don't use if station has < 1 year of new data (ex. 72582794190) Latest commit 2be3881 Dec 7, 2020  History

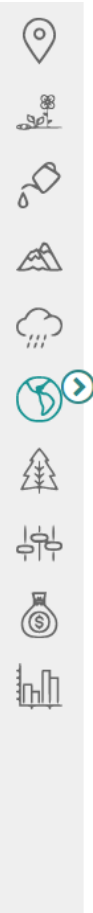
1 contributor ISD: https://github.com/barrc/get_ncei/blob/master/src/isd_stations_to_use.csv

3295 lines (3295 sloc) 349 KB Raw Blame   

Search this file...

	station_id	station_name	state	start_date	end_date	latitude	longitude	in_basins	break_with_basins	network
1	69015093121	TWENTY NINE PALMS	CA	1990-01-02 00:00:00	2020-10-15 00:00:00	+34.300	-116.167	False	False	isd
2	69017099999	IND SPRNG RANGE 63	NV	1980-05-14 00:00:00	2008-12-31 00:00:00	+36.533	-115.567	False	False	isd
3	69019013910	ABILENE DYESS AFB	TX	1943-12-01 00:00:00	2009-12-31 00:00:00	+32.433	-99.850	False	False	isd
4	69023024255	WHIDBEY ISLAND NAS	WA	1989-12-01 00:00:00	2009-06-02 00:00:00	+48.350	-122.667	False	False	isd
5	69026099999	CHEBOYGAN	MI	1980-06-11 00:00:00	2001-10-23 00:00:00	+45.650	-84.467	False	False	isd
6	69026099999	CHEBOYGAN	MI	1980-06-11 00:00:00	2001-10-23 00:00:00	+45.650	-84.467	False	False	isd

0. EPA SWC-CAT SWMM-CAT



Climate Change

Directions

Helpful Resources

- [Scenarios for Climate Assessment and Adaptation - Regions](#)
- [GlobalChange.gov - Regions & Topics](#)
- [US Environmental Protection Agency - Future of Climate Change](#)
- [World Climate Research Programme](#)

Select a future climate change scenario to apply:

- ☒ No Change
- ☐ Hot/Dry
- ☐ Median Change
- ☐ Warm/Wet

Select the time period to which the climate change scenario applies:

- ☒ Near Term (2020 - 2049)
- ☐ Far Term (2045 - 2074)

Print Charts to PDF
File

Help prevent pollution by
controlling stormwater runoff.

It's one of the greatest threats to clean
water in America today.

Whether you're an urban planner, developer, landscape architect, or homeowner, this tool can help you balance land developments and landscaping with the right amount of green infrastructure.

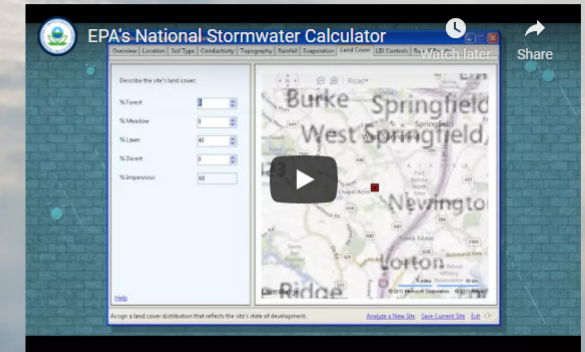
Name Your Site (Optional)

Get Started >

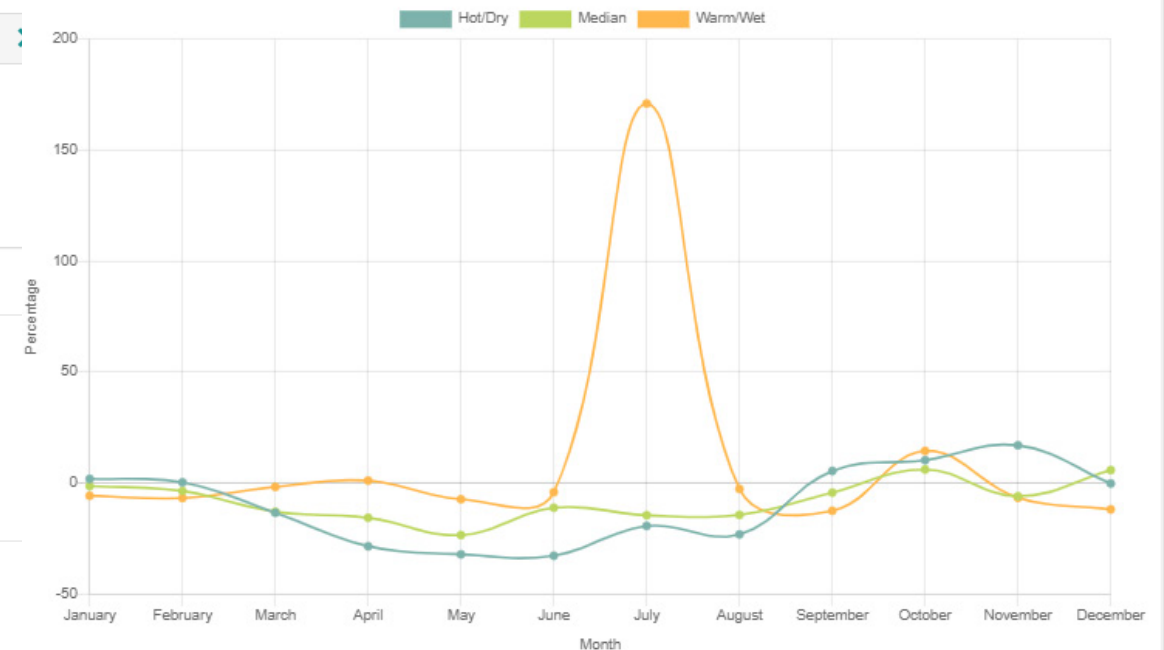
The SWC web app works best with the following browsers: Microsoft Edge, Google Chrome, Mozilla Firefox, and Apple Safari.

Please contact SWC@epa.gov with any questions, suggestions, or problems with this application.

Last updated on: December 10, 2019



Percentage Change in Monthly Rainfall for Near Term Projections



CREAT 2.0 vs 3.0

CREAT 2.0, 9-models, 0.5 by 0.5 degree

Near Term (2020 - 2049)

Far Term (2045 – 2074))

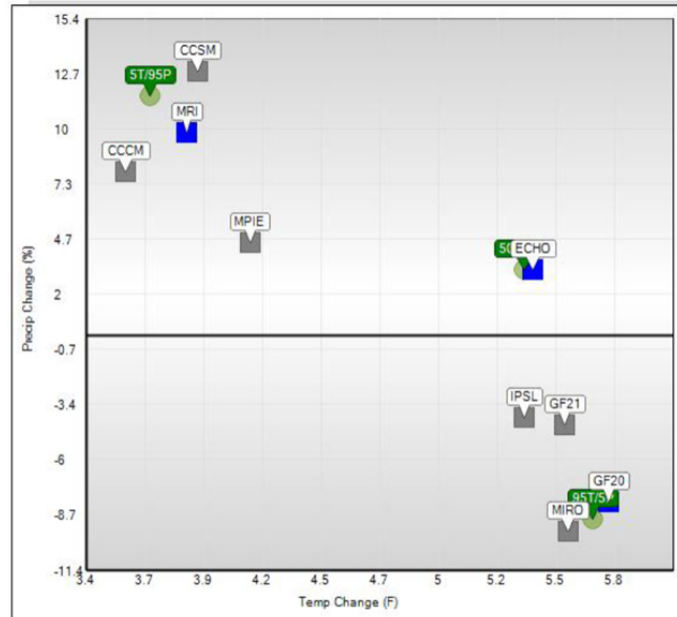


Figure 50. CMIP3 2060 projected changes in temperature and precipitation for Omaha, NE (EPA, 2012).

CREAT 3.0, 38-models, 0.5 by 0.5 degree

2035 (2025-2045)

2060 (2050-2070)

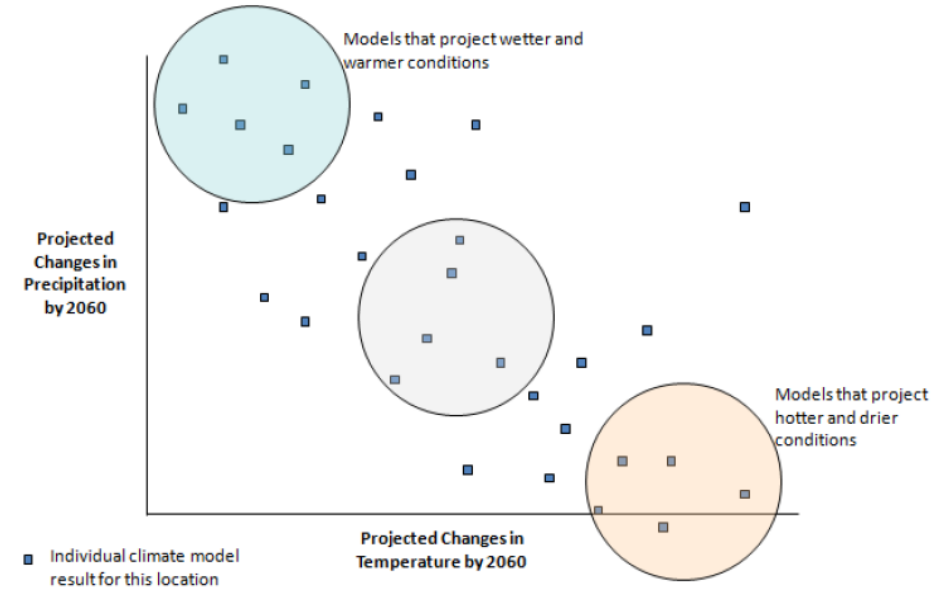


Figure 5. Illustration of Ensemble-informed Selection of Model Projections to Define Potential Future Conditions

- Warmer and wetter future conditions: average of five individual models that are nearest to the 95th percentile of precipitation and 5th percentile of temperature projections;
- Moderate future conditions: average of five individual models that are nearest to the median (50th percentile) of both precipitation and temperature projections; and
- Hotter and drier future conditions: average of five individual models that are nearest to the 5th percentile of precipitation and 95th percentile of temperature projections.

CREAT 3.0 Projected Extreme Events

- 22 of the 38 models
- Scalers from 5-year storms

<https://www.epa.gov/crwu/creat-version-30-methodology-guide-water-utilities>

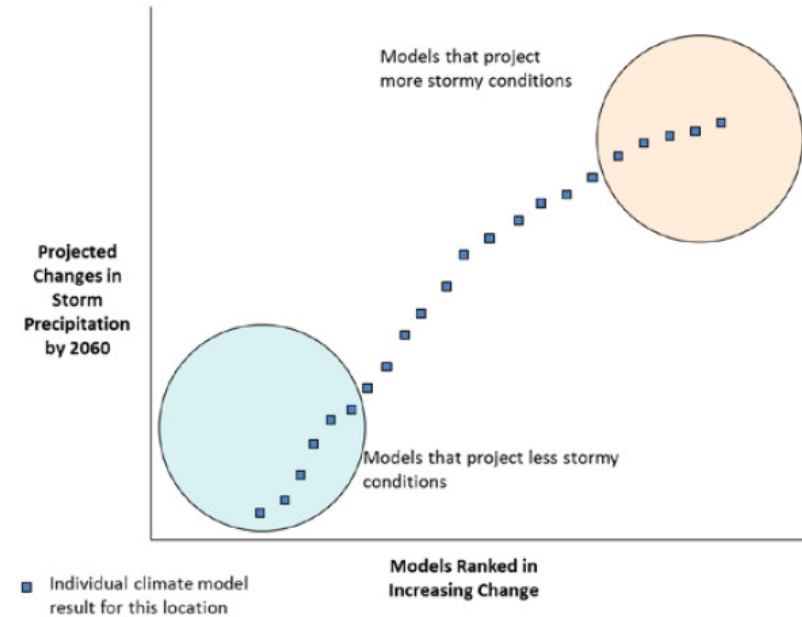


Figure 6. Illustration of Ensemble-informed Selection of Model Projections to Define Potential Future Storm Conditions

The selected models were used to provide ensemble average scalars for changes in precipitation per degree of warming for all the return intervals provided for historical data including 5-year, 10-year, 15-year, 30-year, 50-year and 100-year. Projected changes in event magnitudes were calculated using the scalars, generating a new GEV curve for each future time period, as follows:

$$Intense\ Precip(RI, Proj) = Intense\ Precip(RI, Hist) * (1 + \Delta Intense\ Precip(RI, Proj)), \text{ where}$$

$$\Delta Intense\ Precip(RI, Proj) = Scalar(RI, Proj) * \Delta Temp(Proj),$$

and $\Delta Temp$ is the change in global mean temperature from the same model.

Already Available Data from CREAT 3.0

OBJECTID	CREAT_ID	Longitude_ Centroid	Latitude_ Centroid	TEMP_2035_ HOTDRY_AN	TEMP_2035_ CENTRAL_AN	TEMP_2035_ WETWARM_	TEMP_2060_ HOTDRY_H	TEMP_2060_ CENTRAL_AN	TEMP_2060_ WETWARM_	PRECIP_2035_ HOTDRY_ANN	PRECIP_2035_ CENTRAL_AN	PRECIP_2035_ WETWARM_A
				NUAL_CHAN GEF	NUAL_CHANG EF	ANNUAL_CH ANGEF	OTDRY_ANNU AL_CHANGEF	NUAL_CHANG EF	ANNUAL_CH ANGEF	UAL_CHANGE PCT	NUAL_CHANG EPCT	NNUAL_CHAN GEPCT
1	9720	-67.25	17.75	1.66	1.55	1.35	3.24	3.04	2.65	-10.31	-7	-1.86
2	9721	-66.75	17.75	1.67	1.53	1.35	3.28	2.97	2.65	-9.35	-7.29	-2.14
3	9722	-66.25	17.75	1.67	1.51	1.42	3.26	2.93	2.79	-9.26	-6.99	-0.09
4	9723	-65.75	17.75	1.62	1.49	1.39	3.15	2.93	2.72	-9.89	-6.73	-0.96
5	9713	-67.75	18.25	1.73	1.55	1.44	3.35	3.02	2.81	-10.66	-5.81	0.55

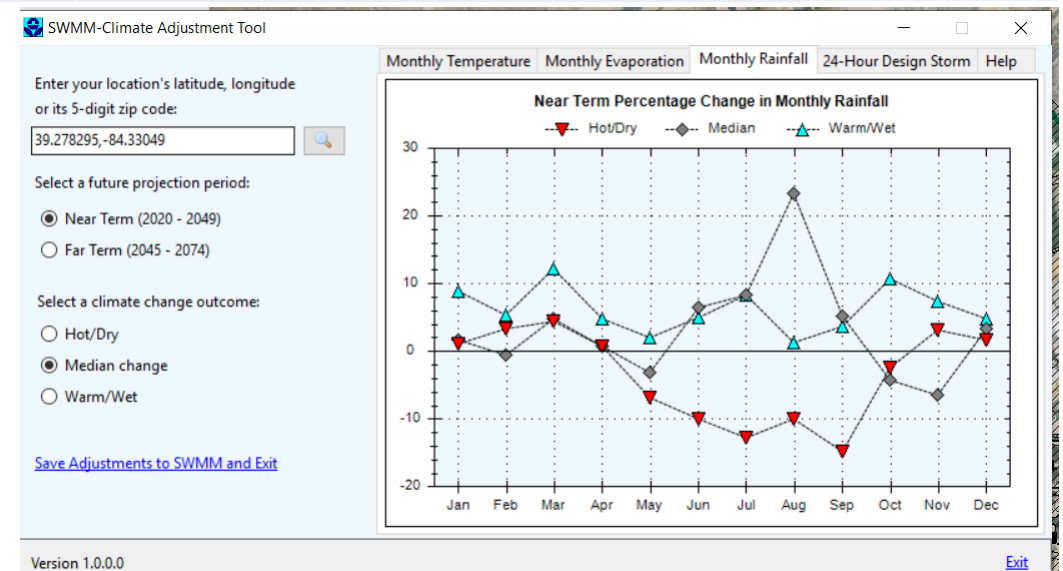
- [CREAT 3.0 Climate Projection Data](#) and [metadata](#)
- [CREAT 3.0 Historic Gridded Weather Data](#) and [metadata](#)
- [CREAT 3.0 Historic Weather Station Point Data](#) and [metadata](#)

Available Data from CREAT 3.0

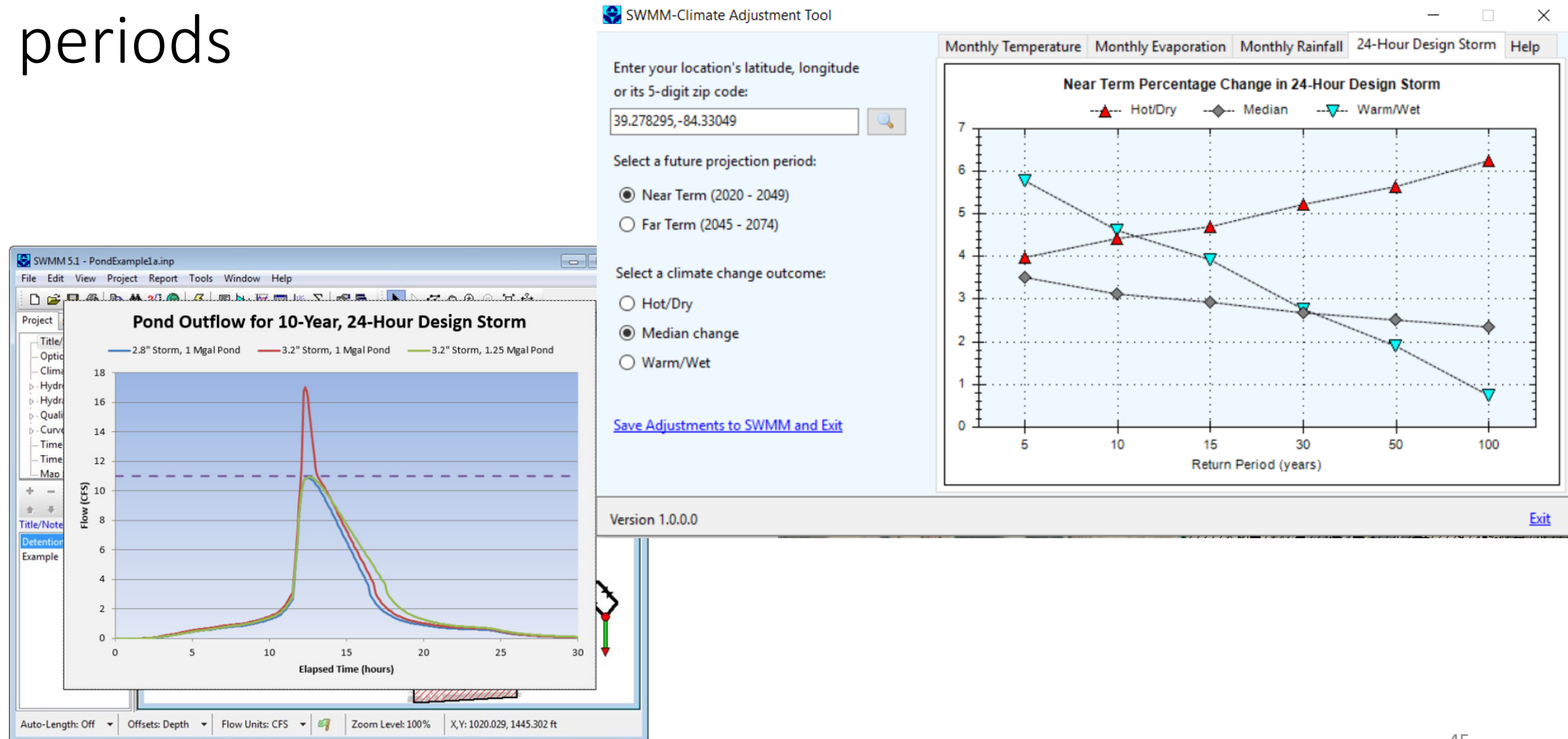
		TEMP_2		035_HO		TDRY_J		TEMP_2035_	TEMP_2035_W	TEMP_2060_	TEMP_2060_	TEMP_2060_	PRECIP_2035_
OBJECT		Longitude	Latitude_C	AN_CH	CENTRAL_JA	ETWARM_JAN_	HOTDRY_JAN	CENTRAL_JA	WETWARM_J	HOTDRY_JAN_			
ID	CREAT_ID	_Centroid	entroid	ANGEF	N_CHANGEF	CHANGEF	_CHANGEF	N_CHANGEF	AN_CHANGEF	CHANGEF			
1	9720	-67.25	17.75	1.66	1.51	1.38	3.23	2.95	2.7	-4.08			
2	9721	-66.75	17.75	1.68	1.51	1.38	3.27	2.94	2.69	-6.79			
3	9722	-66.25	17.75	1.67	1.5	1.44	3.27	2.92	2.81	-7.09			
4	9723	-65.75	17.75	1.59	1.5	1.4	3.11	2.92	2.74	-6.33			
5	9713	-67.75	18.25	1.66	1.56	1.45	3.24	3.05	2.84	-2.98			

- [CREAT 3.0 Climate Projection Data](#) and [metadata](#)
- [CREAT 3.0 Historic Gridded Weather Data](#) and [metadata](#)
- [CREAT 3.0 Historic Weather Station Point Data](#) and [metadata](#)

Demo SWMM-CAT



2. We also need to update extreme 24-Hour Design Storm disaggregations for various return periods



Precipitation Frequency Estimates - ME

← → ↻ https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

General Information

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Precipitation Frequency

Data Server

GIS Grids

Maps

Time Series

Temporals

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Probable Maximum Precipitation Documents

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Storm Analysis

Record Precipitation

Contact Us

Inquiries



NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: ME

Data description

Data type: Precipitation depth Units: English Time series type: Partial duration

Select location

1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: Longitude:

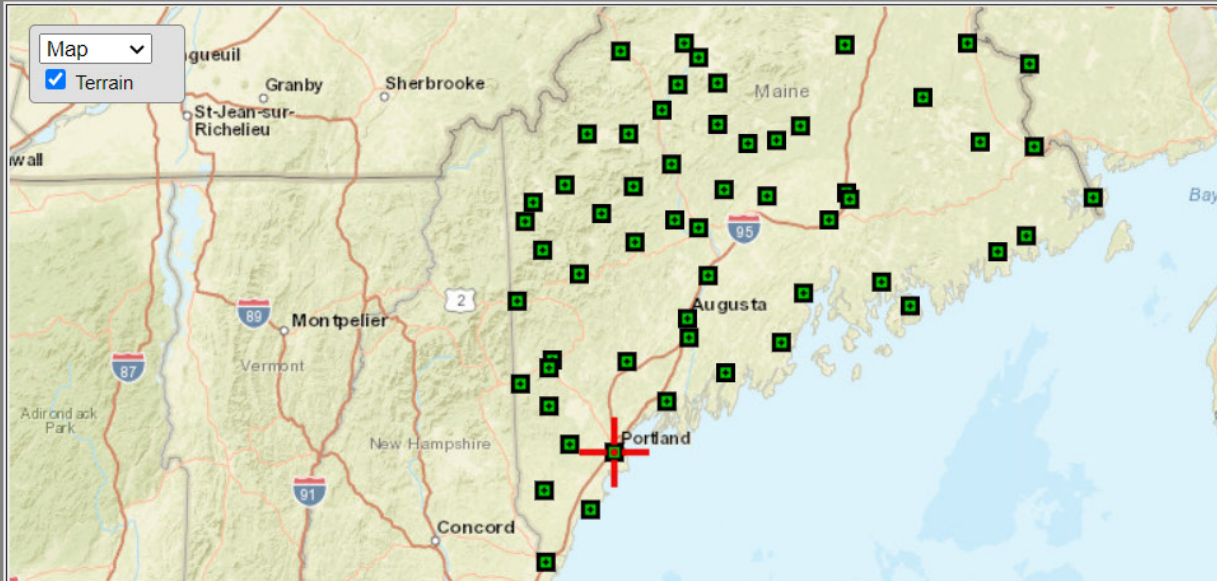
b) By station ([list of ME stations](#)): PORTLAND INTL JETPORT (17-6905)

c) By address

2) Use map (if ESRI interactive map is not loading, try adding the host: <https://js.arcgis.com/> to the firewall, or contact us at hdsc.questions@noaa.gov):

Map ▼

☒ Terrain



a) **Select location**

Move crosshair or double click

b) **Click on station icon**

☒ Show stations on map

Location information:

Name: Portland, Maine, USA*

Station name: PORTLAND INTL JETPORT

Site ID: 17-6905

Latitude: 43.6497°

Longitude: -70.3003°

Elevation: 45 ft

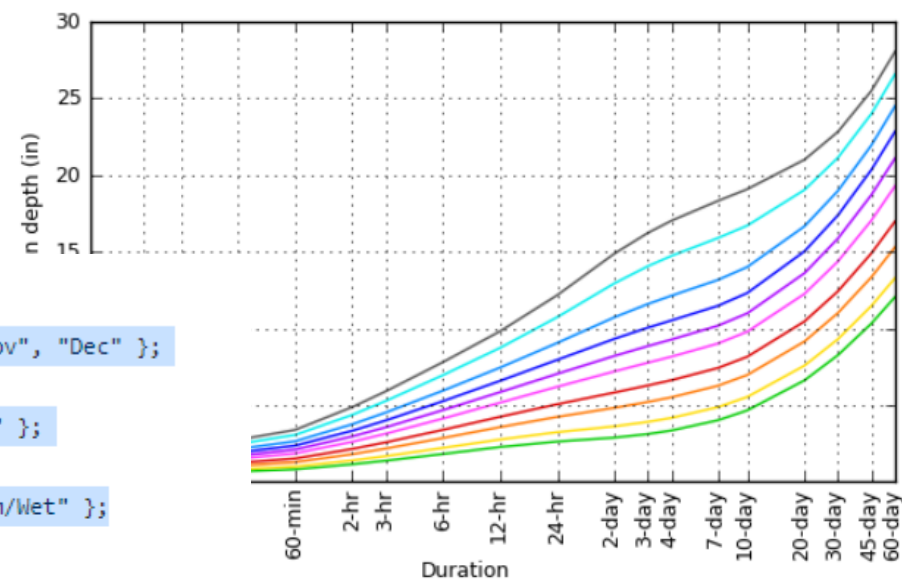


PDS-Based depth-duration-frequency curves

Portland, ME

PDS-based depth-duration-frequency (DDF) curves

Latitude: 43.6497°, Longitude: -70.3003°

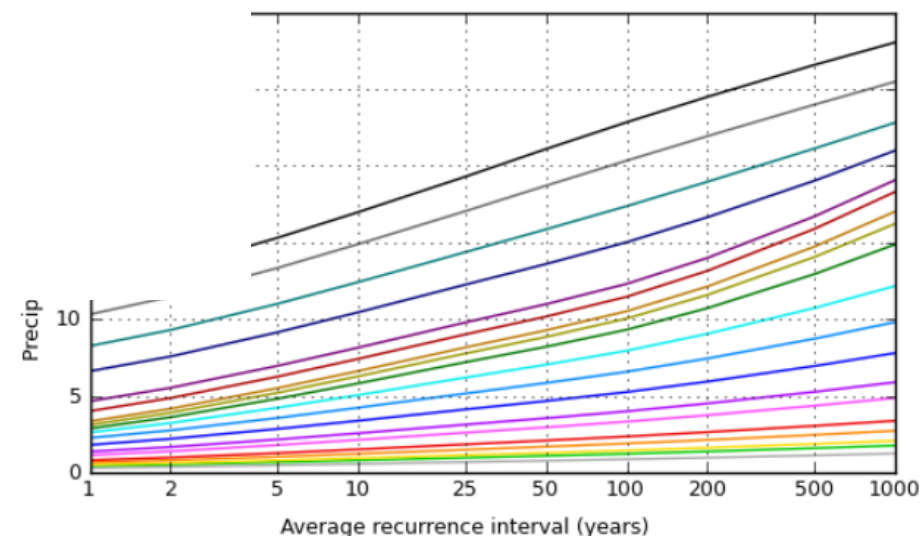


Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000

```
public static string[] monthLabels =  
{ "Jan", "Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec" };  
  
public static string[] returnPeriods = { "5", "10", "15", "30", "50", "100" };  
  
public static string[] scenarioNames = { "None", "Hot/Dry", "Median", "Warm/Wet" };
```

```
// Updates the climate change adjustments displayed on the MainForm's  
// Climate Change page when a new precip. station or climate projection  
// year is selected.
```

```
public static void UpdateAdjustments()  
{  
    UpdateRainfallAdjustments();  
    UpdateMaxRainAdjustments();  
}
```



Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

Currently SWC disaggregates extreme events data based on 1986 temporal rainfall distribution

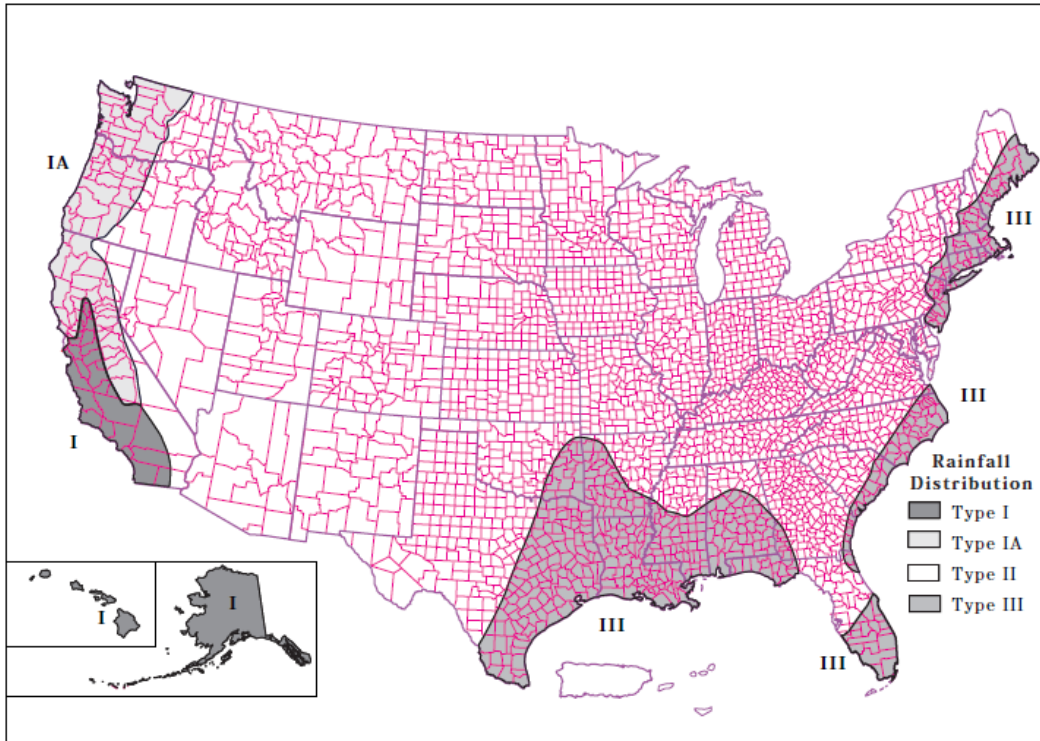


Figure 48. Geographic boundaries for the different NRCS (SCS) rainfall distributions (USDA, 1986).

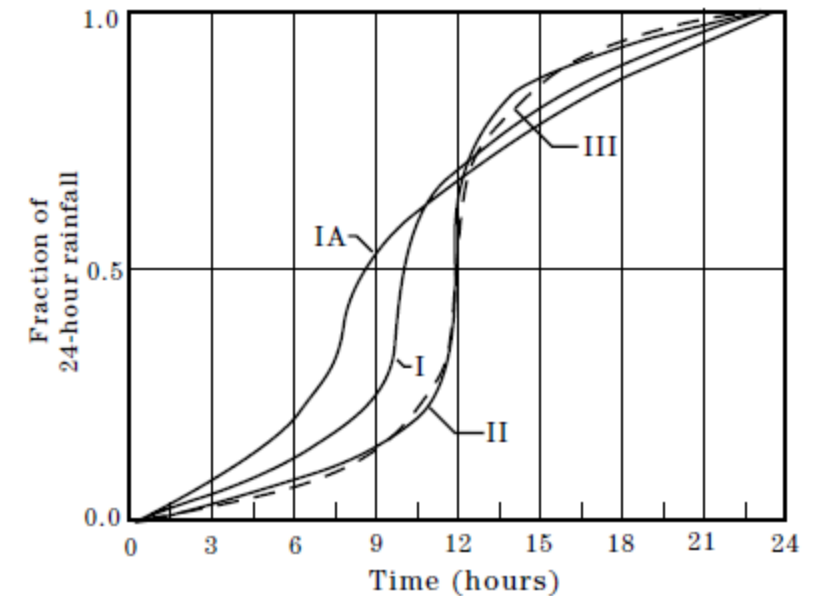
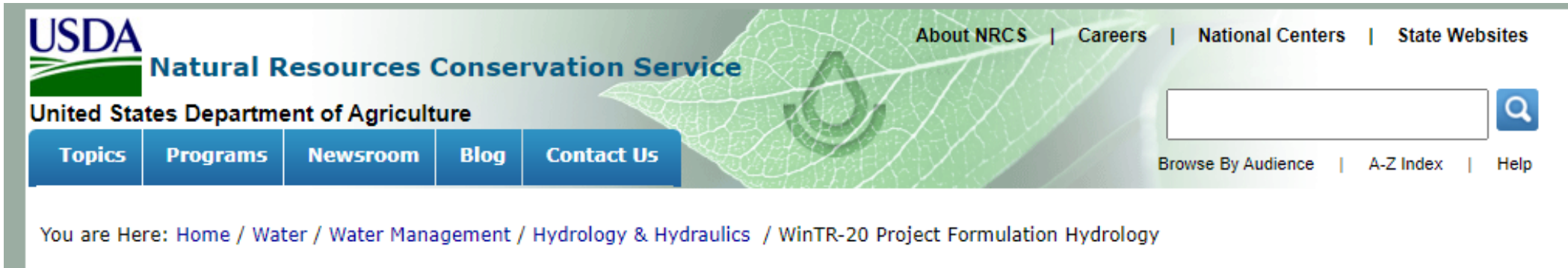


Figure 47. NRCS (SCS) 24-hour rainfall distributions (USDA, 1986).

New - NCRS Updated since 1986

<https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/manage/hydrology/?cid=stelprdb1042793> for 30 states



temporal_dist_file.txt

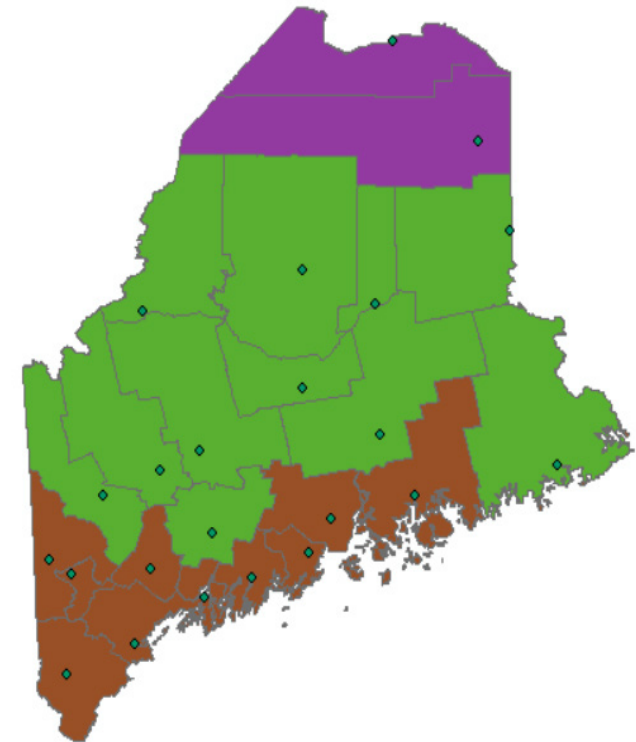
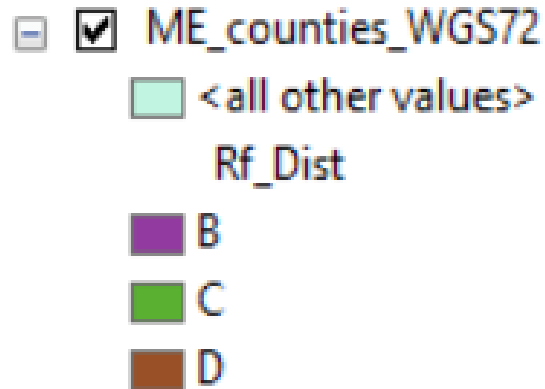
Time	NOAA_ A	NOAA_ B	NOAA_ C	NOAA_ D	NRCC A	NRCC B	NRCC C	NRCC D	NV N	NV S	NV W	SCS I	SCS IA	SCS II	SCS III
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.1	0.00078	0.00101	0.00128	0.0011	0.00098	0.0012	0.00112	0.00146	0.0011	0.00084	0.0014	0.00174	0.00224	0.00101	0.001
0.2	0.00141	0.00182	0.00231	0.0022	0.00177	0.00217	0.00224	0.00287	0.0022	0.0017	0.0028	0.00348	0.00432	0.00202	0.002
0.3	0.00205	0.00265	0.00335	0.00332	0.00257	0.00315	0.00337	0.0043	0.0033	0.0025	0.0043	0.00522	0.00628	0.00305	0.003
0.4	0.0027	0.00348	0.00441	0.00445	0.00338	0.00414	0.00451	0.00573	0.0045	0.0034	0.0057	0.00697	0.00816	0.00408	0.004
0.5	0.00336	0.00433	0.00547	0.00559	0.0042	0.00514	0.00566	0.00718	0.0056	0.0043	0.0072	0.00871	0.01	0.00513	0.005
0.6	0.00403	0.00518	0.00654	0.00674	0.00503	0.00615	0.00683	0.00863	0.0067	0.0051	0.0087	0.01046	0.01184	0.00618	0.006
0.7	0.00471	0.00605	0.00763	0.0079	0.00587	0.00717	0.008	0.0101	0.0079	0.006	0.0101	0.0122	0.01372	0.00725	0.007
0.8	0.00539	0.00692	0.00872	0.00907	0.00671	0.0082	0.00919	0.01158	0.009	0.0069	0.0116	0.01395	0.01568	0.00832	0.008
0.9	0.00609	0.0078	0.00982	0.01025	0.00757	0.00924	0.01038	0.01306	0.0102	0.0078	0.0131	0.0157	0.01776	0.00941	0.009

AL, AK, AR, CA, CO, CT, DE, FL, GA, IN, IA, KY, LA, ME, MD, MA, MN, NE,
NV, NH, NJ, NY, OH, PA, RI, SC, TN, VT, VA, WV, Washington DC is in MD

The new temporal distributions are region-specific.

For example, NOAA_A – NOAA_D apply to the Mid-Atlantic states and NRCC_A – NRCC_D apply to New England.

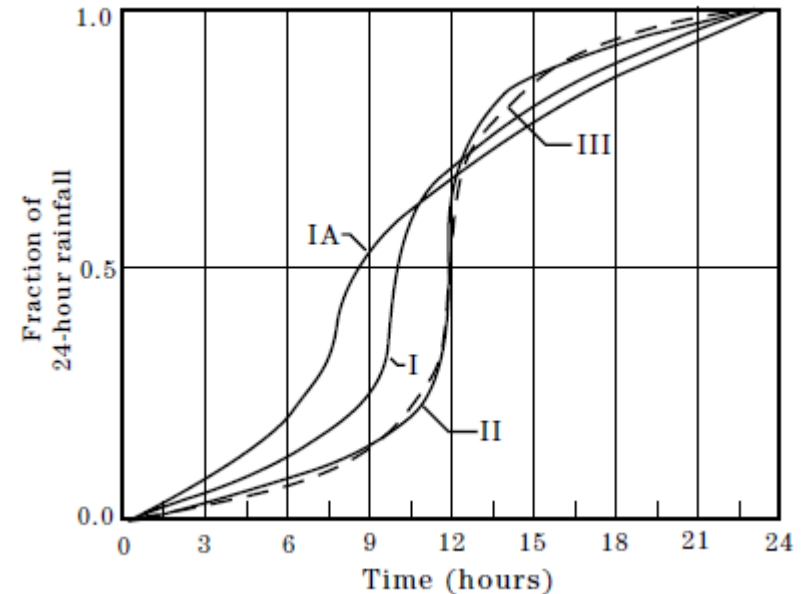
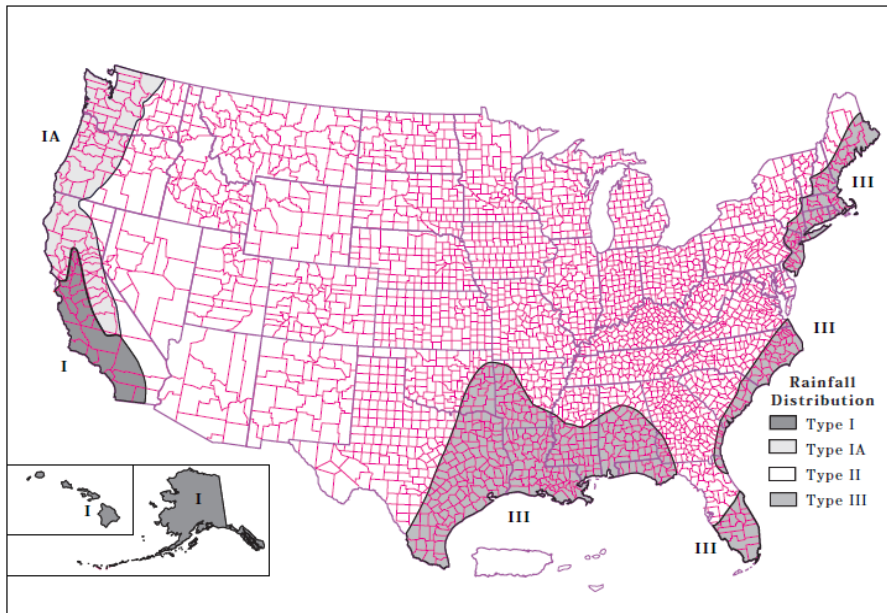
For Maine, the shapefile ME_counties_WGS72.shp shows that Maine falls in temporal distributions B, C, and D:



- This is shown in the attribute table by Rf_Dist.
- Maine uses the NRCC_prefix.

Some states don't have new NRCS temporal distributions available.

AZ, HI, ID, IL, KS, MI, MS, MO, MT, NM, NC, ND, OK, OR, SD, TX, UT, WA, WI, WY



For those the data from `ireg_zones.shp` should be used. This shapefile represents the NRCS 1986 legacy rainfall distribution storm types that are currently used by the SWC.

Any questions

Contact: Simon.michelle@epa.gov

