HYDROLOGIC AND WATER QUALITY SYSTEM WEBCAST

Presented by:

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United States Environmental Protection Agency
Washington, DC

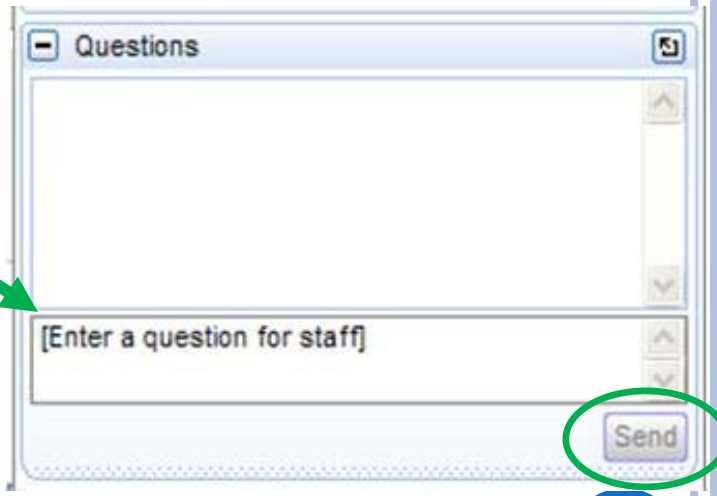
August 16, 2016

Webinar Logistics

- Presentation slides from this webinar will be available to download within about a week or two at: http://epa.gov/hawqs

- Attendees will be in listen-only mode (muted) throughout today's webinar.

- During the webinar, you may submit a question by typing into the Enter a question for staff box and clicking the Send button. Staff will read and answer these questions as time allows.



- Please complete the survey questions at the end of the webinar. Your feedback is important to us!

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Topics for Today's Webcast

- HAWQS Beta Background
- Using HAWQS
  - Registration, User Guide, Getting Help
  - SWAT and HAWQS
  - Starting and completing a project and scenarios
  - Inputs and Outputs
- Use Case Example – Maumee River Basin
- HAWQS Next Steps
- Where to go for Help

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Poll Question #1

- Who runs your water quality models?

  - Yourself – you're a water quality modeling professional.
  - A colleague who is a water quality modeling professional
  - Contractor/consultant
  - Others

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Poll Question #2

- Which WQ Models do you use for your projects?
  - WASP
  - SPARROW
  - BASINS
  - SWAT
  - OTHER

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Poll Question #3

- Which area of modeling are you involved in?

  - Stormwater
  - TMDL
  - Climate Change
  - Agriculture
  - Other

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HAWQS BACKGROUND

- Conceived by an EPA Cross-Office Planning Committee in 2005
- Solicited input from a diverse group during a workshop
- Key themes the Committee/Workshop considered:
  - Impact from regional and national scale policies and programs
  - National or large scale economic benefit assessment
- Full scale development began in 2010

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HAWQS BACKGROUND (CONT.)

- Original themes evolved into the current web-based beta Version of HAWQS
- 2015 – EPA-sponsored peer review:
  - Douglas C. Beyerlein. P.E., WRE (Consultant)
  - Kaye L. Brubaker, Ph.D., University of Maryland
  - Timothy Randhir, Ph.D., University of Massachusetts Amherst.
- 2016 – Addressed peer review comments and other enhancements
  - HAWQS Beta released on June 16, 2016
  - Future releases will integrate additional features and re-visit remaining peer review comments
  - Formal release of Version 1.0 planned sometime in late 2016 early 2017

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HAWQS HOMEPAGE (HTTPS://EPAHAWQS.TAMU.EDU/)

HAWQS
Hydrologic and Water Quality System
A National Watershed and Water Quality Assessment Tool
Log in

What is HAWQS?

The Hydrologic and Water Quality System (HAWQS) is a web-based interactive water quantity and quality modeling system that employs as its core modeling engine the Soil and Water Assessment Tool (SWAT), an internationally-recognized public domain model. HAWQS provides users with interactive web interfaces and maps; pre-loaded input data; outputs that include tables, charts, and raw output data; a user guide, and online development, execution, and storage of a user's modeling projects.

HAWQS substantially enhances the usability of SWAT to simulate the effects of management practices based on an extensive array of crops, soils, natural vegetation types, land uses, and climate change scenarios for hydrology and the following water quality parameters:

- Sediment
- Pathogens
- Nutrients
- Biological oxygen demand
- Dissolved oxygen
- Pesticides
- Water temperature

HAWQS users can select from three watershed scales or hydrologic unit codes (HUCS) – 8-digit ~700mi^2; 10-digit ~227 mi^2; and 12-digit ~40mi^2 – to run simulations. HAWQS allows for further aggregation and scalability of daily, monthly, and annual estimates of water quality across large geographic areas up to and including the continental United States.

The United States Environmental Protection Agency (USEPA) Office of Water supports and provides project management and funding for HAWQS. The Texas A&M University Spatial Sciences Laboratory and EPA subject matter experts provide ongoing technical support including system design, modeling, and software development. The United States Department of Agriculture (USDA) and Texas A&M University jointly developed SWAT and have actively supported the model for more than 25 years.

HAWQS beta was released in June 2016. Comments and proposed enhancements by prospective end-users will be used to plan, prioritize, and release future versions.

View the HAWQS brochure.

How does HAWQS work?

1. Log in or register for a new account to get started
   - Read our user guide for additional help.
2. Create a project
   - Choose a desired catchment resolution: HUC8, HUC10 or HUC12
   - Select your ending HUC ID from a map
3. Create a scenario
   - Specify the model run duration and model run frequency
4. Make further customizations to your model
   - Set HRUs to eliminate minor land uses, soils and slopes
   - Edit general watershed inputs and databases (basin, fertilizer, urban, nutrient efficiency, land use update)
   - Edit subbasin inputs (curve number, potholes, sediment routing, climate change/sensitivity, point source)
   - Modify SWAT output by selecting reach, subbasin and HRU parameters
5. Generate SWAT input files
6. Generate SWAT Access database for SWATeditor
7. Run the available versions of SWAT
8. Analyze your results
   - Run SWAT Check—a program designed to identify potential model problems
   - Generate output reach statistics
   - View output summary charts
   - Download a zip of all project files

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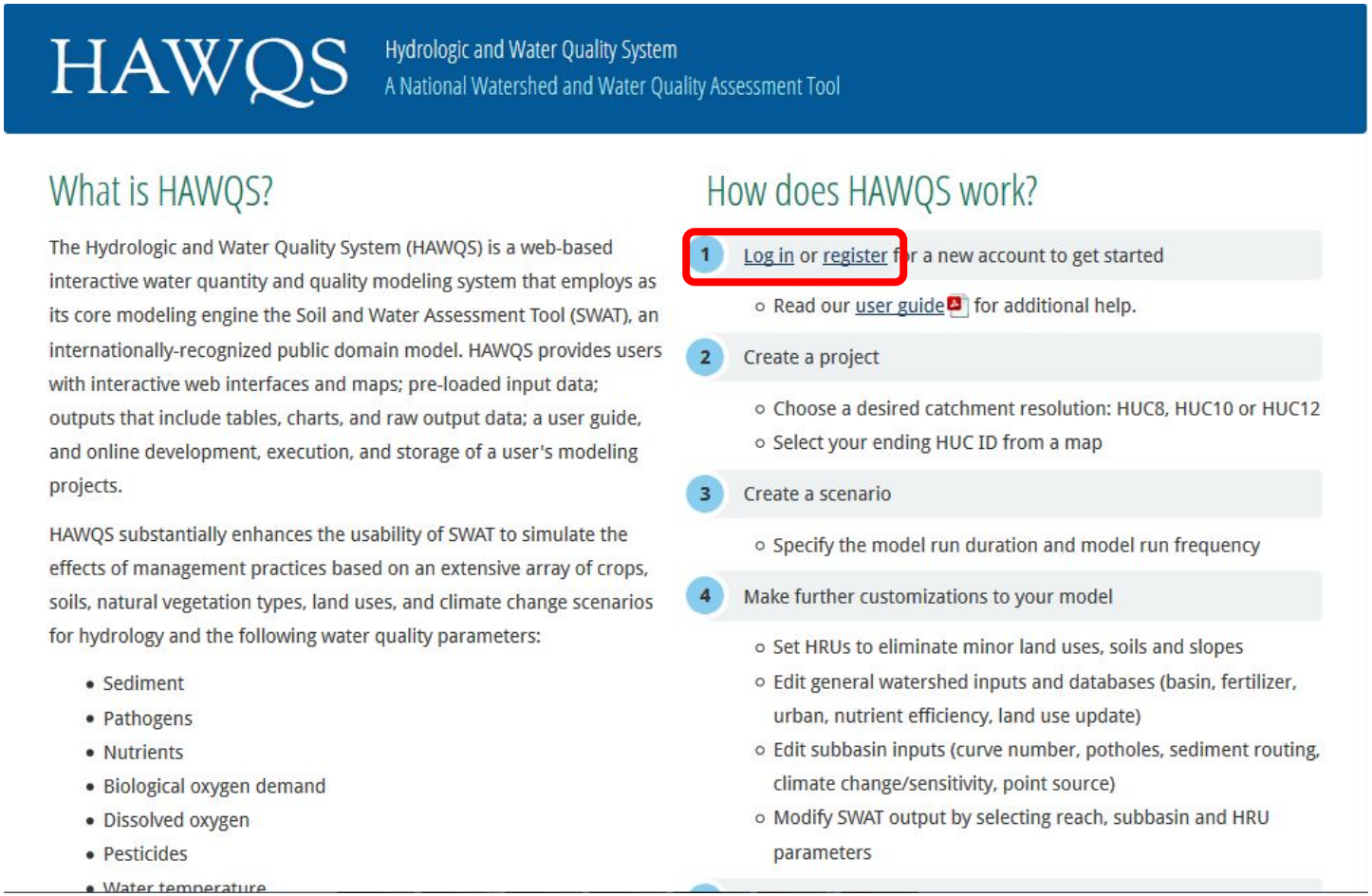
Registering for HAWQS



HAWQS

Hydrologic and Water Quality System

A National Watershed and Water Quality Assessment Tool

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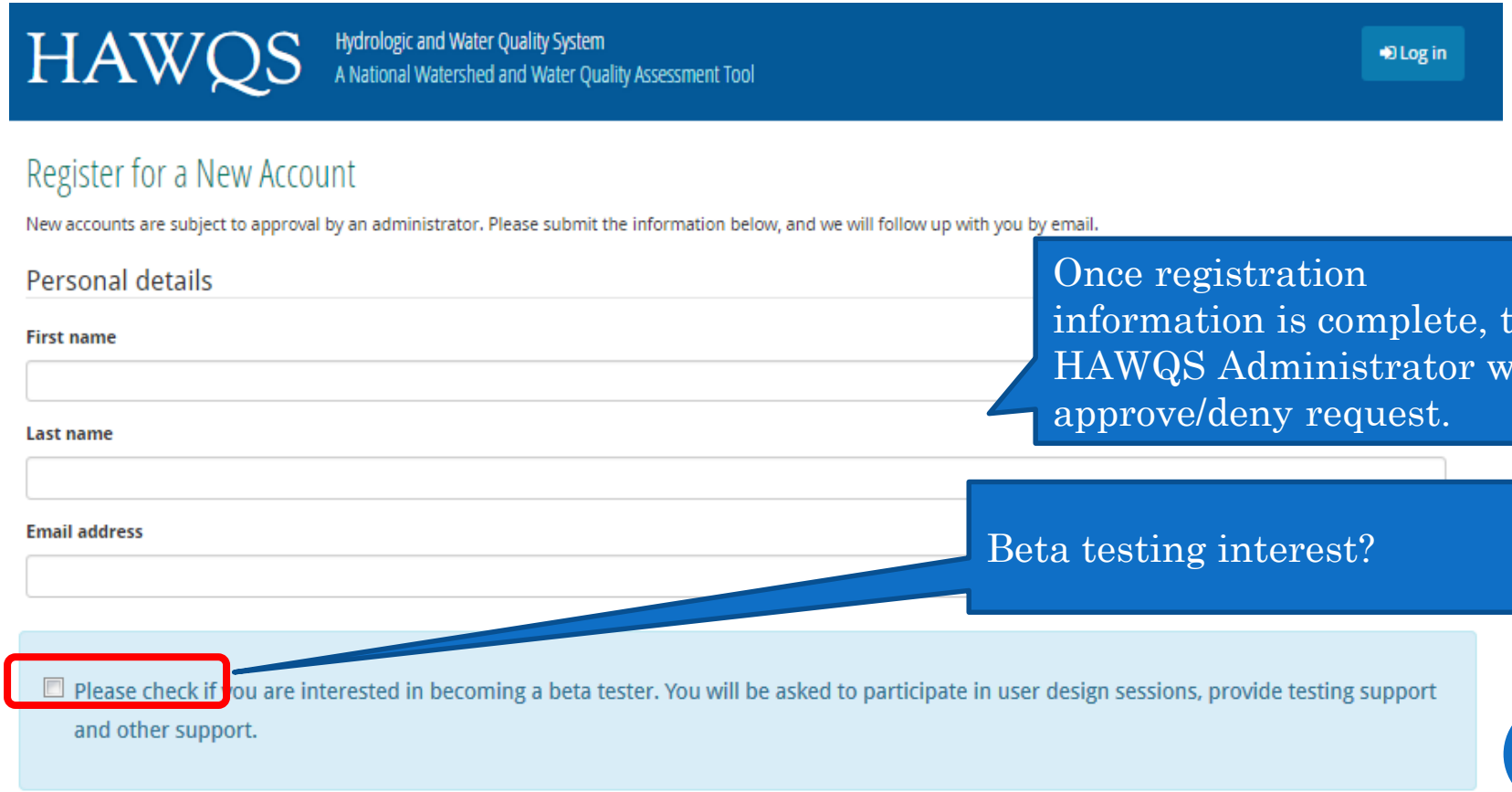
Registering for HAWQS



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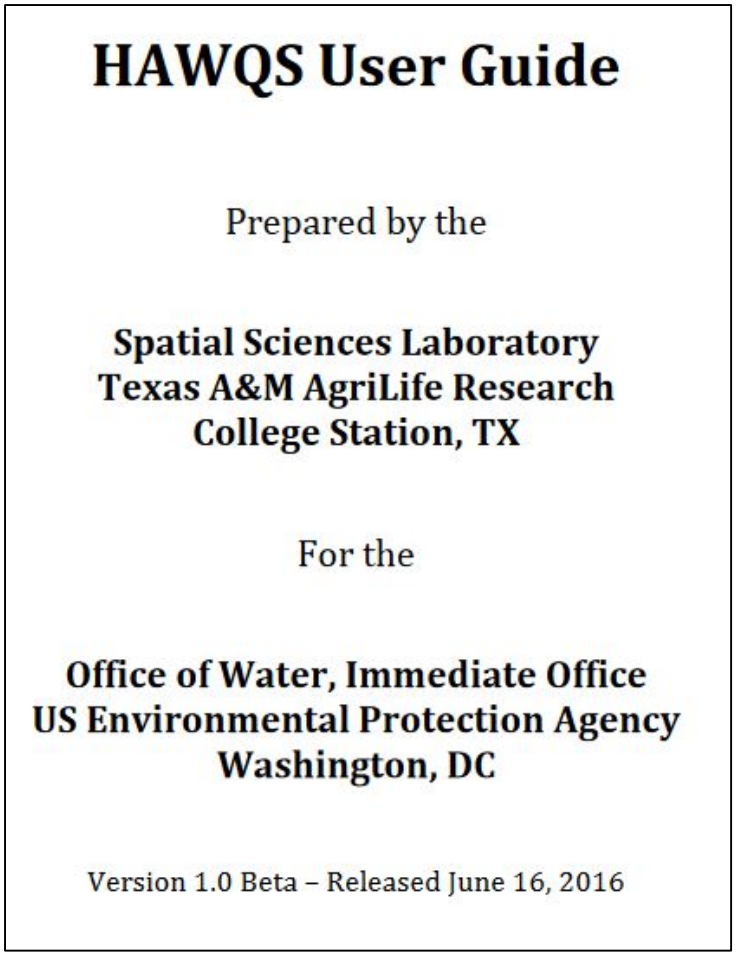
HAWQS USER GUIDE

https://epahawqs.tamu.edu/



HAWQS User Guide

Prepared by the

Spatial Sciences Laboratory
Texas A&M AgriLife Research
College Station, TX

For the

Office of Water, Immediate Office
US Environmental Protection Agency
Washington, DC

Version 1.0 Beta – Released June 16, 2016

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HELP IN HAWQS

Selected SWAT model Documentation

HAWQS methodology, input and database documentation

SWAT Model Documentation

SWAT2012 Input/Output Documentation

SWAT Theoretical Documentation

- Channel Processes
- Climate
- Erosion
- Hydrology
- Management Practices

SWAT Publications

SWAT Check Documentation

HAWQS Data Documentation

HAWQS Appendix

HAWQS Input Database Citation

Calibration/Validation

- Methodology
- SWAT Manual Chapter on Calibration
- SWAT: Model Use, Calibration, and Validation

Climate Change Data and Resources

Land Use Definition Table

Point Sources Methodology

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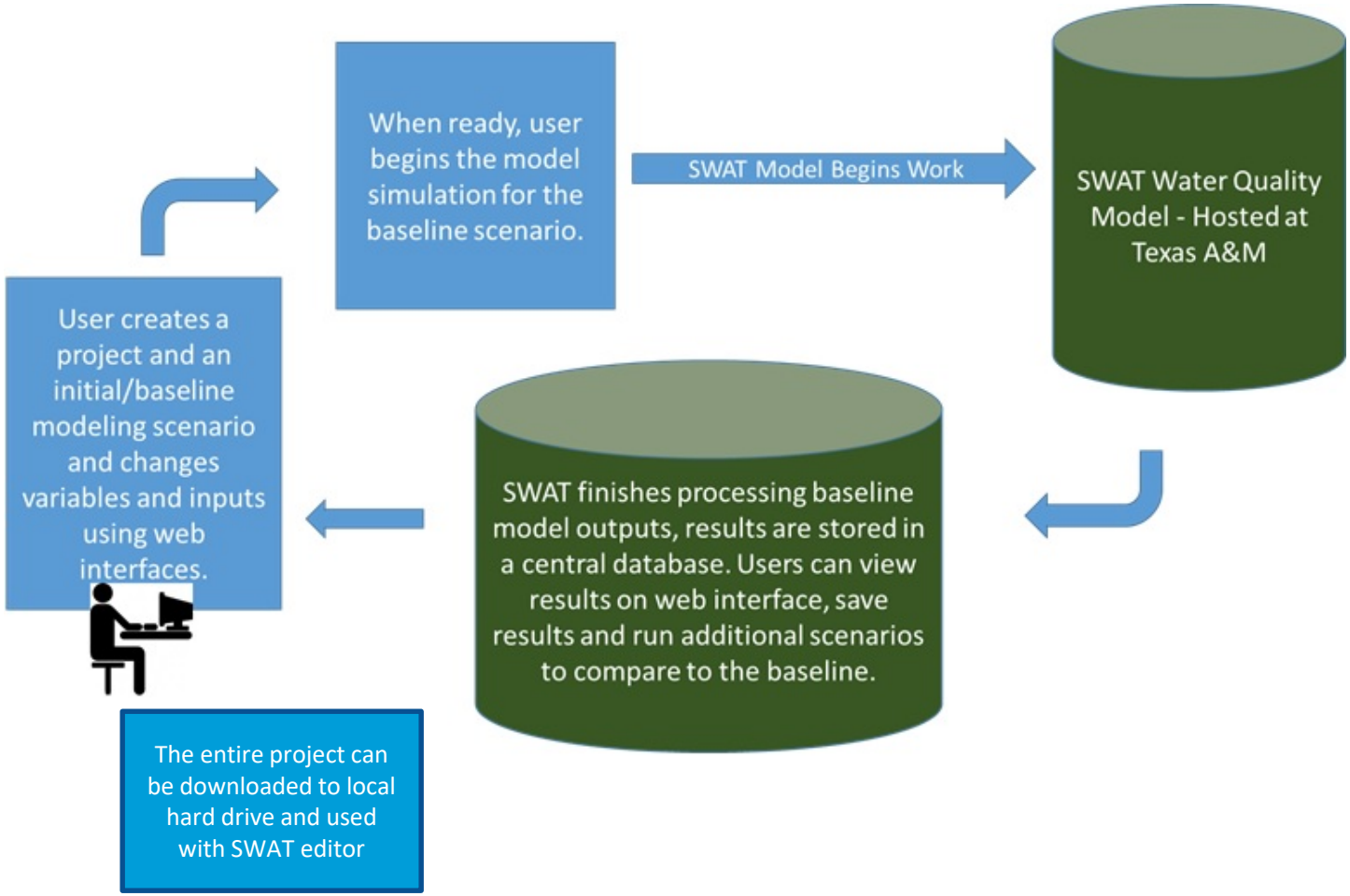
Overview of the HAWQS modeling process



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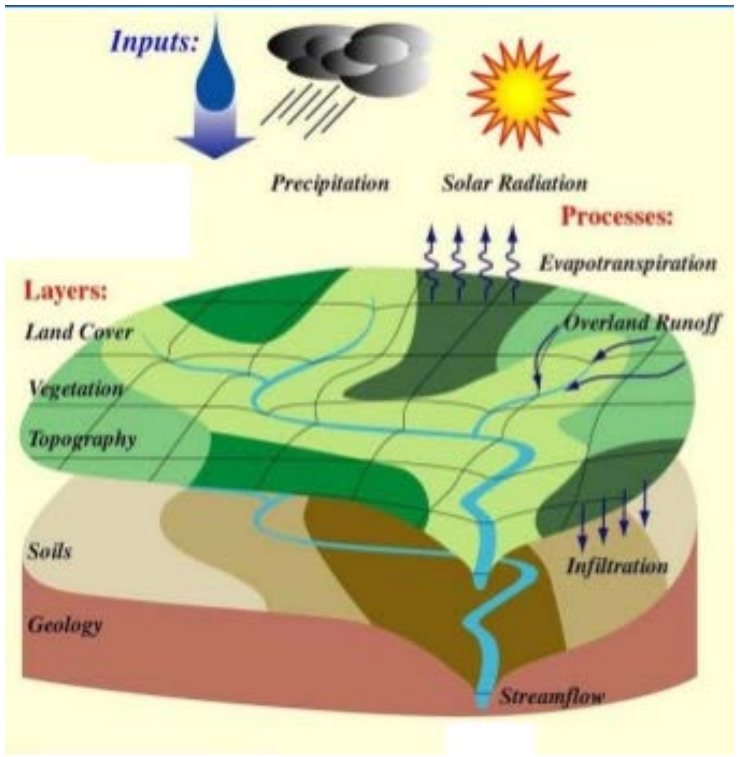
SWAT – THE MODEL BEHIND HAWQS



- SWAT
  - In use for more than 25 years and 2,700 peer reviewed publications
  - Requires specific information about weather, soil properties, topography, vegetation, land management
  - Physical processes associated with water movement, sediment movement, crop growth, and nutrient cycling are directly modeled.
  - Aggregation of outputs (stream flow, pollutants) across large scales (e.g., Mississippi River Basin) both spatial and temporal

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WHY USE HAWQS?

- Interactive web-based/cloud based applications;
- Can be accessed with any platform/browser;
- No GIS software necessary;
- No need for the user to update to the latest version of SWAT;
- Pre-loaded input data at three spatial resolutions (8, 10 and 12 digit watersheds) to reduce manual processing of input data;
- Output data in standardized charts and tables;
- Store baseline model simulation and then the "what-if" simulations in a central database;
- Download projects to desktop for more complex analysis;
- Many users can collaborate on a single project in future versions.

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HAWQS INPUTS

Input	Source	Notes	Date Accessed
Weather*	NCDC corrected for PRISM[1]	1967-2010	October 2010
Soil	USDA-NRCS[2]	STATSGO	October 2010
Land Use	MRLC (Fry)[3]	NLCD (2006) and CDL (2011-2012)	October 2010 and January 2015
Aerial Deposition	NADP[4]	(1980-2010) monthly	October 2010
Watershed Boundaries	USGS[5]	HUCS 8, 10, and 12	October 2010
Stream Networks	NHDPlus[6]	Reduced form	October 2010
Elevation	NED[7]	30 meter DEM	October 2010
Point Sources	USGS[8]	Regression of population and SPARROW model outputs	October 2010
Management Data	NRCS[9]	CDL (tillage, fertilizer/manure, crop yields)(NRCS field database)	January 2015
Reservoirs	USACE[10]	National Inventory of Dams	October 2010
Livestock and Crops	USDA-NASS[11]		October 2010
Model	USDA-ARS and Texas A&M	Soil Water Assessment Tool	January 2015

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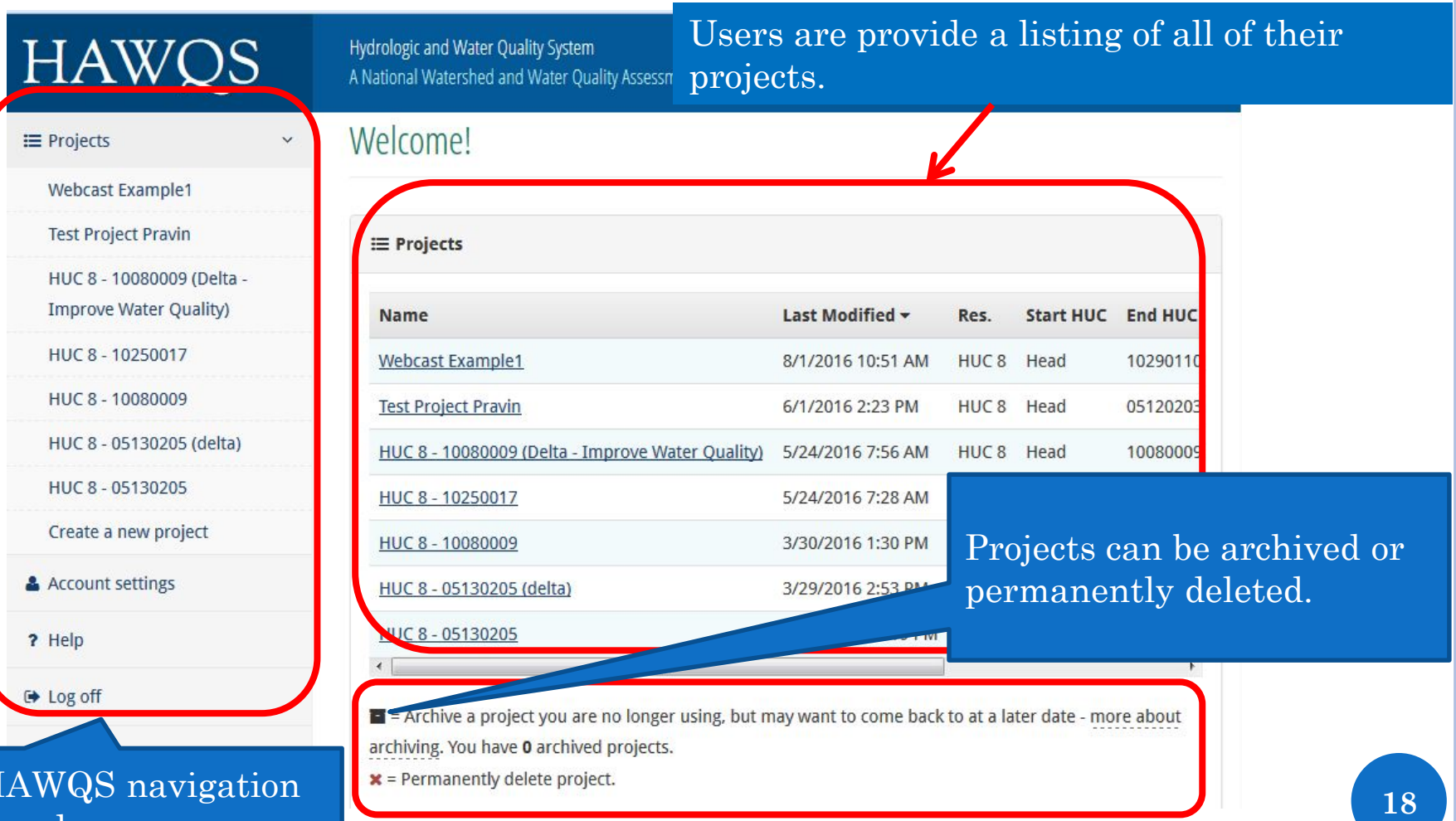
HAWQS PROJECT INTERFACE



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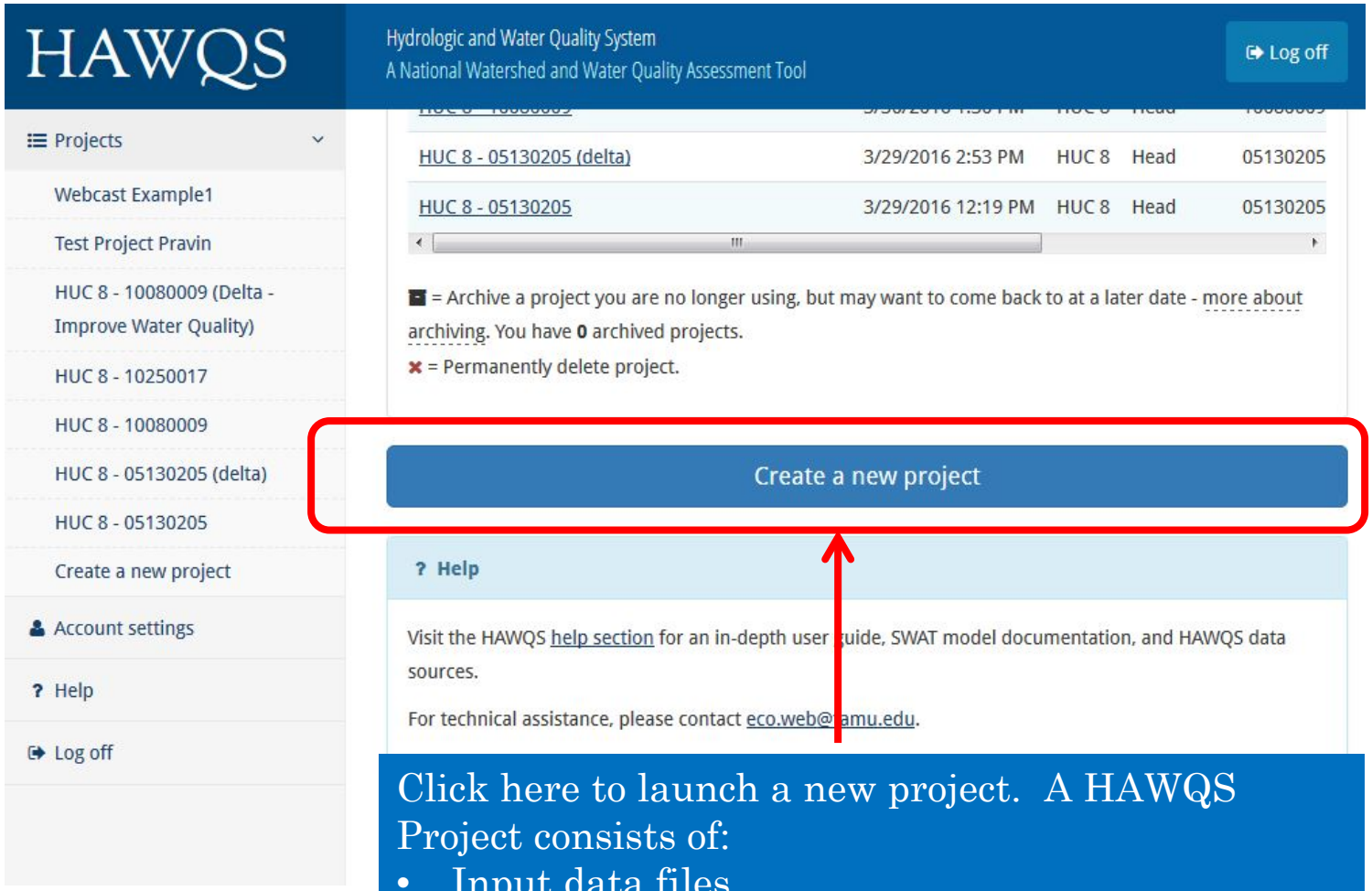
HAWQS PROJECT INTERFACE



Click here to launch a new project. A HAWQS Project consists of:

- Input data files
- Scenarios

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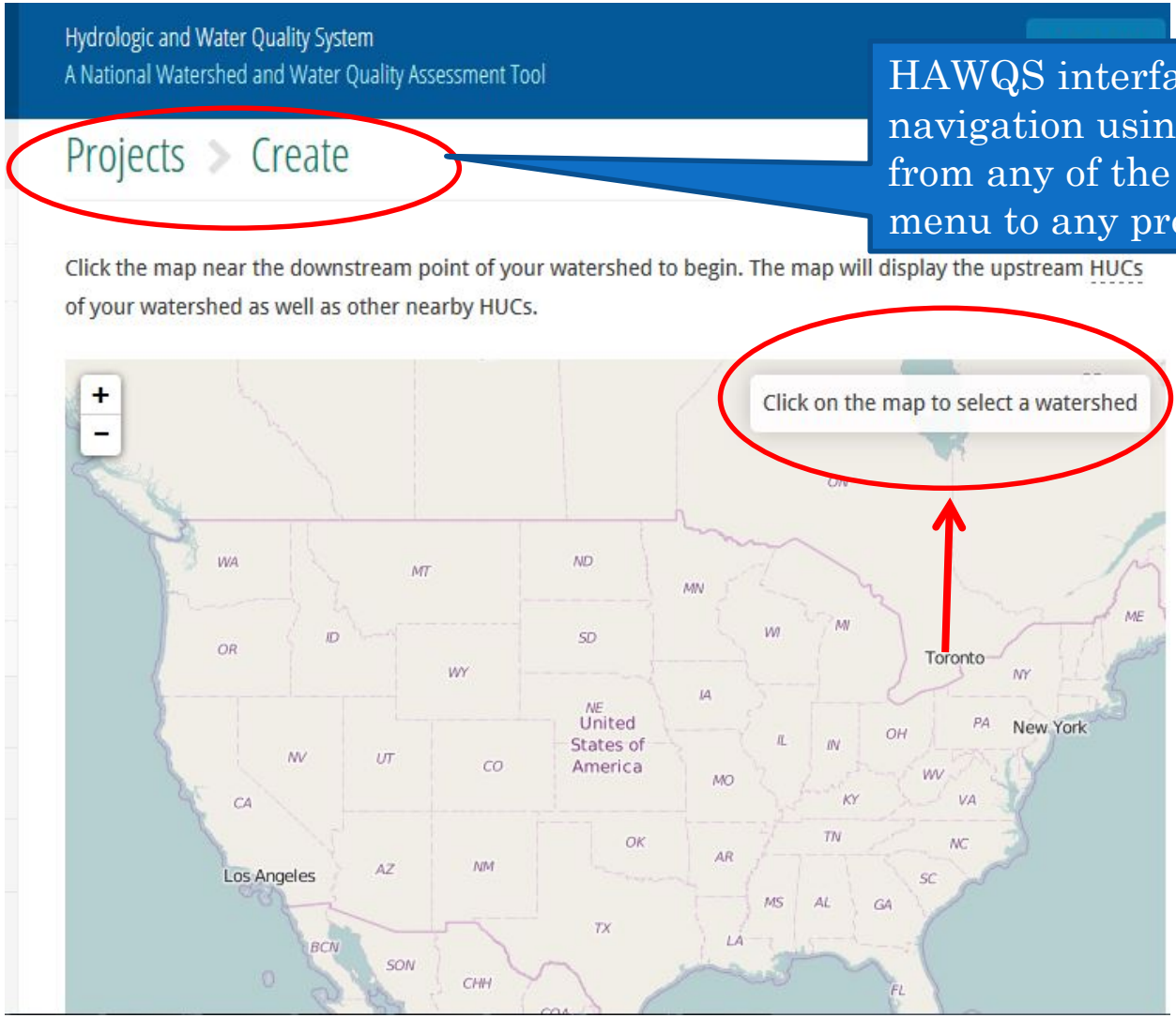
CREATE PROJECT – SELECT A WATERSHED



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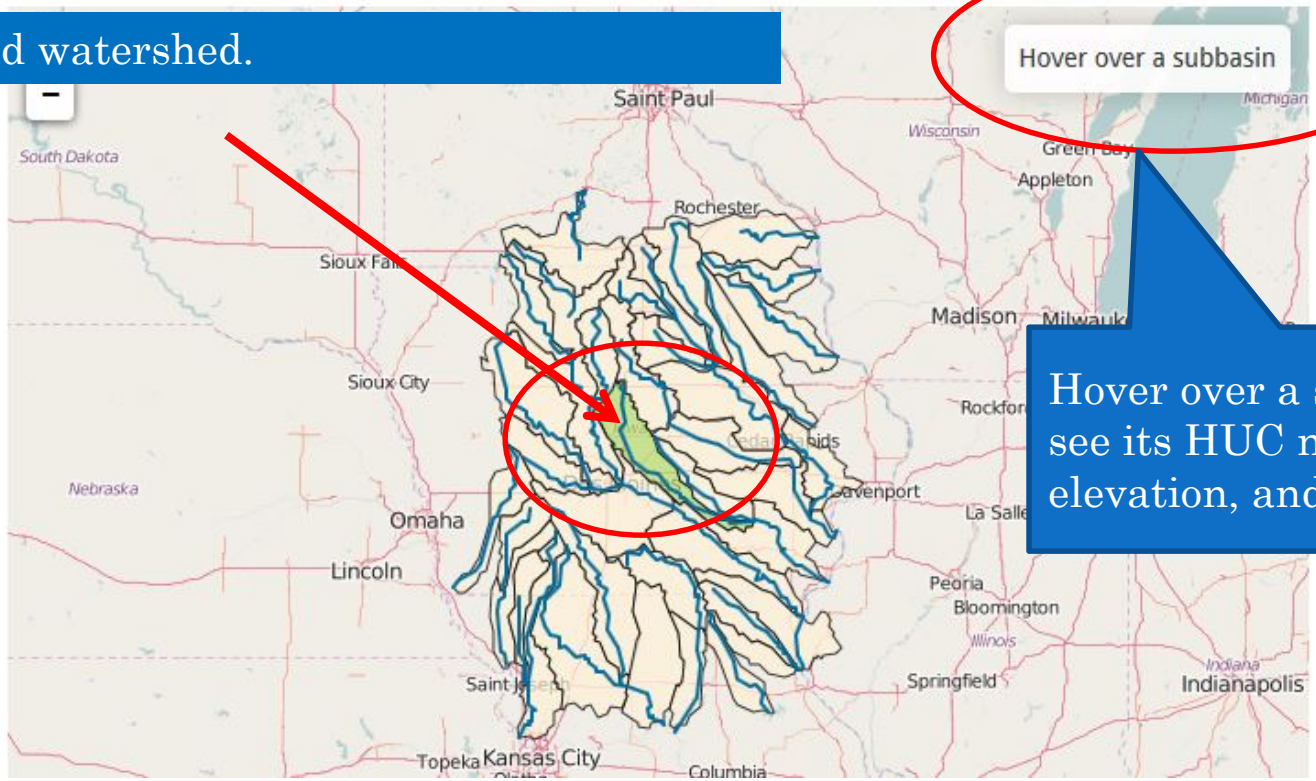
CREATE PROJECT – SELECT A WATERSHED AND SUB-BASINS

Projects > Create

Click the map near the downstream point of your watershed to begin. The map will display the upstream HUCs of your watershed as well as other nearby HUCs.

Selected watershed.



Hover over a subbasin to see its HUC number, area, elevation, and coordinates.

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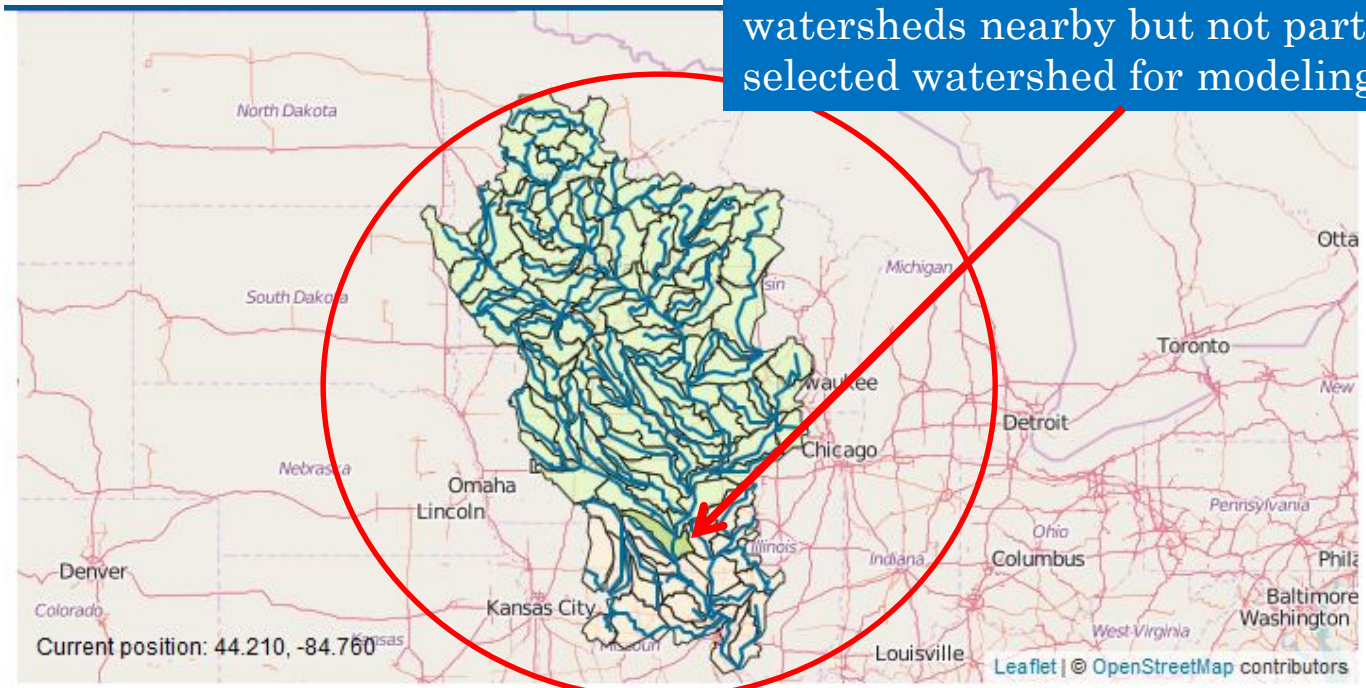
CREATE PROJECT – WATERSHEDS AND SUB-BASINS SELECTED

Watershed in dark green, sub-basins in lighter green color. Light yellow are other watersheds nearby but not part of the selected watershed for modeling



Create your project

The watershed shown above contains **92** subbasins and **28,523** HRUs from the head of the watershed to HUC **07110001**. View watershed routing.

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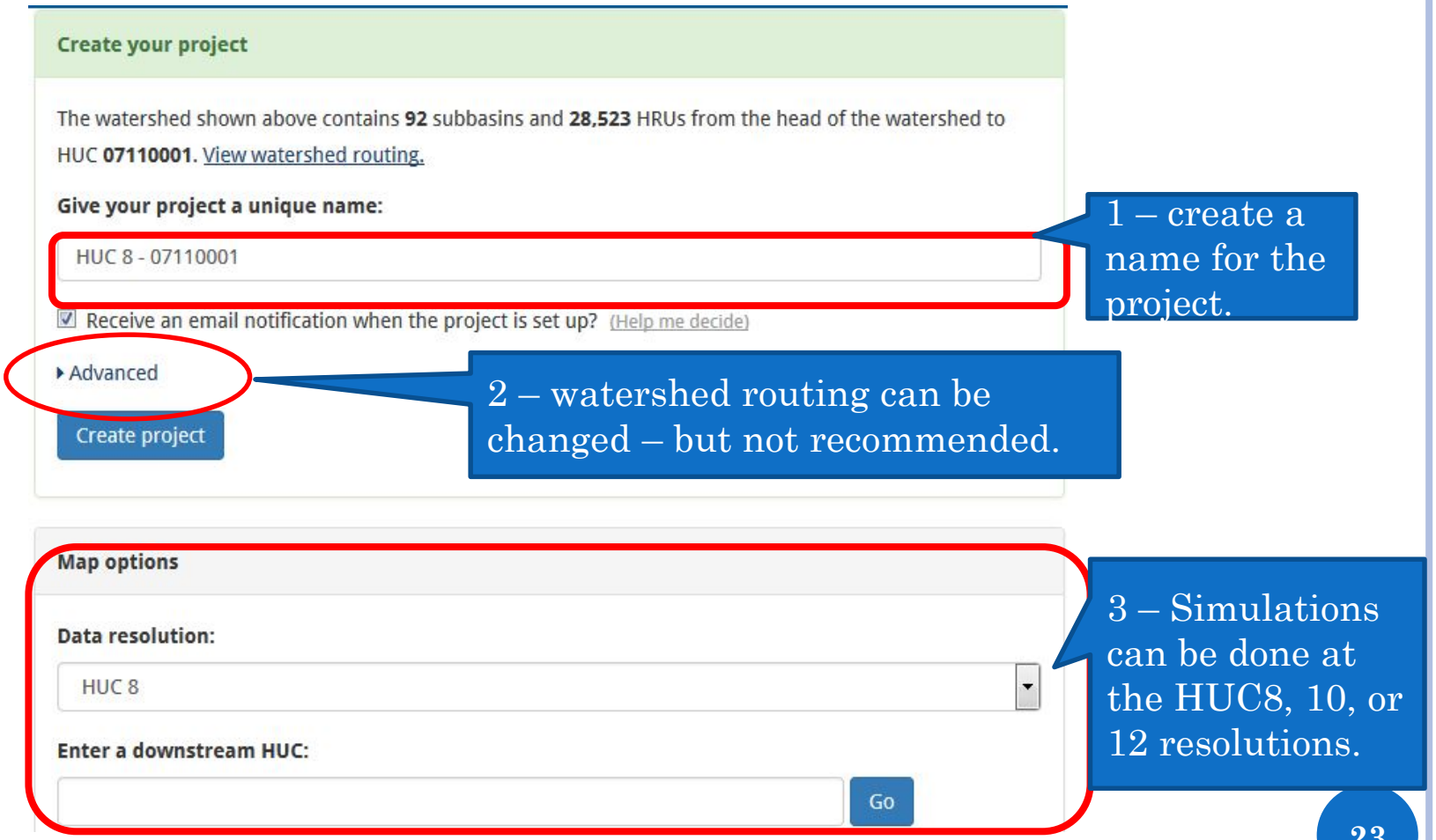
CREATE PROJECT – WATERSHEDS AND SUB-BASINS SELECTED



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PROJECT SUMMARY

1 – watershed summary

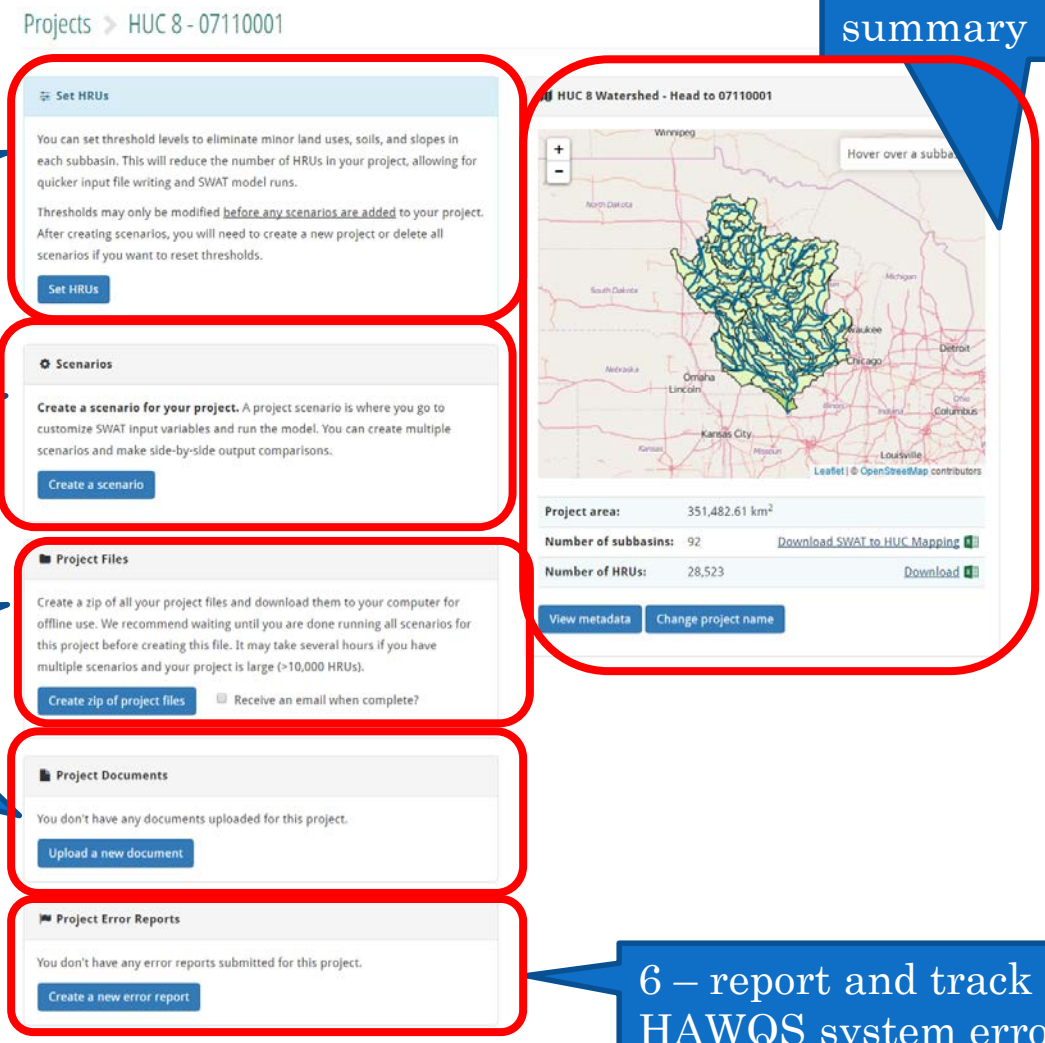
2 – set HRUs

3 – create a scenario

4 – download project files

5 – upload and store project related docs

6 – report and track HAWQS system errors



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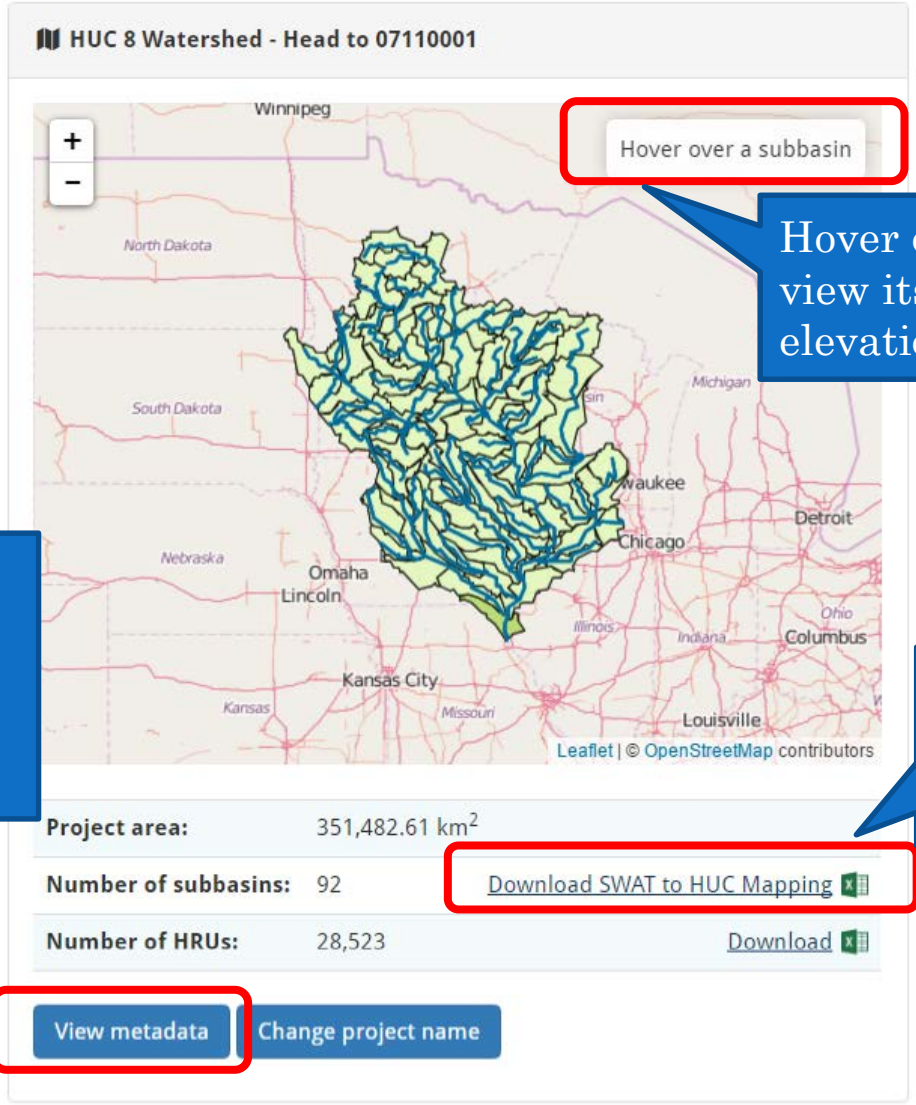
Project Summary - Watershed



Hover over a subbasin to view its HUC number, area, elevation, and coordinates

Metadata includes all input data changes for each scenario in your project

View SWAT designated IDs and corresponding HUC numbers

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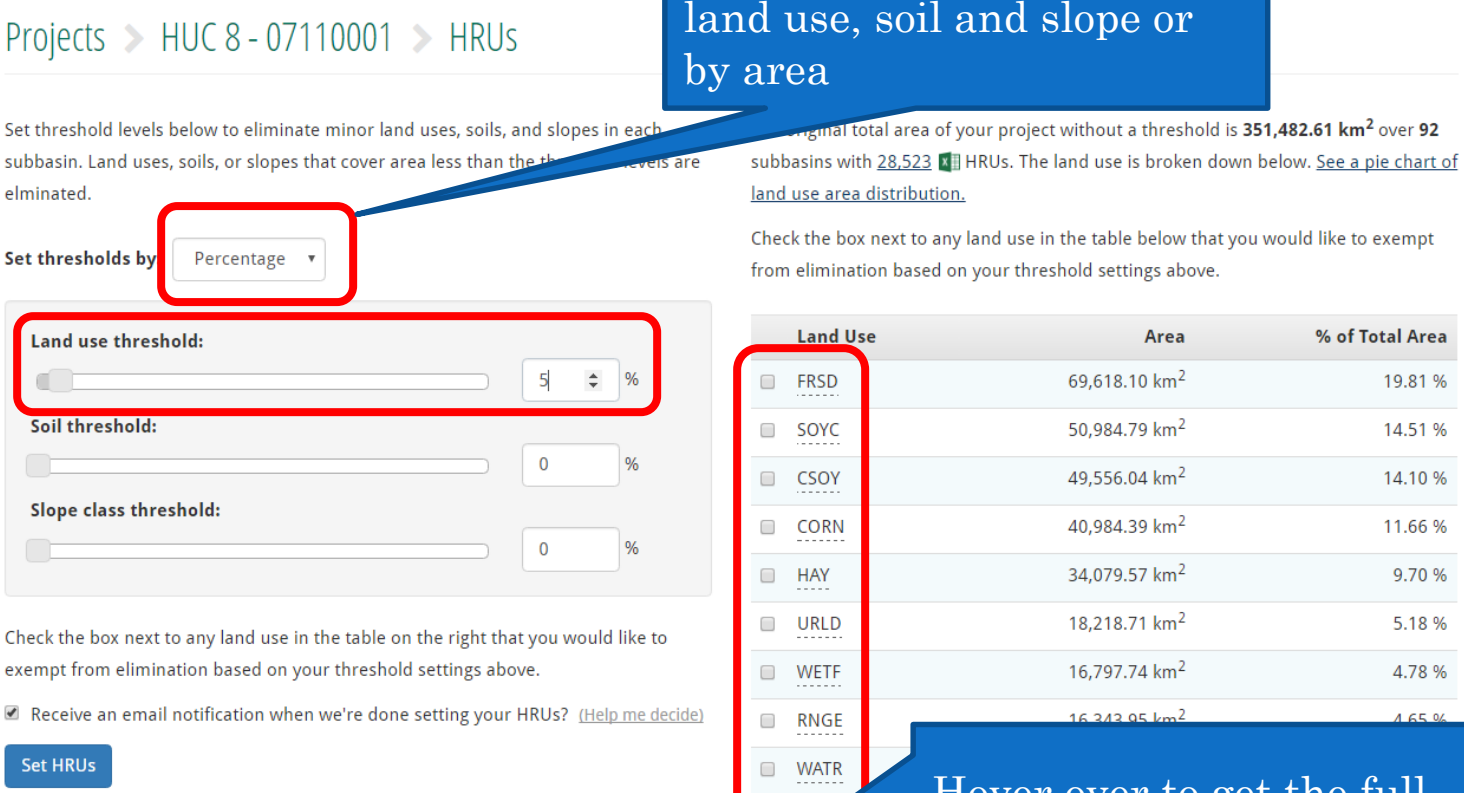
Set Project HRUs

Setting HRUs eliminates minor land uses, soils, and slopes in order to reduce the number of HRUs in your project to improve SWAT model run time.



Threshold can be set by % of land use, soil and slope or by area

Hover over to get the full description of the land use

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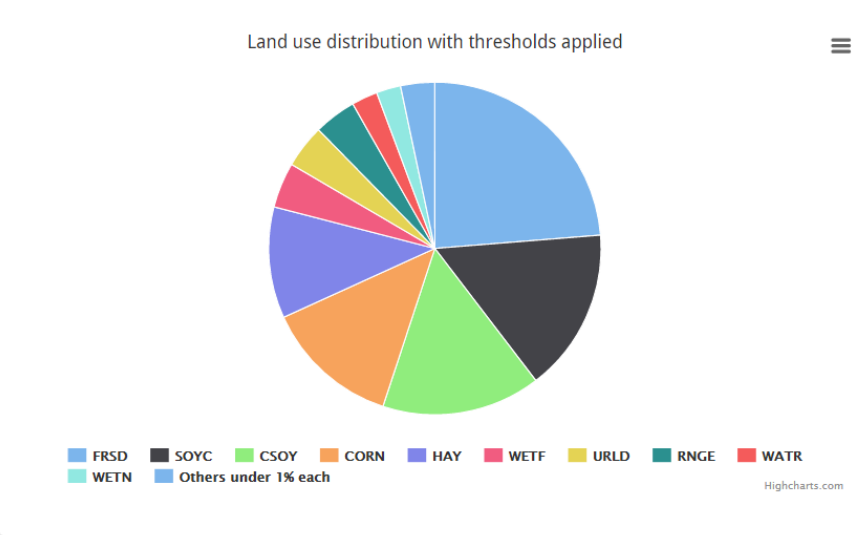
Set HRUs - Results

Your project originally had 28,523 HRUs. Setting thresholds reduced the number to 2,978 HRUs.

⚠ Note: once you create scenarios for your project, you will no longer be able to modify your HRUs.

Reset your HRUs

	Land Use	Soil Type	Slope Class
Thresholds	5%	5%	5%
Area redistribution	55,463.35 km^2	69,218.86 km^2	0.00 km^2



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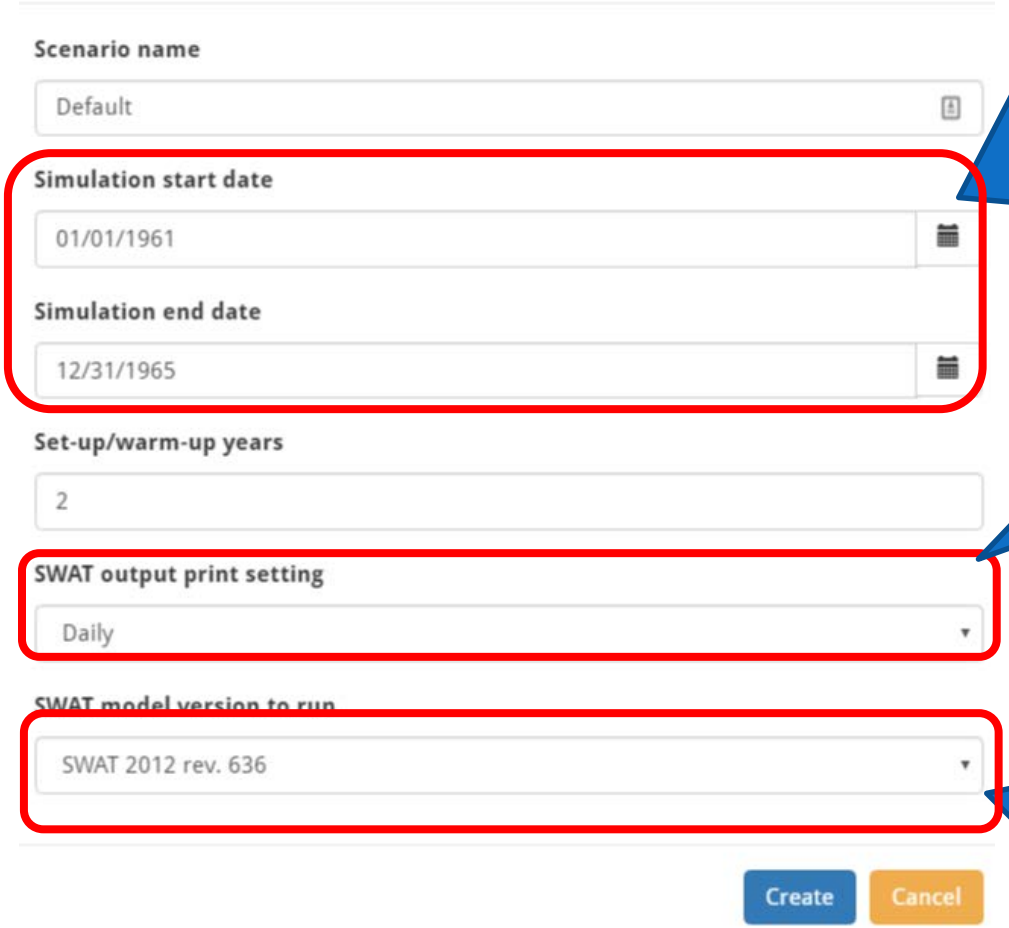
Create Scenario



By default, we set the simulation dates and warm-up years to a short time period to save server resources. A more realistic model run time will span 10-20 years with 5-10 years of model warm-up. The weather data available from 1960-2010

User can choose SWAT output frequency as daily, monthly or annual. Some of the output analysis tools will work with only daily output.

As the SWAT Model is updated, users may choose which version to run. Existing scenarios will not be updated unless the user requests it from the edit screen.

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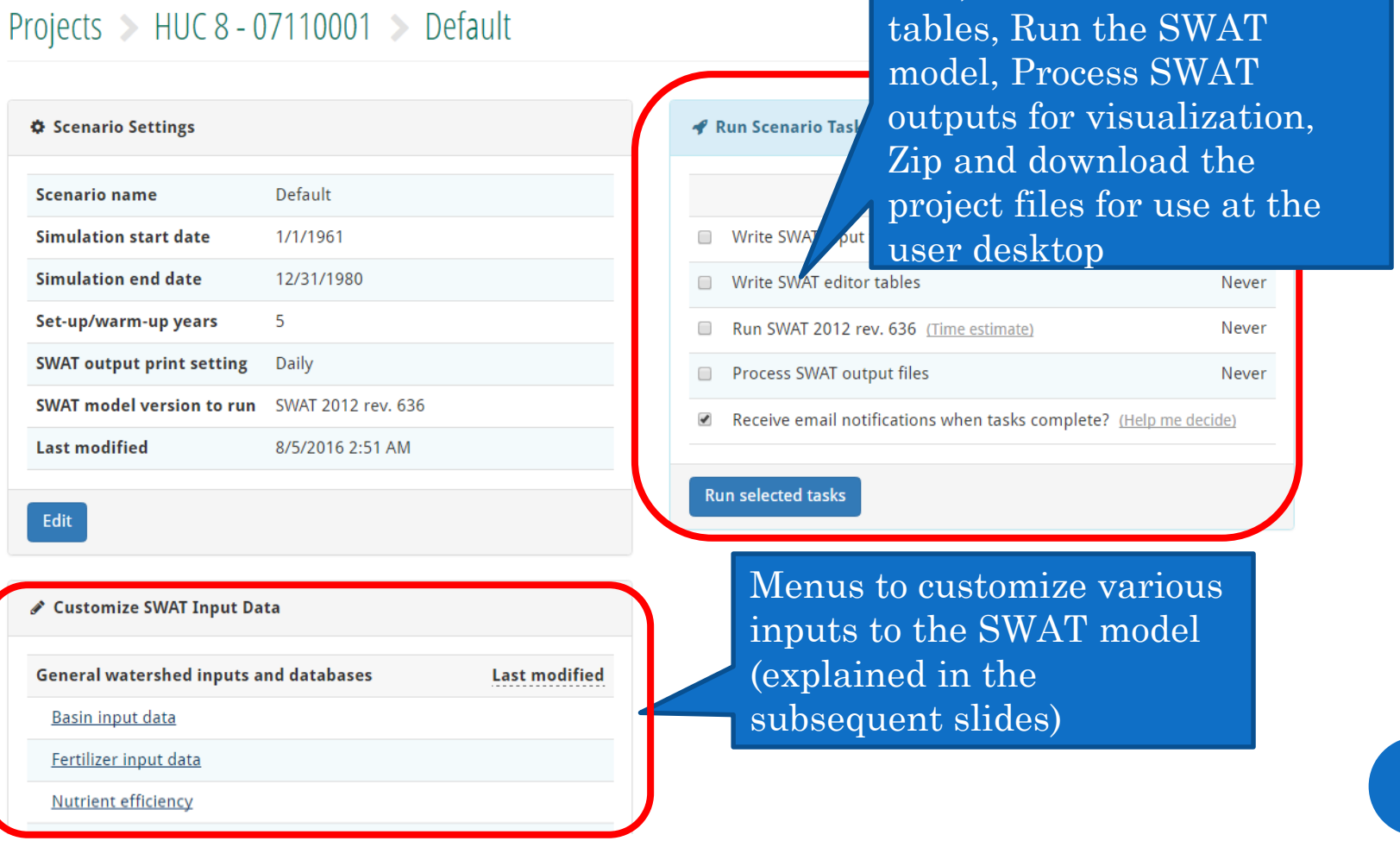
Scenario Summary Page



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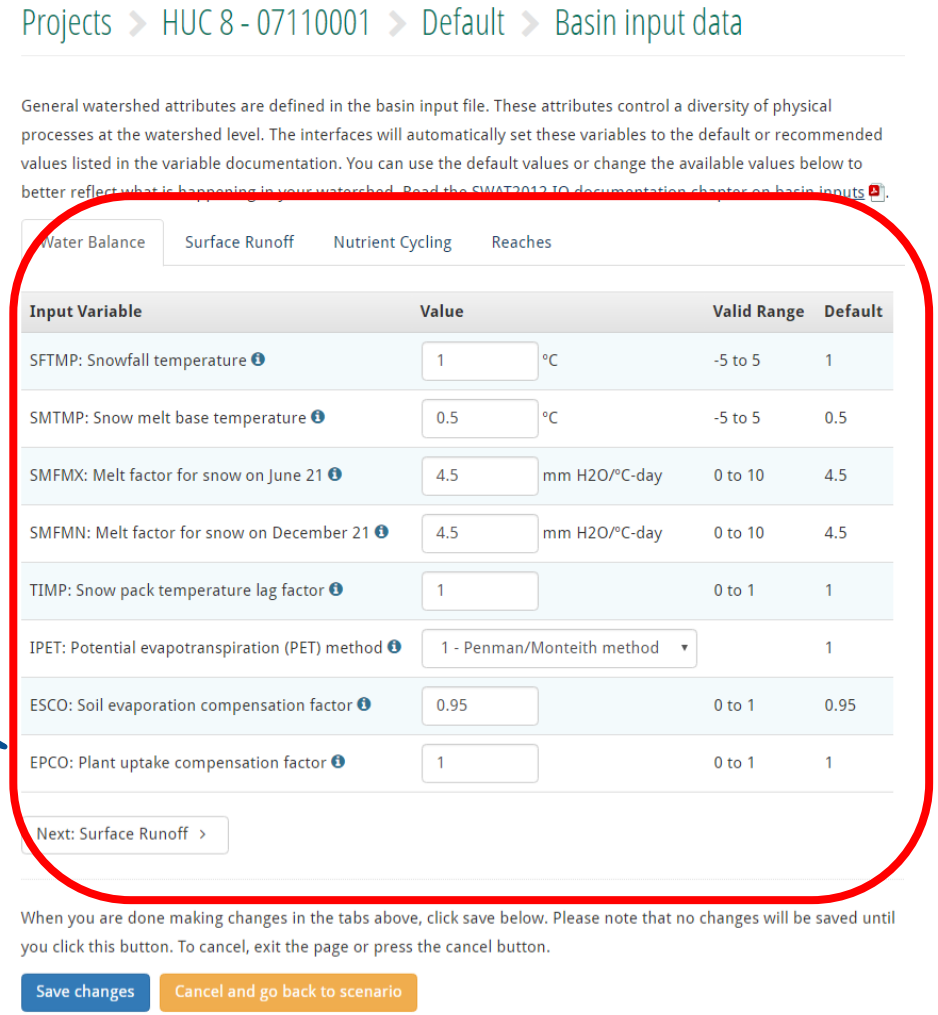
Customize SWAT Input – Basin Input Data

Basin wide input data such as water balance, surface runoff, nutrient cycling and reach data can be edited in this screen. The interface shows what is the default value in the model, typical range for the variable based on the literature and what is the value used by the model for this project which can be edited further by the user



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Customize SWAT Input – Fertilizers

Projects > HUC 8 - 07110001 > Default > Fertilizer input data

The fertilizer database summarizes the relative fractions of nitrogen and phosphorus pools in the different fertilizers. Read the SWAT2012 IO documentation chapter on fertilizer inputs.

	ID	Name	Description	Mineral N	Mineral P	Organic N	Organic P	Mineral N applied as NH3
Edit	1	Elem-N	Elemental Nitrogen	1.000	0.000	0.000	0.000	0.000
Edit	2	Elem-P	Elemental Phosphorous	0.000	1.000	0.000	0.000	0.000
Edit	3	ANH-NH3	Anhydrous					
Edit	4	UREA	Urea					
Edit	5	46-00-00	46-00-00					
Edit	6	33-00-00	33-00-00					

Edit Elemental Nitrogen

Input Variable	Value		Valid Range	Default
FMINN: Fraction of mineral N (NO3 and NH4) in fertilizer	1	kg min-N/kg fertilizer	0 to 2	1
FMINP: Fraction of mineral P in fertilizer	0	kg min-N/kg fertilizer	0 to 2	0
FORGN: Fraction of organic N in fertilizer	0	kg min-N/kg fertilizer	0 to 1	0
FORGP: Fraction of organic P in fertilizer	0	kg min-N/kg fertilizer	0 to 1	0
FNH3N: Fraction of mineral N in fertilizer applied as ammonia	0	kg min-N/kg fertilizer	0 to 1	0

Save Changes Cancel

Nutrients concentration can be modified in the fertilizer and manure data to run scenarios

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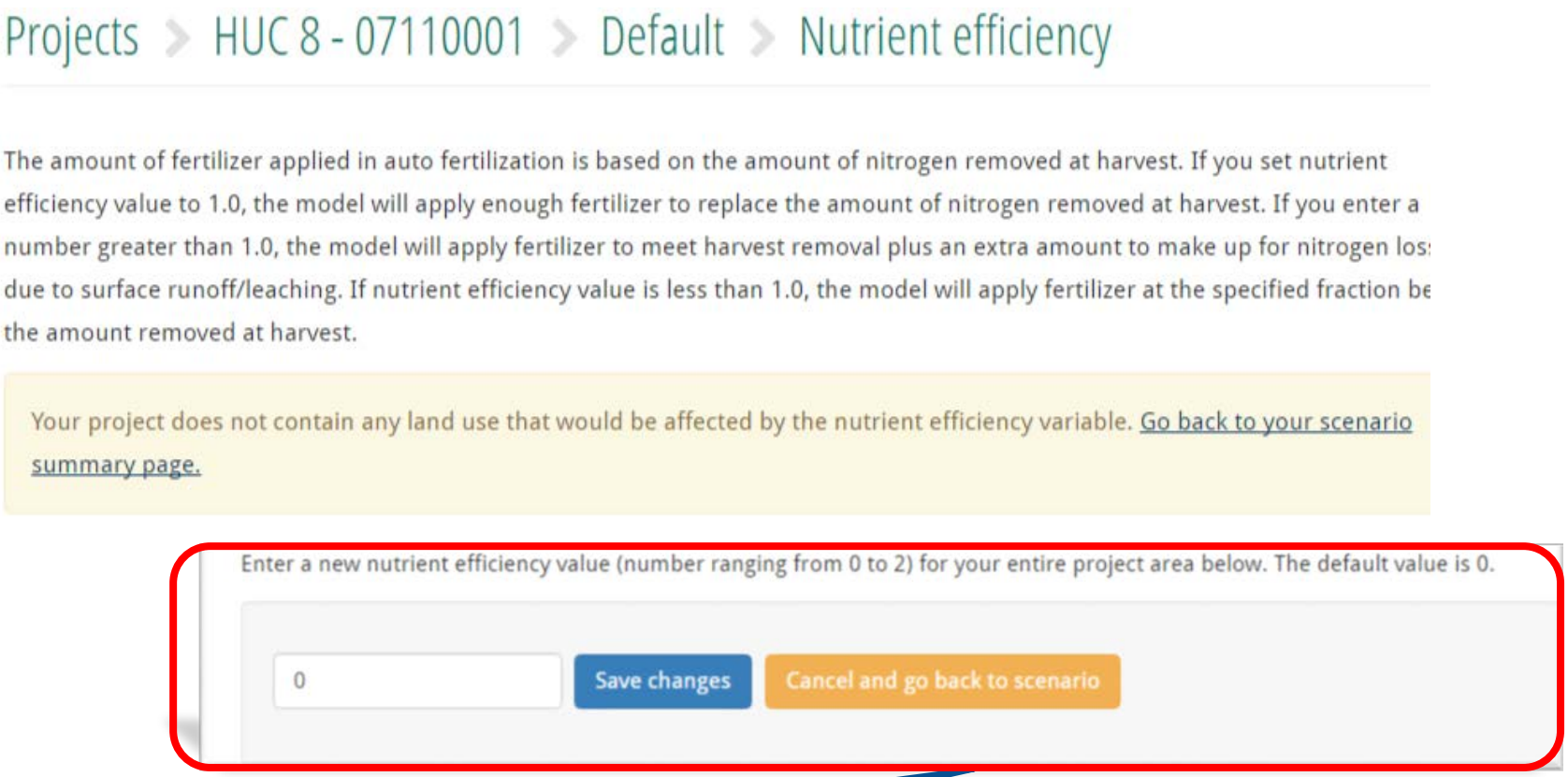
Customize SWAT Input – Nutrient Efficiency



Nutrients efficiency can be changed in the fertilizer run scenarios

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Customize SWAT Input – Urban Input Data

Projects > HUC 8 - 07110001 > Default > Urban input data

The urban database summarizes variables used by the model to simulate different types of urban areas. Read the SWAT2012 IO documentation chapter on urban inputs.

	ID	Name	Description	FIMP	FCIMP	CURBDEN	URBCOEF	DIRTMX	THALF	TNCONC	TPCONC	TNO3CONC	URBCN2
Edit	1	URHD	Residential-High Density	0.550	0.402	0.240	0.180	225.000	0.750	550.000	223.000	7.200	98.000
Edit	2	URMD	Residential-Medium Density	0.292	0.231	0.240	0.180	225.000	0.750	550.000	223.000	7.200	98.000
Edit	3	URML	Residential-Med/Low Density	0.200	0.170	0.240	0.180	225.000	0.750	460.000	196.000	6.000	98.000
Edit	4	URLD	Residential-Low Density										
Edit	5	UCOM	Commercial										
Edit	6	UIDU	Industrial										

Edit Residential-High Density

Input Variable		Value		Valid Range	Default
FIMP	Fraction total impervious area in urban land type	0.5501		0 to 1	0.5501
FCIMP	Fraction directly connected impervious area in urban land type	0.4016	km/ha	0 to 1	0.4016
CURBDEN	Curb length density in urban land type	0.23999		0 to 1	0.23999
URBCOEF	Wash-off coefficient for removal of constituents from impervious area	0.18	mm^{-1}	0 to 1	0.18
DIRTMX	Maximum amount of solids allowed to build up on impervious areas	225	kg/curb km	0 to 2000	225
THALF	Number of days for amount of solids on impervious areas to build up from 0 kg/curb km to half the maximum allowed, i.e. 1/2 DIRTMX	0.75	days	0 to 100	0.75

To update the urban land use properties such as pervious/impervious cover, N and P concentration loading can be modified to run urban land use scenarios

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Customize SWAT Input – Land use Update

Projects > HUC 8 - 07110001 > Default > Land use update

The land use update file (lup.dat) is an optional file which allows HRU fraction updating during a simulation run. The lup.dat file is particularly useful to initialize conservation measures mid-simulation. After their initialization, the practices remain in effect for the remainder of the simulation.

The lup.dat file must contain five parameters per line: sequential number, month, day, year, and name of the file that contains the fraction update. You are restricted to **25 lines** in lup.dat. Each file referenced in lup.dat must reserve the first line for comments, then for each line after contain the HRU number and updated HRU fraction value. The number of HRUs in the file must match the number of HRUs in your project or you will receive an error. In addition, the HRU fraction for each subbasin in your project must add up to one.

Download a sample zip file containing the file structure needed for your project.
Download your project HRUs.
Read the SWAT2012 IO Documentation chapter on land use update

Upload land use update zip file

Choose File No file chosen

Upload file | Cancel and go back to scenario

To update the land use the HAWQS menu provides listing of HRUs in the watershed being modeled along with sample input file for formatting the land use change scenarios and upload the same.

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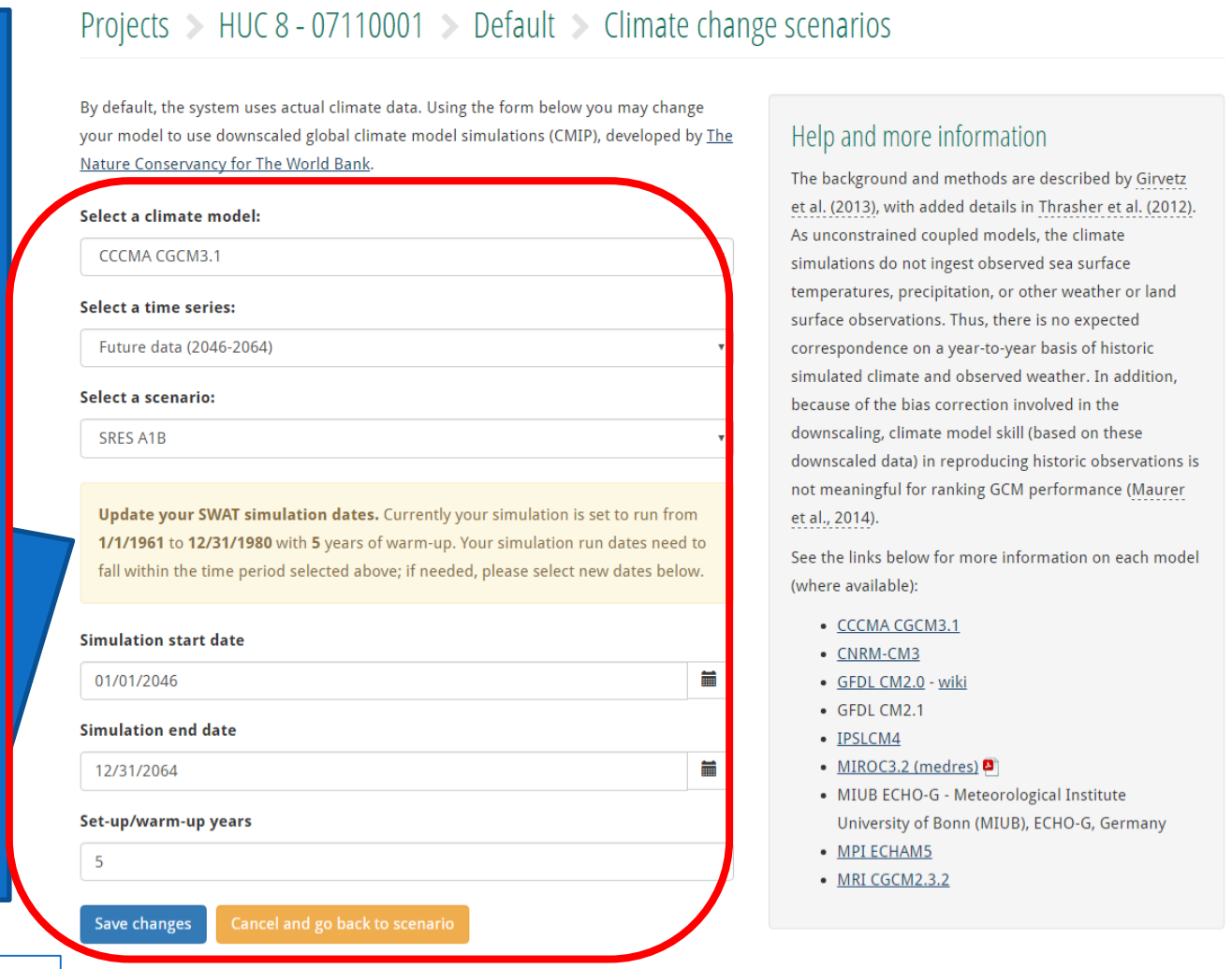
Customize SWAT Input – Climate Change Scenarios

This interface helps to choose a climate change model (9 GCM models are available), select time period of future simulation, and climate change scenarios. (in addition more reading resources are linked to learn more about various GCM models



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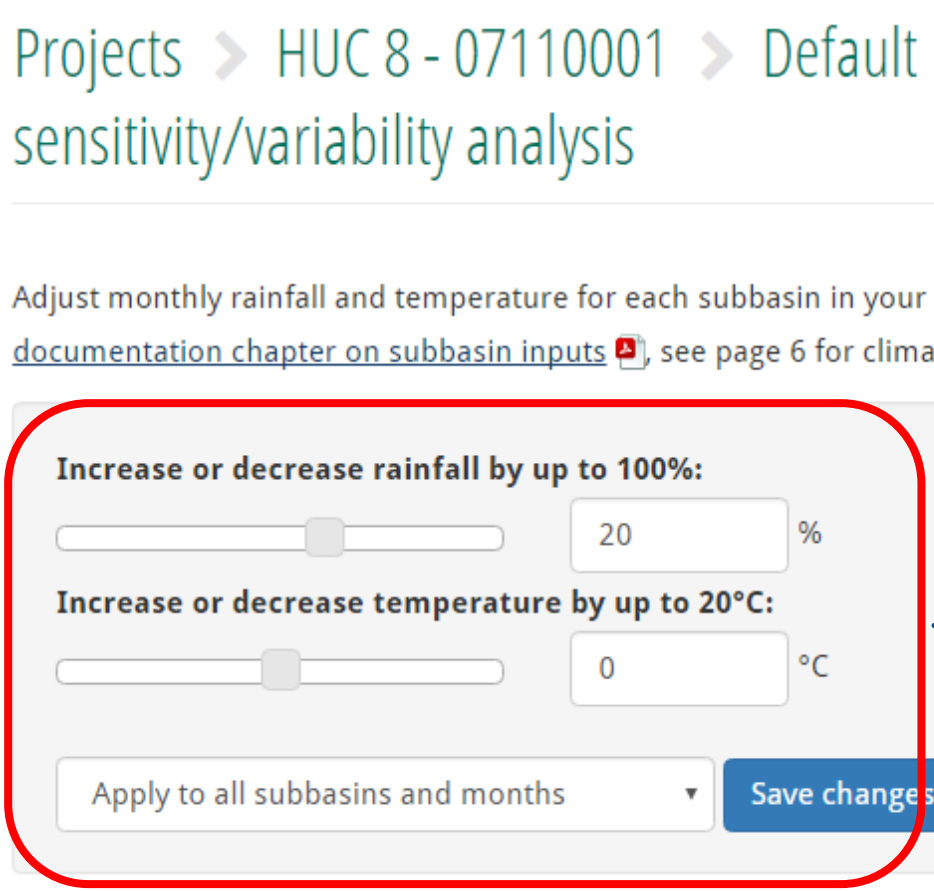
Customize SWAT Input – Climate sensitivity/variability analysis



Here climate sensitivity analysis can be performed by adjusting precipitation and temperature values by subbasin and by month

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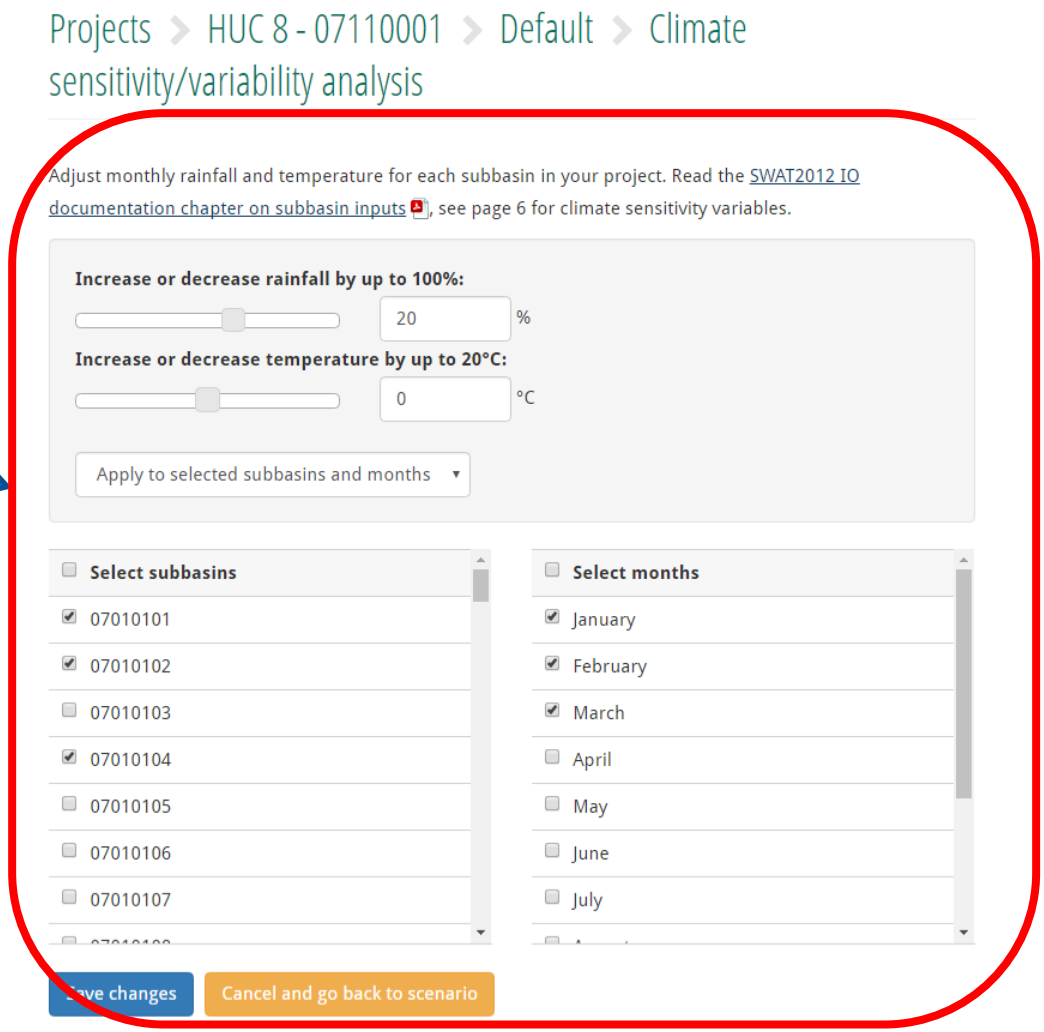
Customize SWAT Input – Climate sensitivity/variability analysis

This screen shows how the user can apply the change in climate variables by all or selected subbasins and all or selected months



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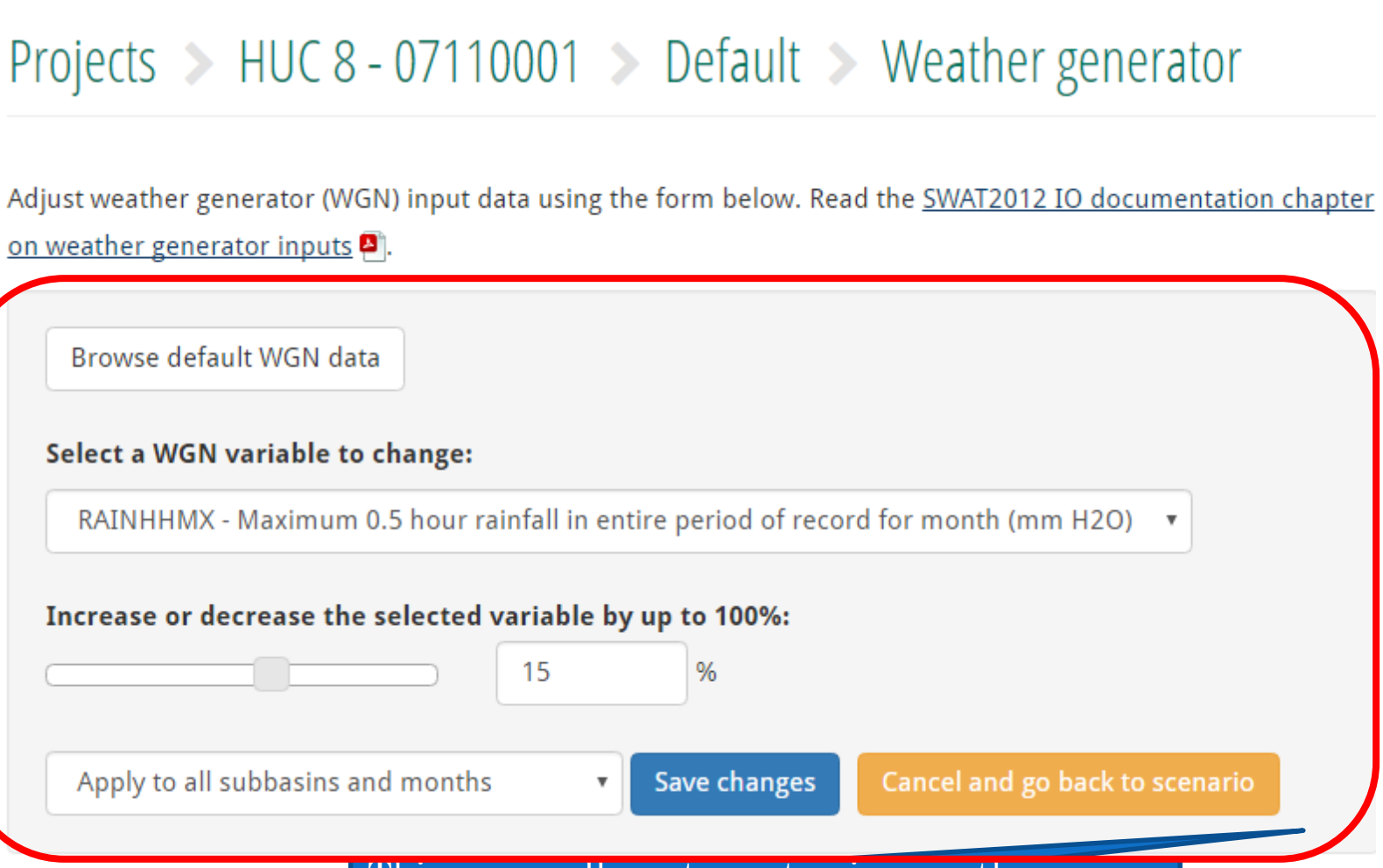
Customize SWAT Input – Weather Generator



This menu allows to customize weather generator variables by subbasin and by month

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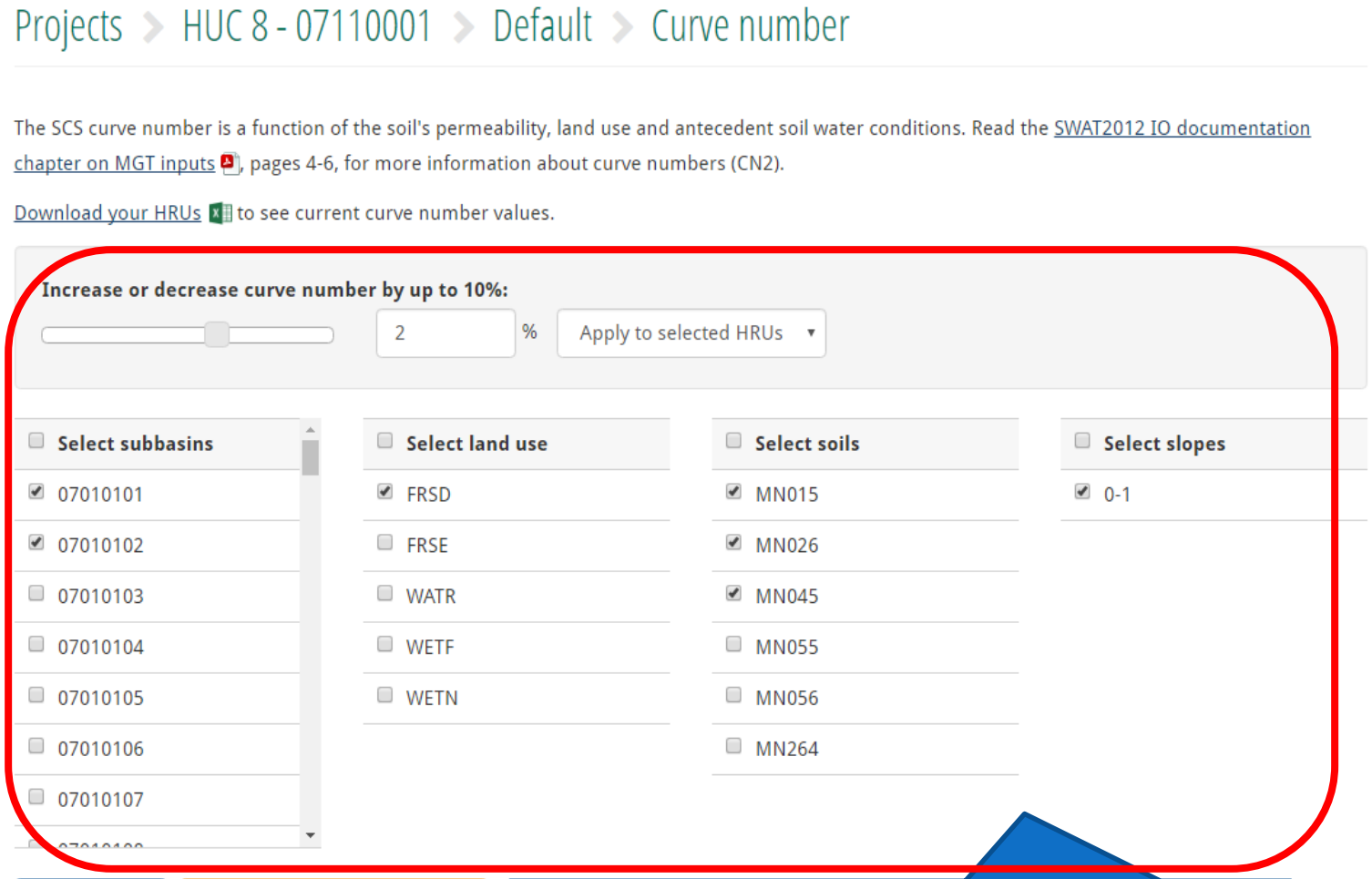
Customize SWAT Input – Curve Number



This menu allows to change SCS CN variable in the model by subbasin and by land use, soils and slope

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Customize SWAT Input – Curve Number – Saved Changes Table

Saved curve number modifications

We will provide a CSV file with your curve number values after you write your SWAT input files. Download your HRUs to see original curve number values without the modifications shown below.

NOTE: Each row below is applied in order, starting from the top. Bottom settings may overwrite rows above. Click here to remove all changes and use the default curve numbers.

CN2	Subbasins	Land Use	Soil	Slopes	Added	
2%	07010101	FRSD	MN026, MN045	0-1	8/5/2016 3:24 AM	✖
1%	07010102	WETF, WETN	MN015, MN026	0-1	8/5/2016 3:25 AM	✖

Once the inputs are modified the screen shows what HRUs in what subbasin will be affected and also allows to download the changes as a CSV file for user reference

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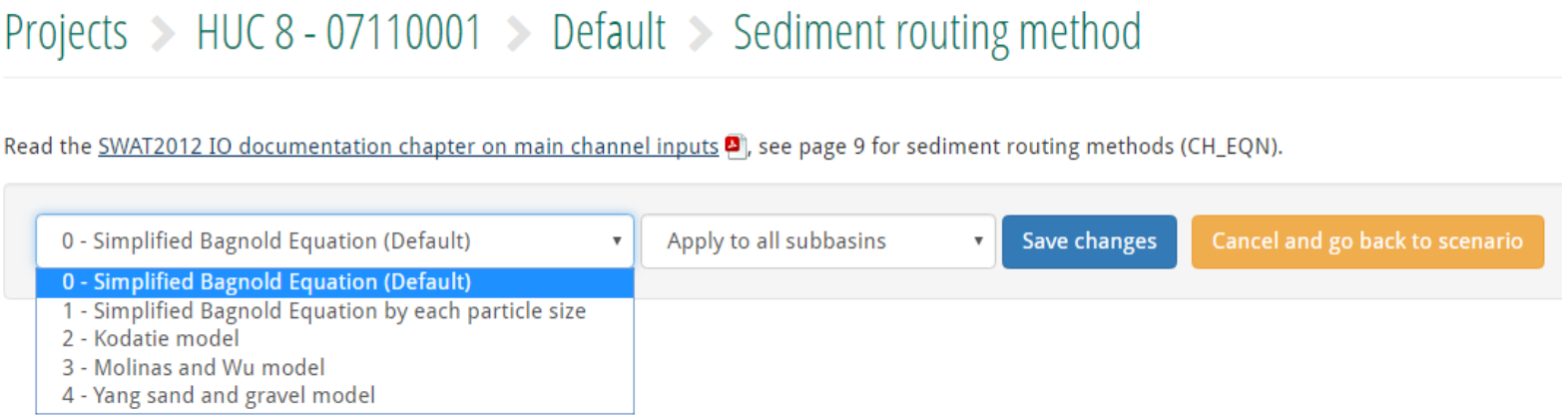
Customize SWAT Input – Sediment Routing Method



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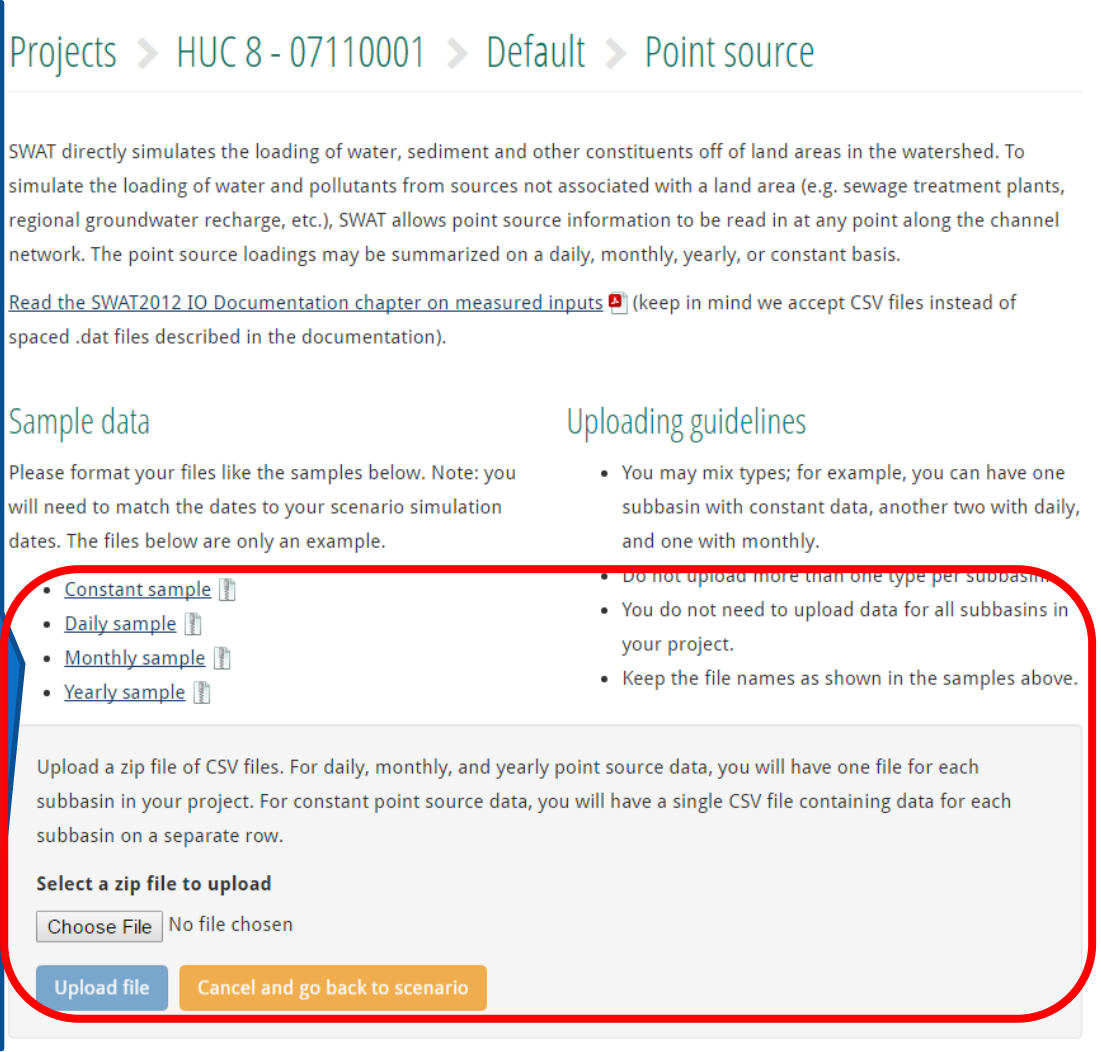
Customize SWAT Input – Point Source

User can update point source inputs in the HAWQS system. This menu provides sample file format of constant, daily, monthly or annual point source loadings by subbasin. Once the file is prepared on the desktop in a CSV format and zip them, the zipped file can be uploaded to be used as a point source scenario input in HAWQS



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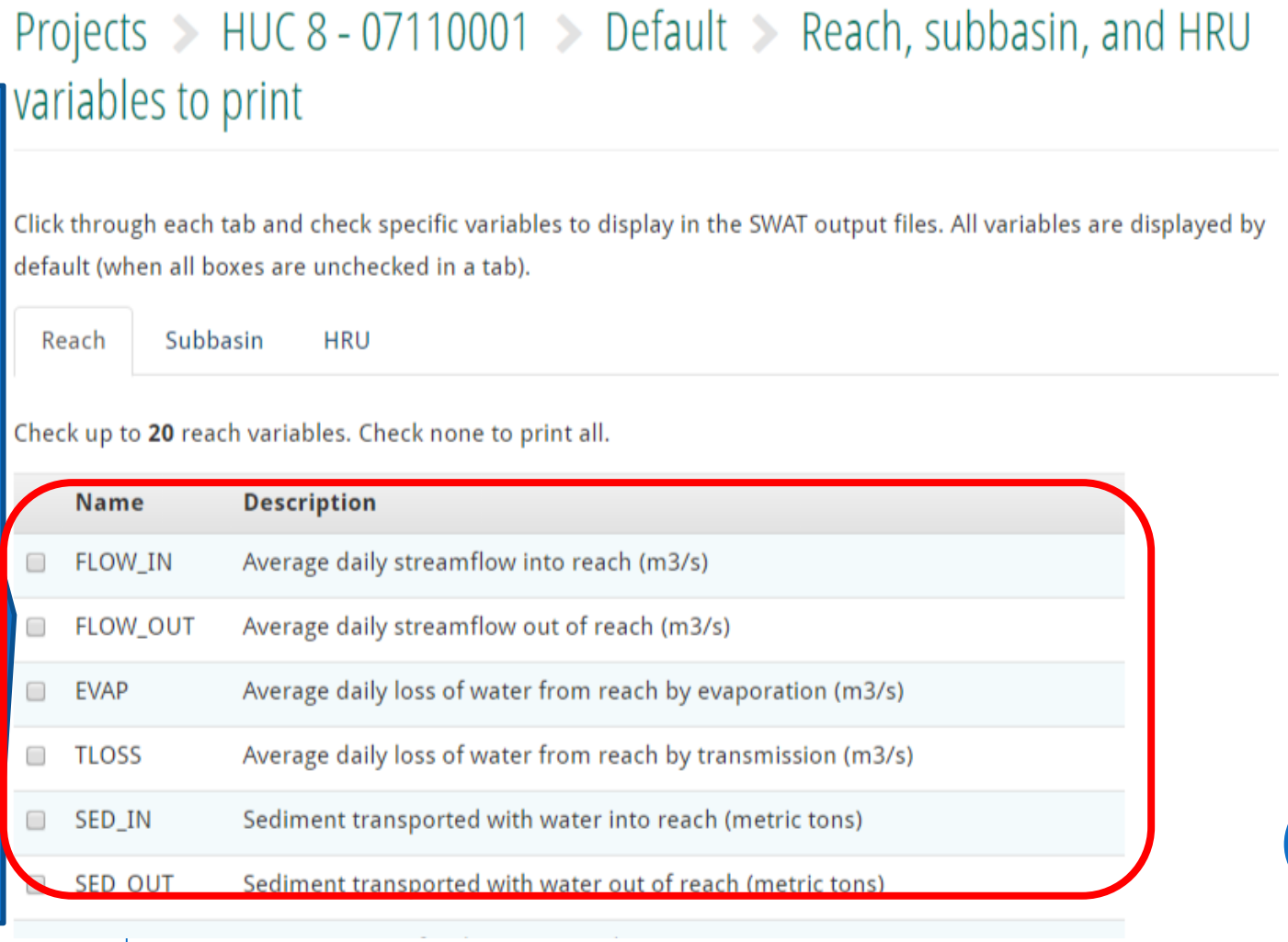
Customize SWAT Input – Print Variables

User can select up to 20 variables for each of the model output, if none selected all SWAT output variables will be printed



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CUSTOMIZE SWAT INPUT – PRINT HRUS

Projects > HUC 8 - 07110001 > Default > HRUs to print

Select up to 20 HRU IDs to print when running SWAT. Select IDs by typing them in the textbox below, separating each ID by a comma (e.g. 1,2,3).

By default, only the first HRU is printed in SWAT output in order to minimize SWAT model run time and output size. Due to the number of HRUs in your project, we cannot print all of them. You will need to reduce your HRUs to 1000 or fewer.

1 | Save changes | Cancel and go back to scenario

Download your HRUs and use the number written in the **Print ID** column in the text box above.

User can select up to 20 HRUs, if none selected all HRU outputs will be printed

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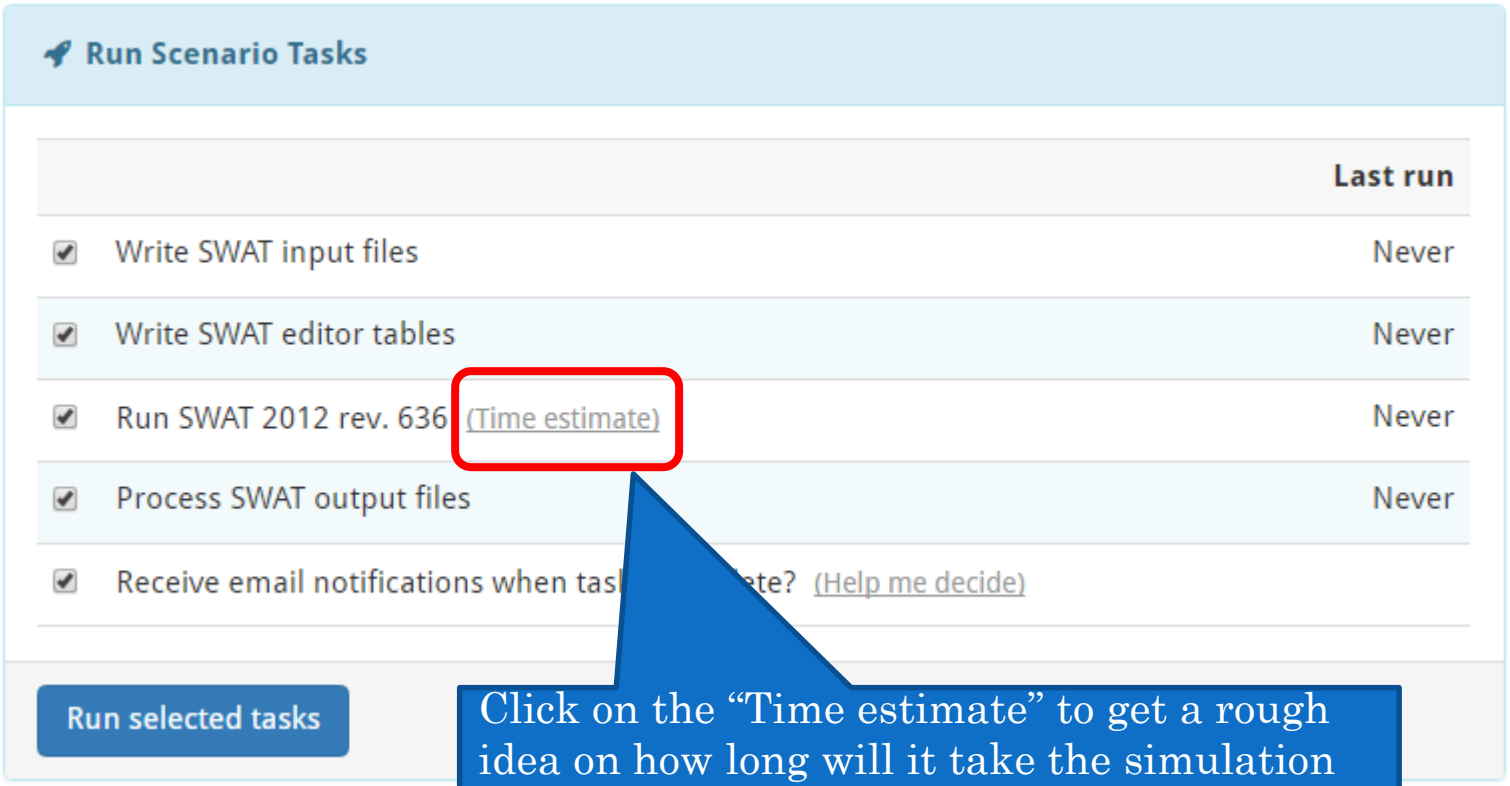
Scenario Summary – Run Tasks

When you are done modifying SWAT inputs for a summary, select tasks to run:



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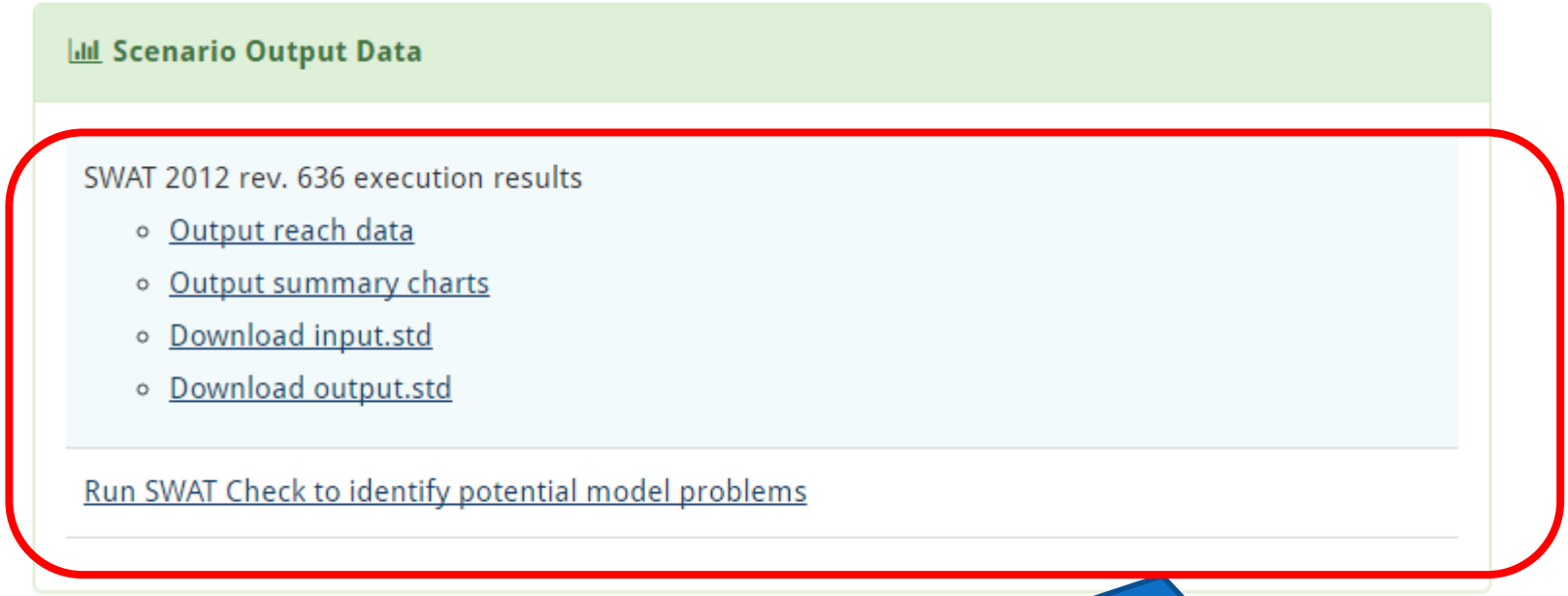
Scenario Summary – Output Data



Here user can download summary input and output files, view summary charts of hydrology and sediment by month and select to analyze the reach outputs. In addition the SWAT_check program can be run online to diagnose any issues with SWAT model inputs

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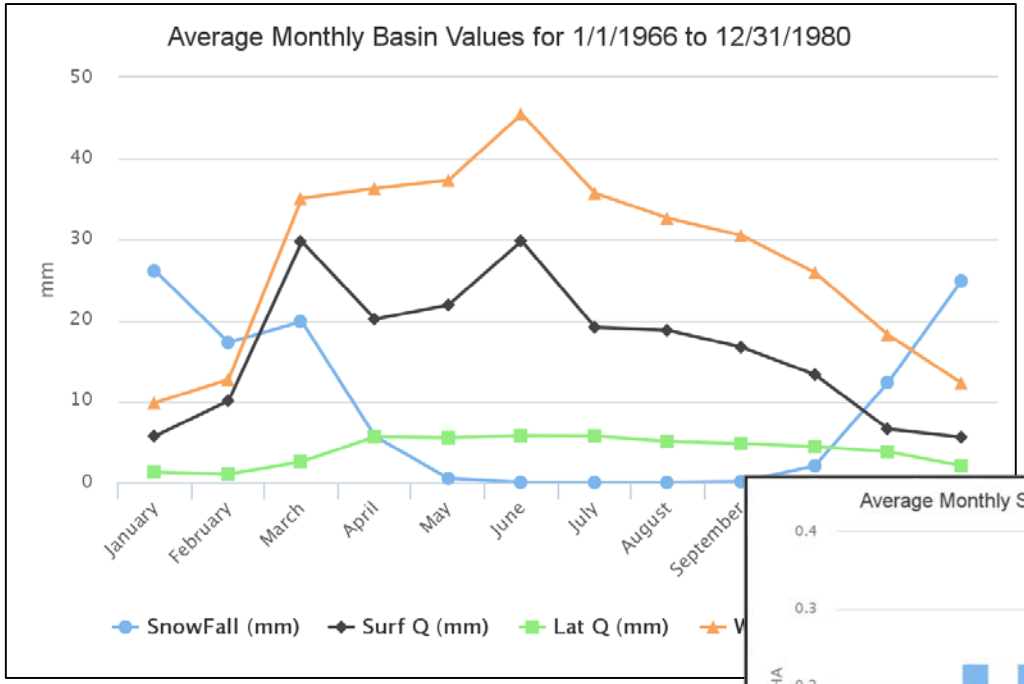
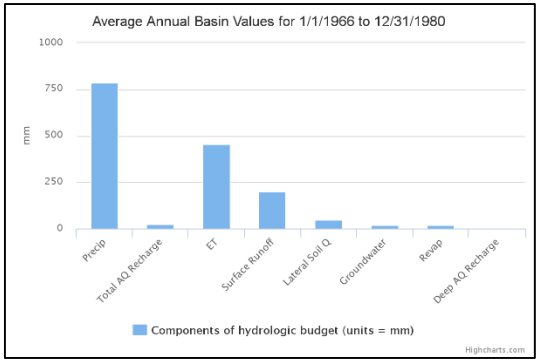
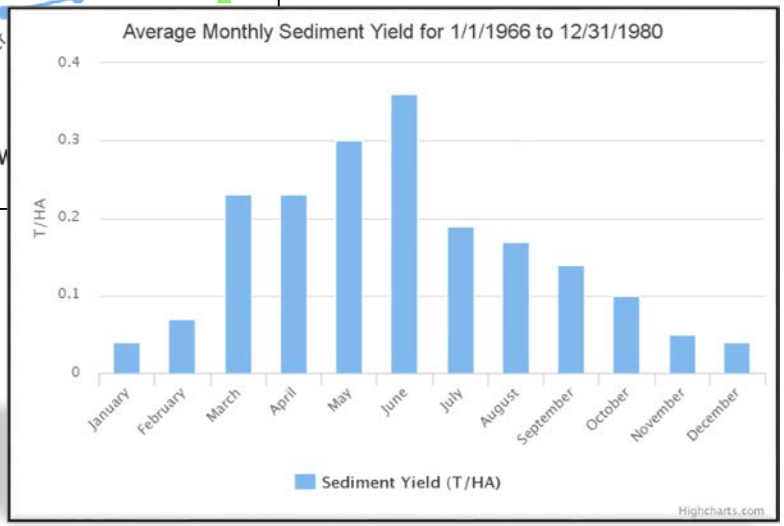
SWAT Output Analysis – Output Summary Charts







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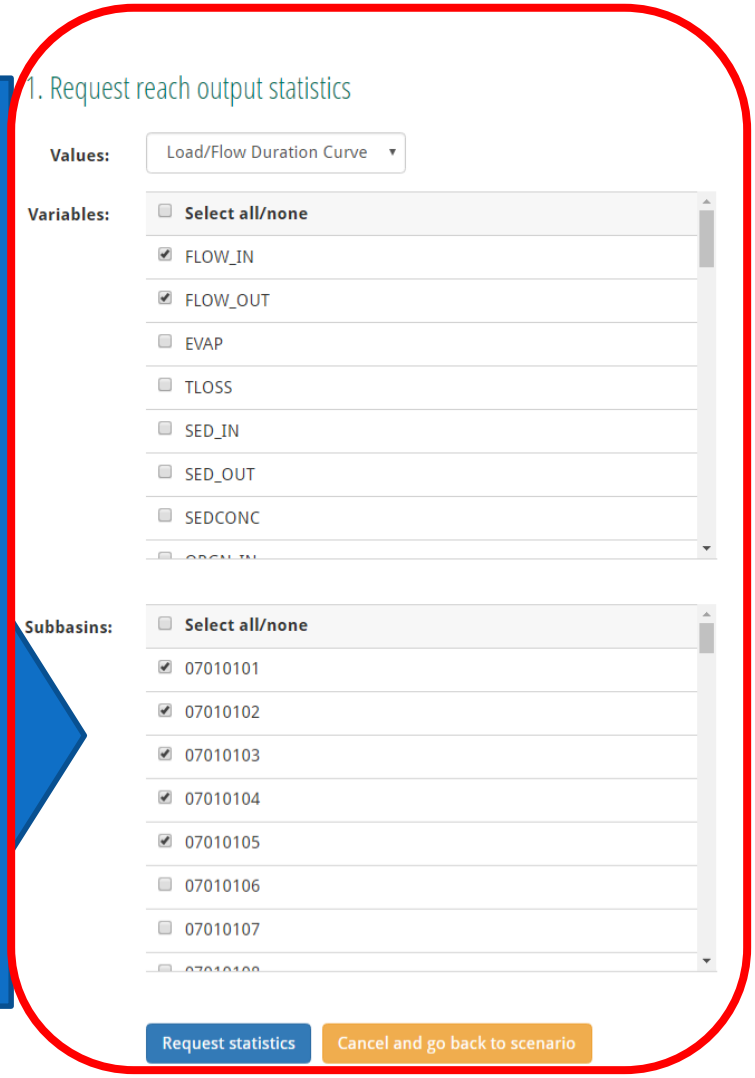
SWAT Output Analysis – Output Reach

Generate charts of SWAT reach output by subbasin. Available statistics are:

- Load/Flow Duration Curve
- Average
- Maximum
- Minimum
- Exceedances
- Percentile



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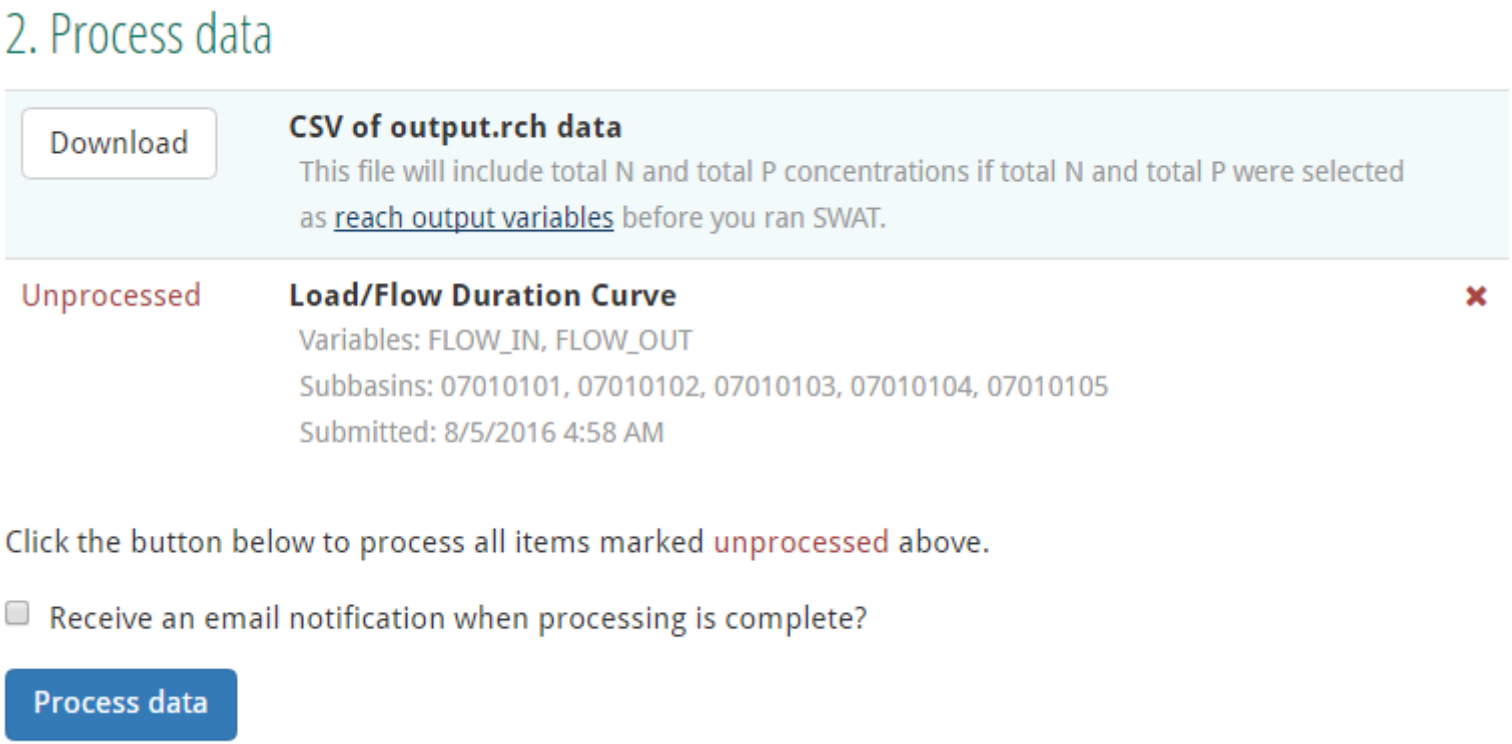
SWAT Output Analysis – Output Reach



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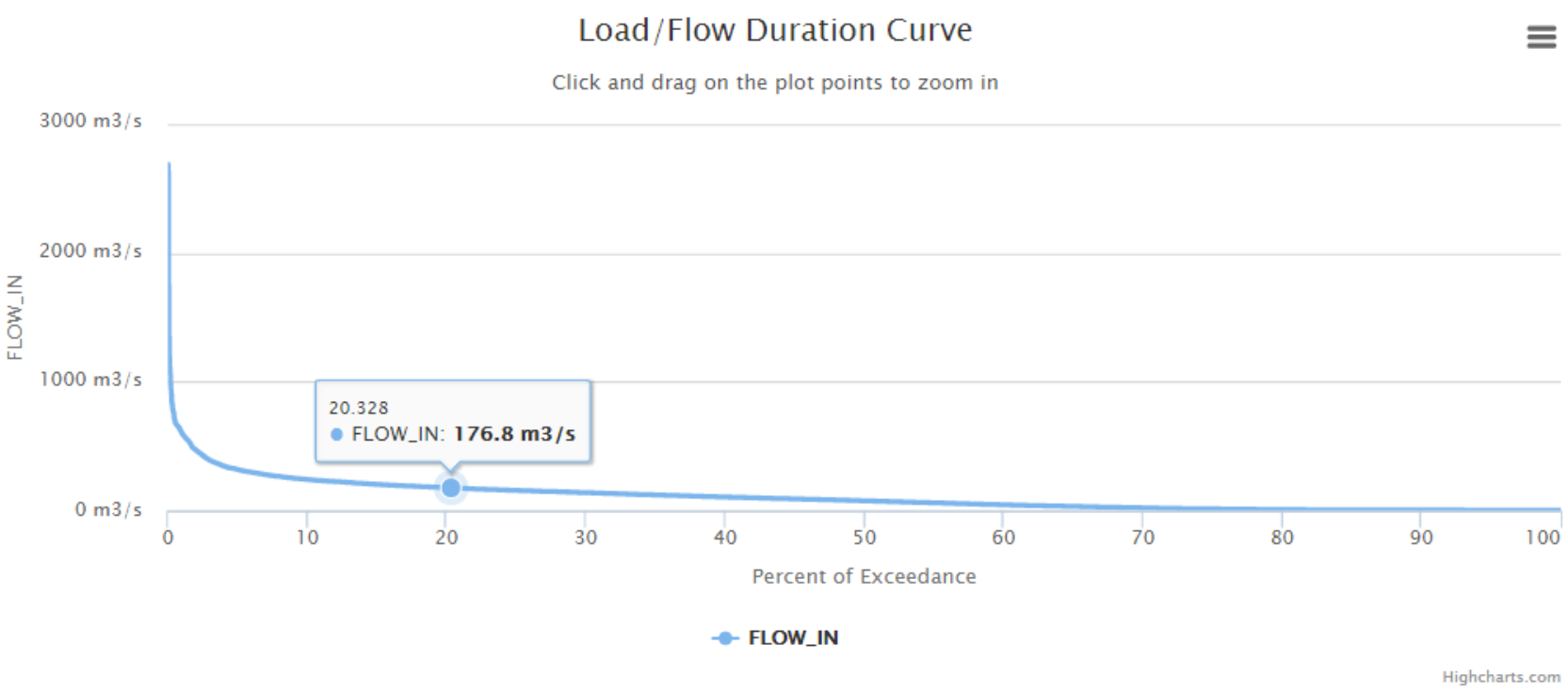
SWAT Output Analysis – Output Reach



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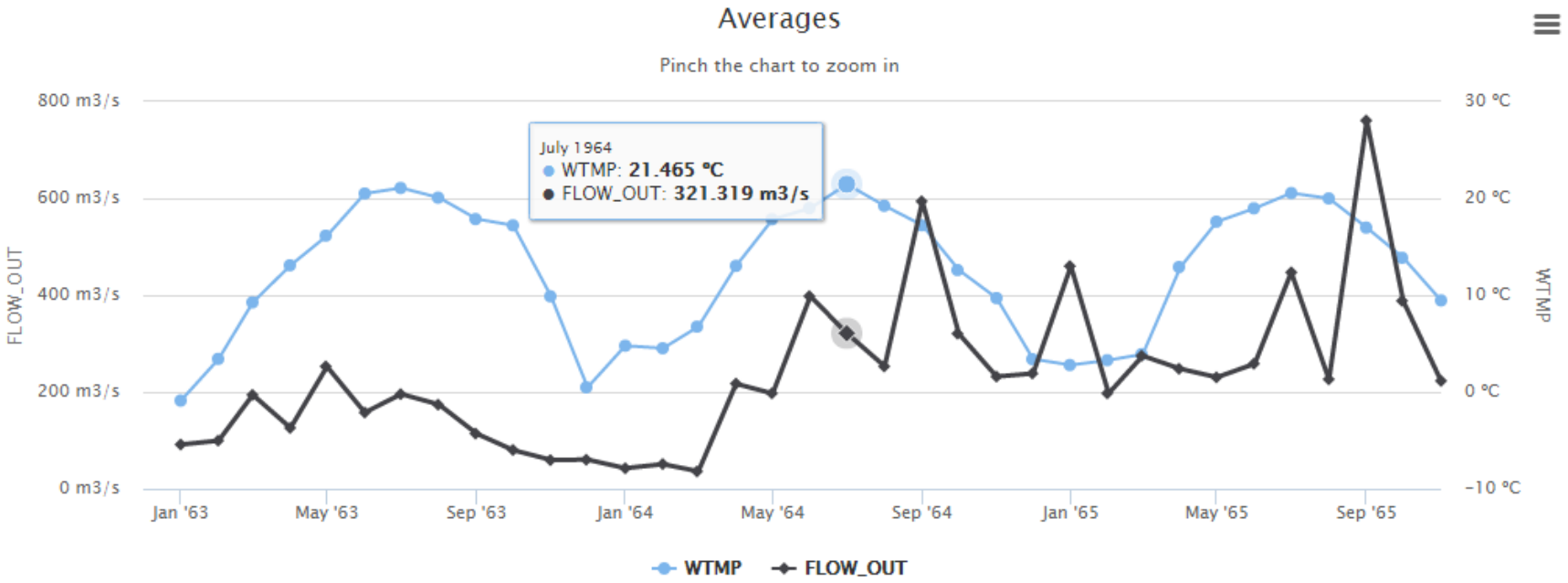
SWAT Output Analysis – Output Reach



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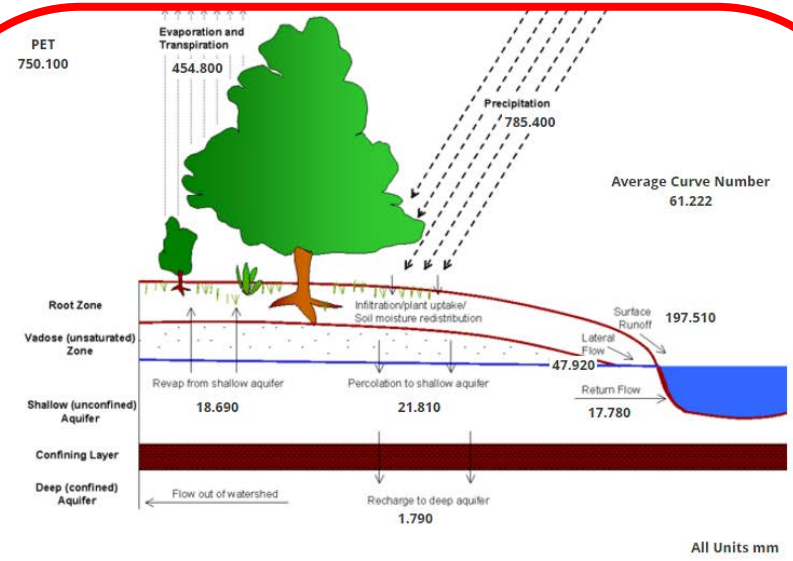
SWAT Output Analysis – SWAT Check

SWAT Check reads model output from a SWAT project and performs many simple checks to identify potential model problems. The intended purpose of this program is to identify model problems early in the modeling process



Sediment

Nitrogen Cycle

Phosphorus Cycle

Plant Growth

Landscape Nutrient Losses

Land Use Summary

Instream Processes

Point Sources

Reservoirs

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METADATA

Metadata keeps tracks of all inputs and changes in inputs for default and all the scenario runs

Projects > HUC 8 - 01070006 - merrimack > Metadata

This page lists your SWAT input data settings for each scenario in your project.

Watershed

Name	HUC 8 - 01070006 - merrimack
Data Resolution	HUC 8
Starting HUC ID	Head
Ending HUC ID	01070006
Number of Subbasins	6
Project Area	12,968.29 km^2

HRUs

Original number of HRUs	1,302
Number of HRUs	823
Land Use Threshold	1 km^2
Soil Type Threshold	1 km^2
Slope Class Threshold	1 km^2
Land Use Classes Exempted	None

Scenarios

Scenario Name	Simulation Start Date	Simulation End Date	Set-up/Warm-up Years	Print Setting	Climate Data
Climate change - cmip5 -hadgcm-85-2070-2100	1/1/2065	12/31/2099	5	Daily	HadGEM2-ES, RCP85, Future data (2006-2099)
Climate change - cmip5 - rcp85 - esm (Copy)	1/1/2065	12/31/2099	5	Daily	CanESM2, RCP85, Future data (2006-2099)
Climate change - cmip5 - rcp85 - esm	1/1/2015	12/31/2050	5	Daily	CanESM2, RCP85, Future data (2006-2099)
Climate change - cmip5	1/1/2015	12/31/2050	5	Daily	HadGEM2-ES, RCP85, Future data (2006-2099)
Default	1/1/1965	12/31/2000	5	Daily	Actual climate data (default)

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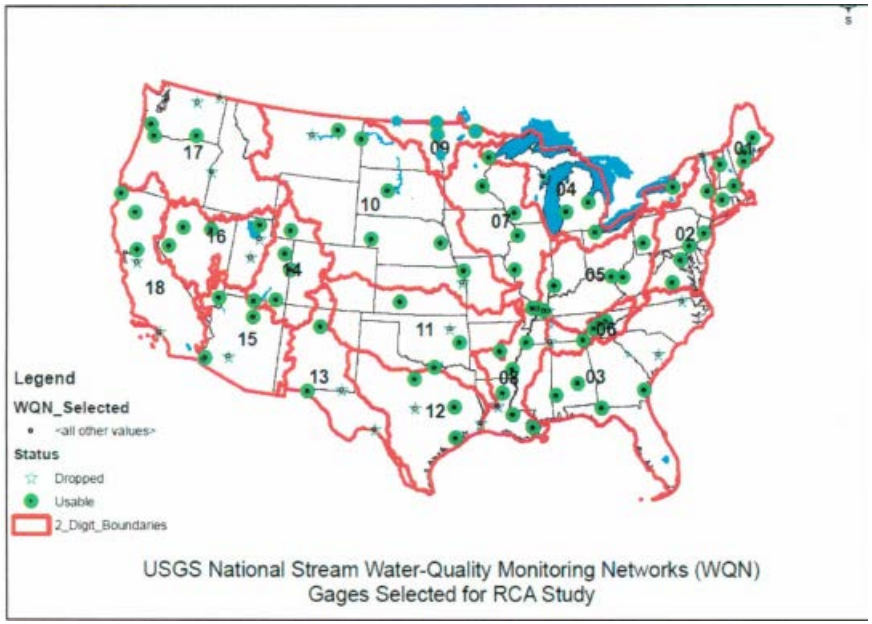
HAWQS - CALIBRATION

- Monthly calibration for flow, sediment, Total N and P were performed on selected sites at the 8-digit basin for the available data
- The calibrated parameters were extended to other 10 and 12 digit basin scales



- Calibration is a continuous process as more data becomes available and from current and prospective users

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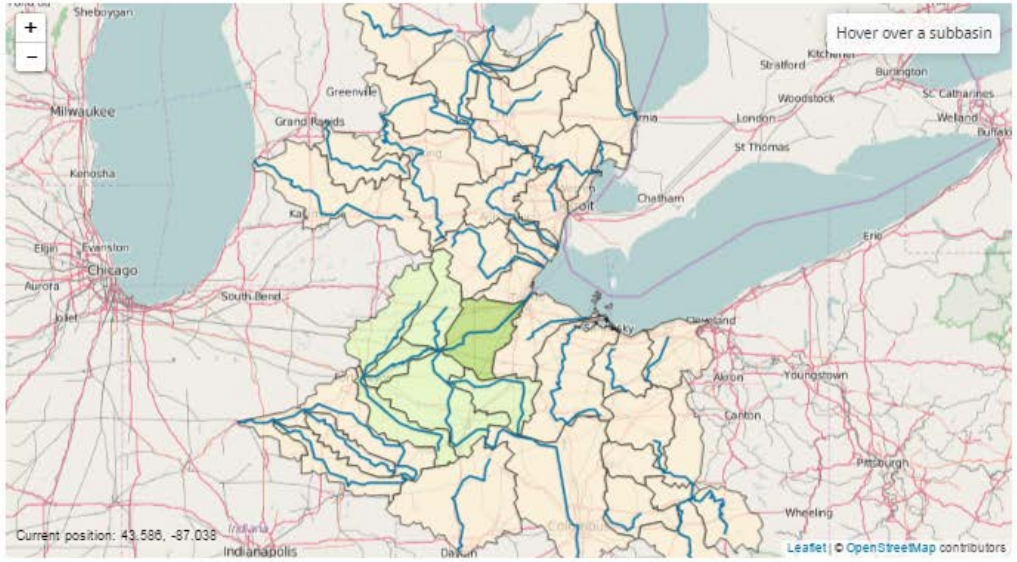
USE CASE EXAMPLE: MAUMEE RIVER BASIN

Click the map near the downstream point of your watershed to begin. The map will display the upstream HUCs of your watershed as well as other nearby HUCs.



Map options

Data resolution:

HUC 8

Enter a downstream HUC:

Go

Map legend

- HUC in the watershed
- Downstream HUC
- HUCs surrounding downstream HUC, but not in the watershed
- Stream

Create your project

The watershed shown above contains **7** subbasins and **1,892** HRUs from the head of the watershed to HUC **04100009**. View watershed routing.

Give your project a unique name:

HUC 8 - 04100009

Receive an email notification when the project is set up? (Help me decide)

Advanced

Create project

Disclaimer

You may find that the total area of a watershed in HUC 8 does not match the area of the watershed in HUC 10 or HUC 12 resolutions. Some of the 10 and 12-digit basins do not flow into the big subbasins because they are closed subbasins; i.e., the rivers do not flow out of the subbasin.

Watershed area still look incorrect? Please submit an error report and we will look into it.

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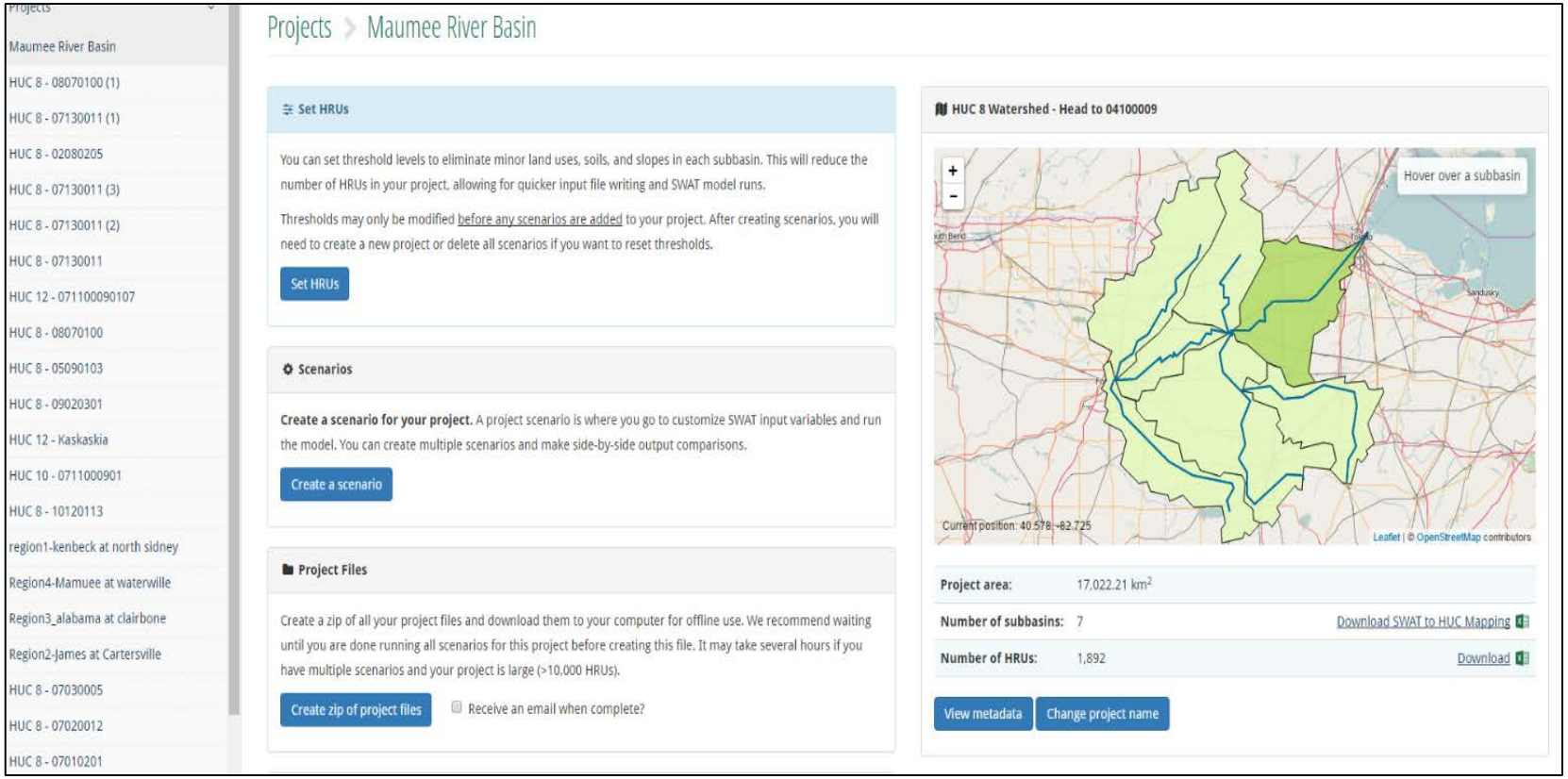
Use Case Example: Maumee River Basin



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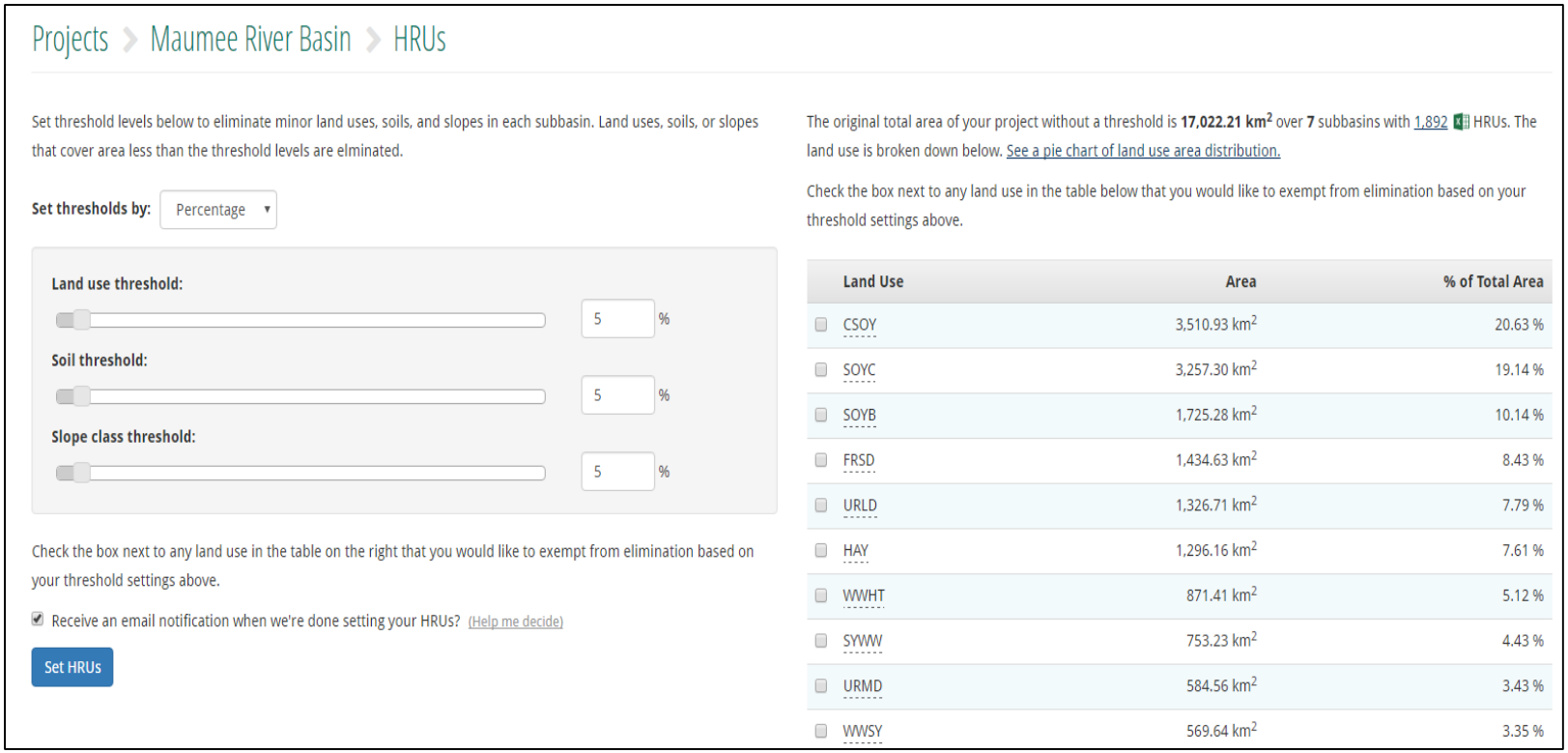
Use Case Example: Maumee River Basin – Set HRUs



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Use Case Example: Maumee River Basin – Set HRUs

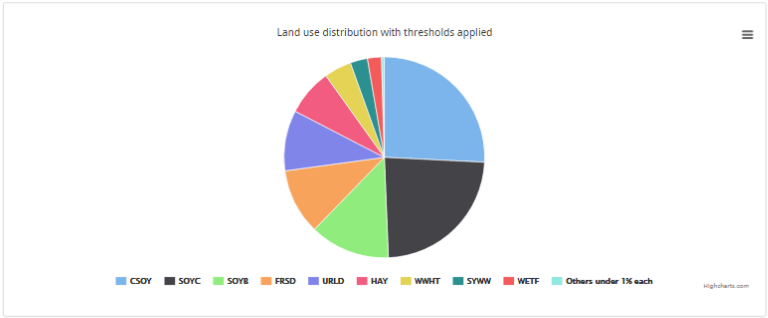
Projects > Maumee River Basin > HRUs

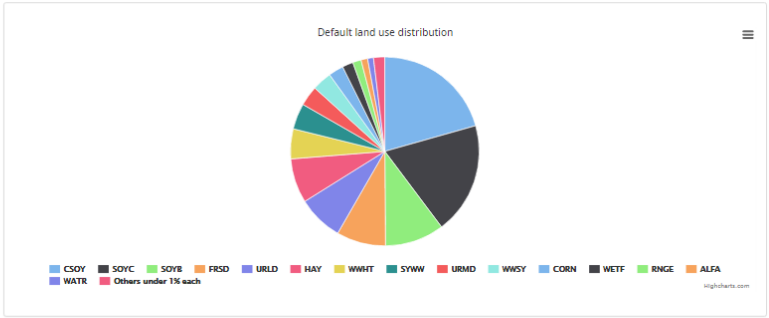
Your project originally had 1,892 HRUs. Setting thresholds reduced the number to 229 HRUs.

⚠ Note: once you create scenarios for your project, you will no longer be able to modify your HRUs.

Reset your HRUs

	Land Use	Soil Type	Slope Class
Thresholds	5%	5%	5%
Area redistribution	3,400.22 km²	2,490.64 km²	0.00 km²





Land use distribution comparison

	With thresholds applied		Original	
Land Use	Area	% of Total Area	Area	% of Total Area
CSOY	4,387.55 km²	25.78 %	3,510.93 km²	20.63 %
SOYC	4,015.94 km²	23.59 %	3,257.30 km²	19.14 %
SOYB	2,196.35 km²	12.90 %	1,725.28 km²	10.14 %
FRSD	1,803.18 km²	10.59 %	1,434.63 km²	8.43 %
URLD	1,657.15 km²	9.74 %	1,326.71 km²	7.79 %
HAY	1,277.65 km²	7.51 %	1,296.16 km²	7.61 %
WWHT	752.38 km²	4.42 %	871.41 km²	5.12 %
SYWW	473.08 km²	2.78 %	753.23 km²	4.43 %
URMD	74.02 km²	0.43 %	584.56 km²	3.43 %
WWSY	-	-	569.64 km²	3.35 %
CORN	-	-	439.55 km²	2.58 %

Soils and slope classes after applying thresholds

Soil Type	Area	% of Total Area
OH022	4,628.20 km²	27.19 %
OH006	2,867.75 km²	16.85 %
IN005	1,539.78 km²	9.05 %
IN004	1,410.36 km²	8.29 %
OH017	1,160.23 km²	6.82 %
OH009	1,115.83 km²	6.56 %
OH021	980.76 km²	5.76 %
OH014	814.39 km²	4.78 %
OH005	561.81 km²	3.30 %
MI017	515.63 km²	3.03 %
MI055	491.93 km²	2.89 %
OH011	334.02 km²	1.96 %

Slope Class	Area	% of Total Area
0-1	17,022.21 km²	100.00 %

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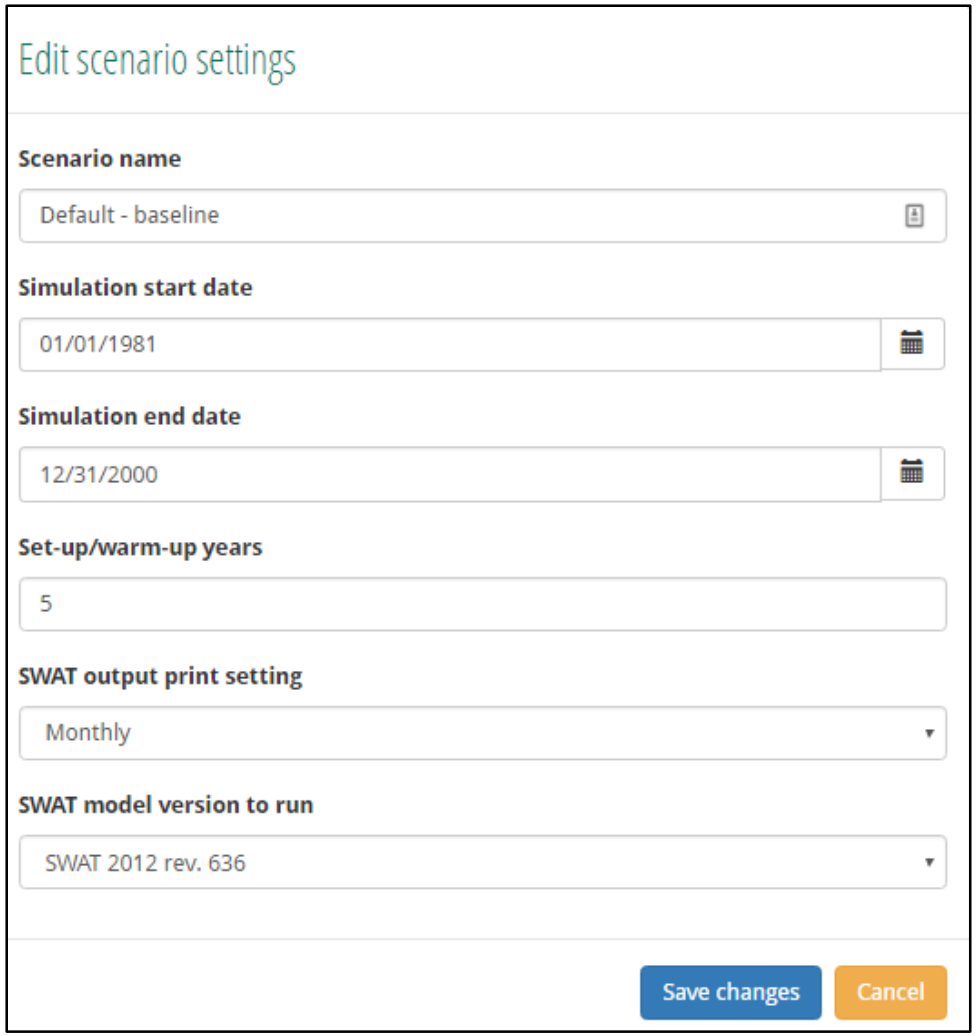
Use Case Example: Maumee River Basin – Create Default (Baseline) Scenario



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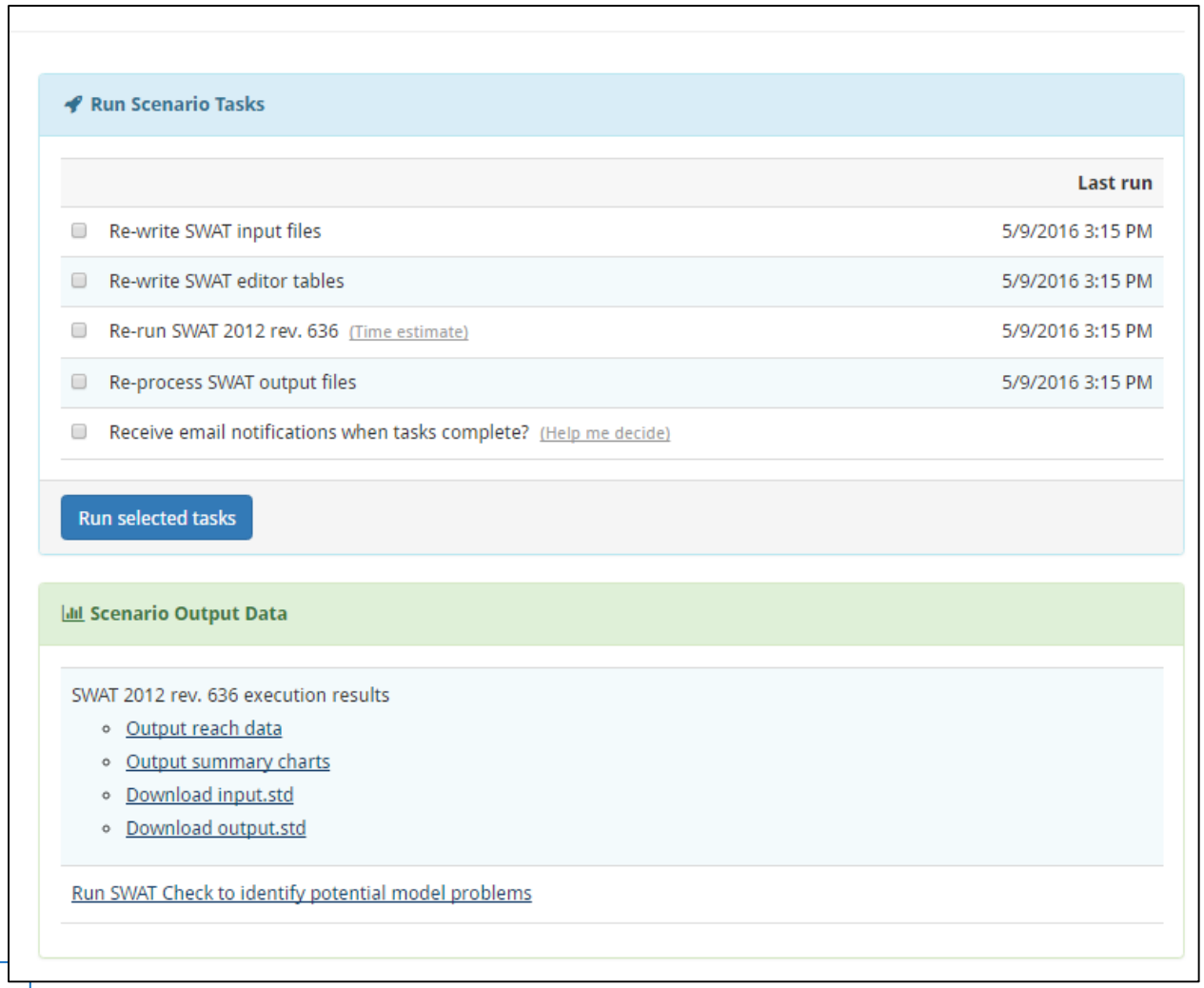
Use Case Example: Maumee River Basin – Run Scenario Tasks



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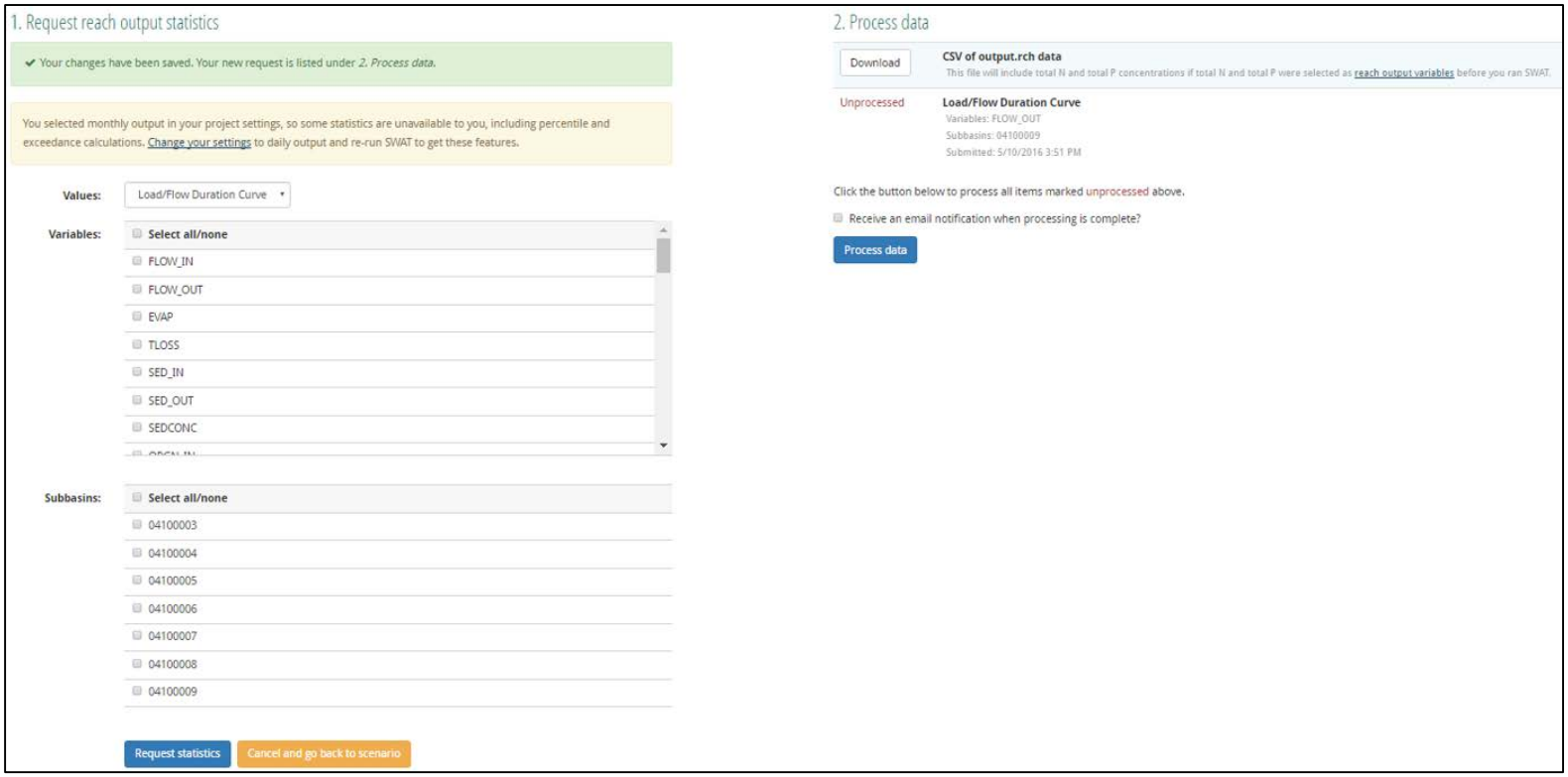
Use Case Example: Maumee River Basin – Visualizing Output



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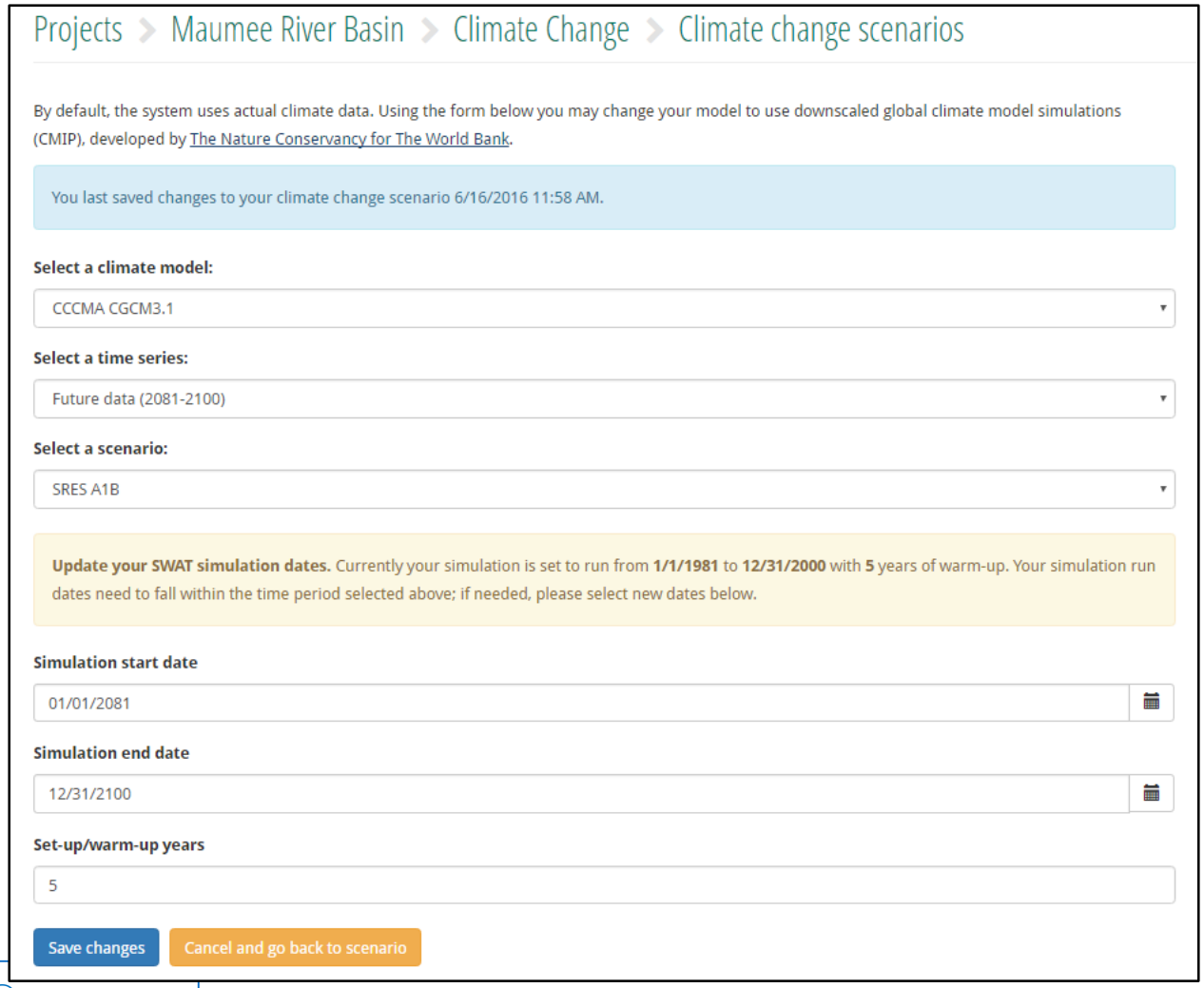
Use Case Example: Maumee River Basin – Climate Change Scenario



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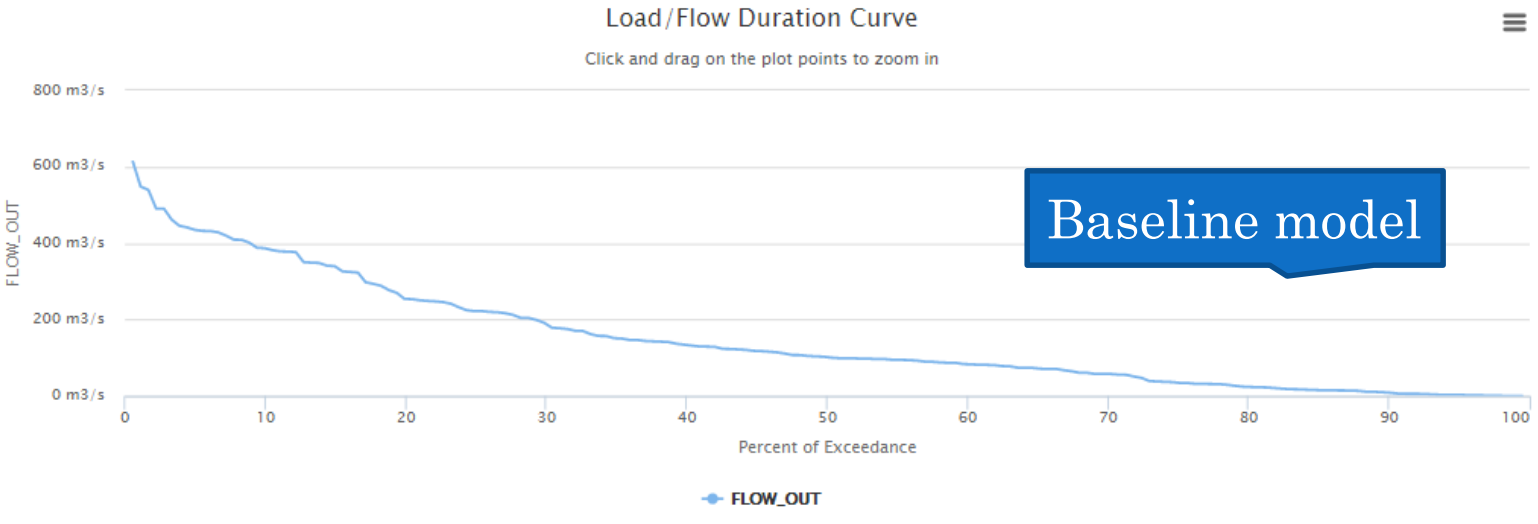
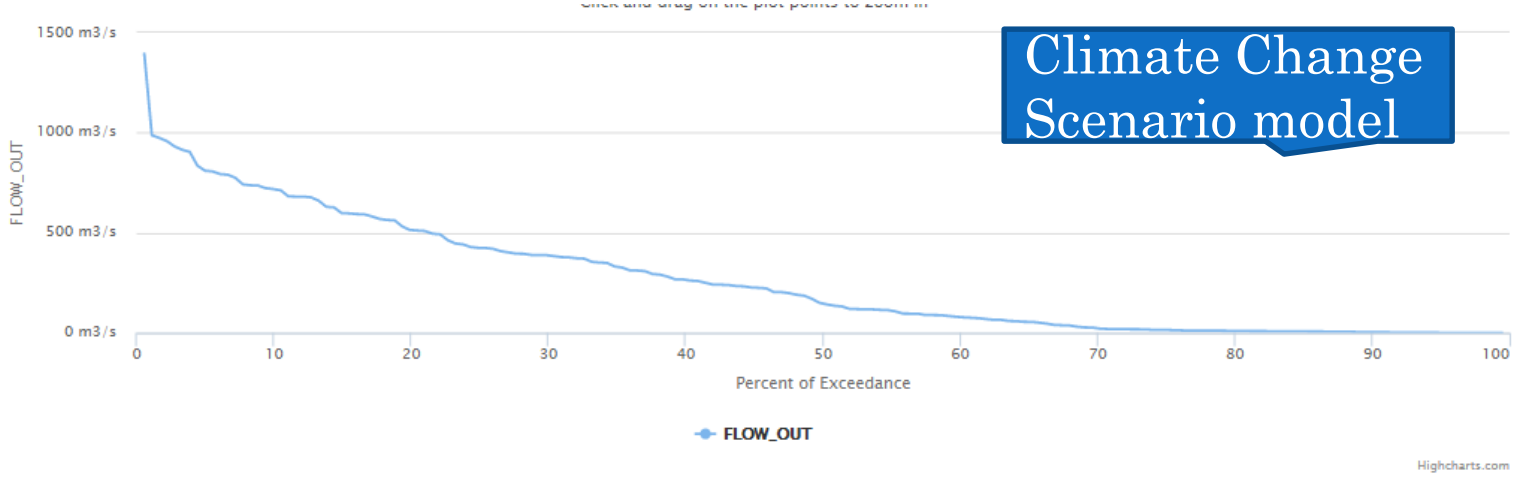
Use Case Example: Maumee River Basin – Visualizing Output



Baseline model



Climate Change Scenario model

Use Case Example: Maumee River Basin – Visualizing Output

Water Balance Ratios	
Streamflow/Precip	0.335
Baseflow/Total Flow	0.043
Surface Runoff/Total Flow	0.957
Perc/Precip	0.013
Deep Recharge/Precip	0.001
ET/Precipitation	0.630

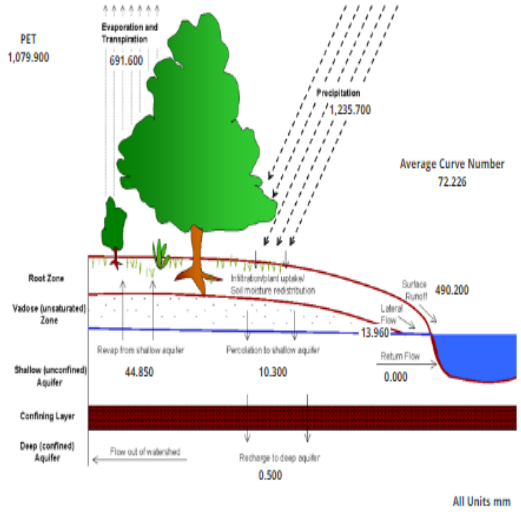
Baseline model

Water Balance Ratios	
Streamflow/Precip	0.408
Baseflow/Total Flow	0.028
Surface Runoff/Total Flow	0.972
Perc/Precip	0.008
Deep Recharge/Precip	0.000
ET/Precipitation	0.560

Messages and Warnings

- Surface runoff ratio may be high (> 0.8)
- Groundwater ratio may be low
- Lateral flow is greater than groundwater flow, may indicate a problem
- Water yield may be excessive
- Surface runoff may be excessive

Climate Change Scenario model



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HAWQS – Next steps

- Identify and engage prospective users of HAWQS;
- Further enhance HAWQS interfaces;
- Improve output visualization tools including mapping the results, comparing multiple scenarios for a project;
- Enhance project-level sharing and collaboration;
- Add CMIP5 climate change models and scenarios;
- Improve water temperature model;
- Selectively update and analyze input data (e.g., atmospheric deposition and point sources)
- Improve agricultural inputs such as SSURGO soils and crop management
- Enhance uncertainty analysis on model outputs stemming from model input parameters.

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Poll Question #4

- Based on what you know about HAWQS now, do you envision using HAWQS to support any current or future water quality modeling work?
  - Yes
  - No
  - Maybe
  - Do not know at this time

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Questions

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