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# About NTT

## Nutrient Tracking Tool (NTT) Overview

The **Nutrient Tracking Tool (NTT)** was designed and developed by the Texas Institute for Applied Environmental Research (TIAER), Tarleton State University with funding from USDA Office of Environmental Markets, USDA-NRCS Conservation Innovation Grants program, and various state agencies.

NTT is a web-based program that evaluates the environmental (e.g., nutrient and sediment losses) and economic (e.g., cost and benefit) impacts of agricultural and forestry management practices at the farm and small watershed scale.

Agricultural producers and land managers can define a number of management scenarios and generate a report showing the expected nutrient loss differences between any selected scenarios for a given field or small watershed.

NTT compares agricultural management systems to calculate a change in expected flow, nitrogen, phosphorus, sediment losses, and crop yield. Estimates are made using the **APEX** model (Williams et al. 2000). Results represent average losses from the field based on 35 years of simulated weather.

NTT requires regional soils, climate and site-specific crop management information. NTT currently provides selections for **every U.S. County**, but it has only been validated for a limited number of states and counties. As validation becomes possible in other parts of the country, parameter files may be updated for additional counties in future versions.

There are two versions of new NTT program available:

1. The BASIC version is a user-friendly version of NTT that allows users to estimate N, P and sediment from crop and pasture lands.
2. The Research and Education version of NTT (NTT-RE) was developed for researchers and educational institutes for teaching and training purposes. NTT-RE includes additional functions allowing the user to view and edit soil layers, view crop water and nutrient stresses, and modify and the APEX parameters file for calibration and validation purposes.
3. The data sources and APEX simulations in both versions are identical. For more information regarding NTT, please refer to Saleh et al. (2011 and 2015).

For more information regarding NTT, please refer to Saleh et al. (2011 and 2014).

## About APEX

NTT uses a biophysical simulation model, the Agricultural Policy Environmental eXtender model (APEX), version 0806, to process user supplied information (APEX; Williams et al., 2000). Below are characteristics of the APEX model.

- The APEX (Agricultural Policy/Environmental eXtender) model was developed to extend the **EPIC** model capabilities to whole farms and small watersheds (Williams et al., 2000).
- The individual field simulation components of EPIC were used for APEX development.
- In addition to the EPIC functions, APEX has components for **routing water, sediment, nutrients, and pesticides** across complex landscapes and channel systems to the watershed outlet.
- Recently, the **carbon fate** and **transport** function of **CENTURY** model was incorporated in the latest version of APEX (version 2110). This allows APEX to simulate carbon dynamics in soil-plant system.
- APEX also has **groundwater** and **reservoir** components. A field or watershed can be subdivided as much as necessary to assure that each subarea is relatively homogeneous in terms of soil, land use, management, etc.
- The **routing mechanisms** provide for evaluation of interactions between subareas involving **surface runoff, return flow, sediment deposition and degradation, nutrient transport, and groundwater flow**.
- Water quality in terms of **nitrogen** (ammonium, nitrate, and organic), **phosphorus** (soluble and adsorbed/mineral and organic), and **pesticides concentrations** may be estimated for each subarea and at the watershed outlet.
- Commercial or manure may be applied at any rate and depth on specified dates or automatically.

### Disclaimer

Last updated: 16 Feb 2018

The information contained in NTT (Nutrient Tracking Tool) has been tested for use in the **Ohio counties surrounding Lake Erie, in the Mississippi Delta, Missouri, Yakima County in the State of Washington, the northern portion of Oregon, Maryland, Delaware, Pennsylvania, Virginia, Puerto Rico, and Sonoma County in California**. Because your area of interest may contain unique features, the program may not provide the appropriate results in your area when model default parameters are used. All input data and results should be carefully reviewed as errors or omissions in the input data may lead to misleading outcomes. We are currently in the process of completing the testing and validating NTT across the US (this page will be updated accordingly as new information becomes available).

If you have questions regarding the application of NTT or are interested in having it calibrated and validated for your area, please contact Dr. Ali Saleh at (254)592-1975 (saleh@tarleton.edu) or Ms. Mindy Selman at (202) 401-0531 (mselman@oce.usda.gov).

Finally, although NTT has been tested by its developers, NO warranty, expressed or implied, is made as to the validity of the results and functioning of the program and related program material, nor shall the fact of distribution constitute any such warranty; and NO responsibility is assumed by the developers in connection therewith. The user assumes all risks and responsibilities for the use and application of NTT and interpretation of the results generated from the tool. The authors and their affiliated institution, TIAER, Tarleton State University, and any other U.S. Government agencies will NOT be liable to NTT users for any damage, including lost profits, lost savings, lost time, actions by regulatory agencies, or any other direct or indirect incidental or consequential damages occurring from the use of or inability to use NTT, its databases, its results, or its documentation for any purpose.

#### References

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- Winchell, M., D. Meals, S. Folle, J. Moore, D. Braun, C. DeLeo and K. Budreski. 2011. Identification of critical source areas of phosphorus within the Vermont sector of the Missisquoi Bay basin. Grand Isle, VT: Lake Champlain Basin Program.

# Contact Information

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# System Requirements

## Minimal Requirements

- Windows: X86 or X64 1.6 GHz or higher processor with 512-MB of RAM
- Macintosh (Intel-based): Intel Core Duo 1.86 GHz or higher processor with 512 MB of RAM

## Supported Web Browsers

The Nutrient Tracking Tool (NTT) has been tested on the following browsers:

Apple Macintosh OS 10.5.7+ (Intel-based):

- Firefox 12+
- Safari 4+
- Chrome 12+

Microsoft Windows 8.1 Desktop:

- internet Explorer 11
- Firefox 12+
- Chrome 12+

Microsoft Windows 8 Desktop:

- Internet Explorer 10
- Firefox 12+
- Chrome 12+

Microsoft Windows 7:

- Internet Explorer 8 and 9
- Firefox 12+
- Chrome 12+

Microsoft Windows 7 SP1:

- Internet Explorer 8, 9, 10, and 11
- Firefox 12+
- Chrome 12+

2012r2

- internet Explorer 11
- Firefox 12+
- Chrome 12+

Microsoft Windows Server 2012:

- Internet Explorer 10
- Firefox 12+

- Chrome 12+

Microsoft Windows Server 2008 SP2:

- Internet Explorer 7, 8, and 9
- Firefox 12+
- Chrome 12+

Microsoft Windows Server 2008 R2 SP1:

- Internet Explorer 8, 9, and 11
- Firefox 12+
- Chrome 12+

Microsoft Windows Vista:

- Internet Explorer 7, 8, and 9
- Netscape 9.0
- Firefox 12+
- Chrome 12+

Microsoft Windows Server 2003/Windows XP:

- Internet Explorer 7 and 8
- Netscape 9.0
- Firefox 12+
- Chrome 12+

## Display Resolution

The software has been tested and works correctly at resolutions as low as 800 × 600, but the lower the resolution, the more you will have to scroll.

## JavaScript

To run NTT, JavaScript is required. If JavaScript is disabled in your browser, the application simply will not work at all. You will see an error message in this case.

## Cookies

NTT maintains a session between the server and your browser. This requires that session cookies be enabled for the NTT site. Session cookies are valid only for your current browser session. They are maintained only in browser memory, not written to your system disk. If session cookies are not enabled, the application will end your session with a message saying session cookies must be enabled.

## Popup Blocker

By default, NTT opens some content in an external browser window, specifically:

- Links to other sites
- Help Screens

If you have a pop-up blocker configured, it will probably not allow this. If you wish to open these types of content in an external browser window, configure your pop-up blocker to allow pop-ups from this site.

## Navigation Basics

The Nutrient Tracking Tool was designed to be user-friendly and contains the following pages:

On the Projects page, users can create a project by entering the name and description of the project, opening saved/example projects, or uploading projects from local source.

On the Location page, the users may delineate the field or fields in their project using the interactive map. Alternately, users may upload their own shape files

On the Fields page, the users can verify the fields drawn on the Location page. Clicking on the fields allows the user to further define the field characteristics in the Soils and Management pages.

On the Soils page, the users may add new soil(s). Additionally, users may verify or delete the soils returned by the SSURGO database for their field. Users are also asked to indicate the soil P content for the field.

On the Weather page, the users may select the source of weather information, as well as the length of simulation.

On the Management Scenarios page, users can create and name one or more management scenarios for the field. Each management scenario must be further defined in the Operations and Conservation Practices sub-project pages. Once the management scenario(s) has been defined, users may also simulate the scenario(s) by selecting the box next to the scenario name and clicking "Simulate".

On the Operations page, users can create the crop schedule and define management for the given field management scenario.

On the Structural Conservation Practices page, users may indicate the conservation practices that are in place on the field for the given field management scenario.

On the Results page, users can view and compare results of up to three management scenarios for a given field in tabular or graphical presentations. In addition, a PDF-formatted report for the project and results summary will be available for download.

On the Field Routing page, users can create and name field routing scenarios. This can also be used for simulating different scenario(s) in multiple fields or subbasins within a watershed. A routing scenario will route runoff, sediment, and nutrients from one field to the next (within a subbasin and from a subbasin to the next if used for a watershed) in the specified order. For each routing scenario, users will need to list the field-scenario order.

To advance to the next page, simply click Next




# NTT Projects Page

After creating an account in NTT and logging in, you will be directed to the Projects page. Projects page displays all the projects that the user has previously created/saved. On this page, users can open saved projects, create a new project, upload a project stored on their local machine or upload an example project.

## Projects

Buttons: [Create New Project](#) [Upload Project](#) [Migrate Project](#) [Run SEC Project](#)

To select an existing project, click on the project name.

Project Name ▲	Description	Date Created	Actions
Test01	Test01 Description	2025-05-19	  

## Create a New Project

Click the **Create New Project** button to create a new project. You will be asked to provide a project name and a project description (optional).

After you have entered the information, click the **Save** button to save the information and continue.

## Create New Project

Project Name

Project Description

[Save](#) [Cancel](#)

## Upload Project

Users may use the **Upload Project** button to retrieve a previously saved NTT project file stored on their local machine.

Click **Upload Project**, then select **Choose File** and navigate to the saved file on your computer. After you have selected the project, click the **Upload Project** button to upload the project and continue.

## Upload Project

[Browse...](#) No file selected.

[Upload Project](#) [Cancel](#)

## Location Page

After creating a new project, users will be asked to define the location of the project using the interactive Google map. The interactive map allows the user to define one or more areas of interest (AOI). The area of interest should correlate with the fields within the project area. The map is **ONLY used for mainland United States**. If you would like to simulate using an area outside of mainland United States, follow the instructions for User Input.

When defining the AOI, the underlying weather, soils, and slope information is retrieved from the underlying spatial data.

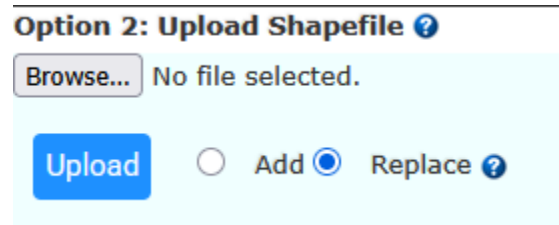
## Mapping System

There are two ways to define your areas of interest (AOI): you may upload your own shapefile or you may manually draw your areas of interest (AOI) using the zoom features and drawing tools on the interactive map.

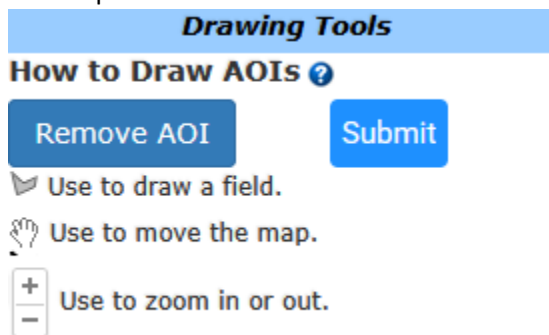
## Upload Shapefile

If you already have a shapefile that you would like to use as your project area, you may upload the shapefile. You will need to upload a file that consists of at least files with the same name but different extensions (.shp, .shx, .dbf, and .prj). Ensure that the .shp file is the format of an ESRI Shapefile that uses the geographic coordinate system (latitude and longitude). The shapefiles need to be stored within a .zip folder, and you need to upload the .zip folder.

1. **Choosing a Shapefile:** Select the Browse button located above the Upload button as shown in the Figure:



2. **Uploading a Shapefile:** Once you have located the shapefile (.zip folder) you wish to use, upload the file by clicking the Upload button.
3. **Submitting a Shapefile:** You need to submit the changes to the map once you have uploaded the shapefile. Be sure to click the Submit button.



## Zoom and Draw the AOI

If you do not already have a shapefile, you may draw your areas of interest (AOI) using the zoom features and drawing tools on the interactive map. Users may draw multiple AOIs. **AOIs should represent fields** within the project area.


1. **Zoom to your area of interest:** A field is considered an area of interest (AOI). There are several ways to zoom in to your area of interest (AOI). You may enter an address, enter the lat/long (using the correct format where latitude comes before longitude, north latitude is positive, east longitude is positive) and select the state and county from the available dropdown lists, or manually zoom on the map using the zoom tool located near the bottom right corner of the map.



**Area of Interest (AOI)**

**Option 1: Zoom and Draw AOI** ⓘ

A. Zoom to the AOI using one of the following choices

1. Address
2. Latitude, Longitude
3. State and County  
Select State ▾  
▾
4. Manual zoom on the map

B. Use the drawing utility   
on the map to draw the AOIs

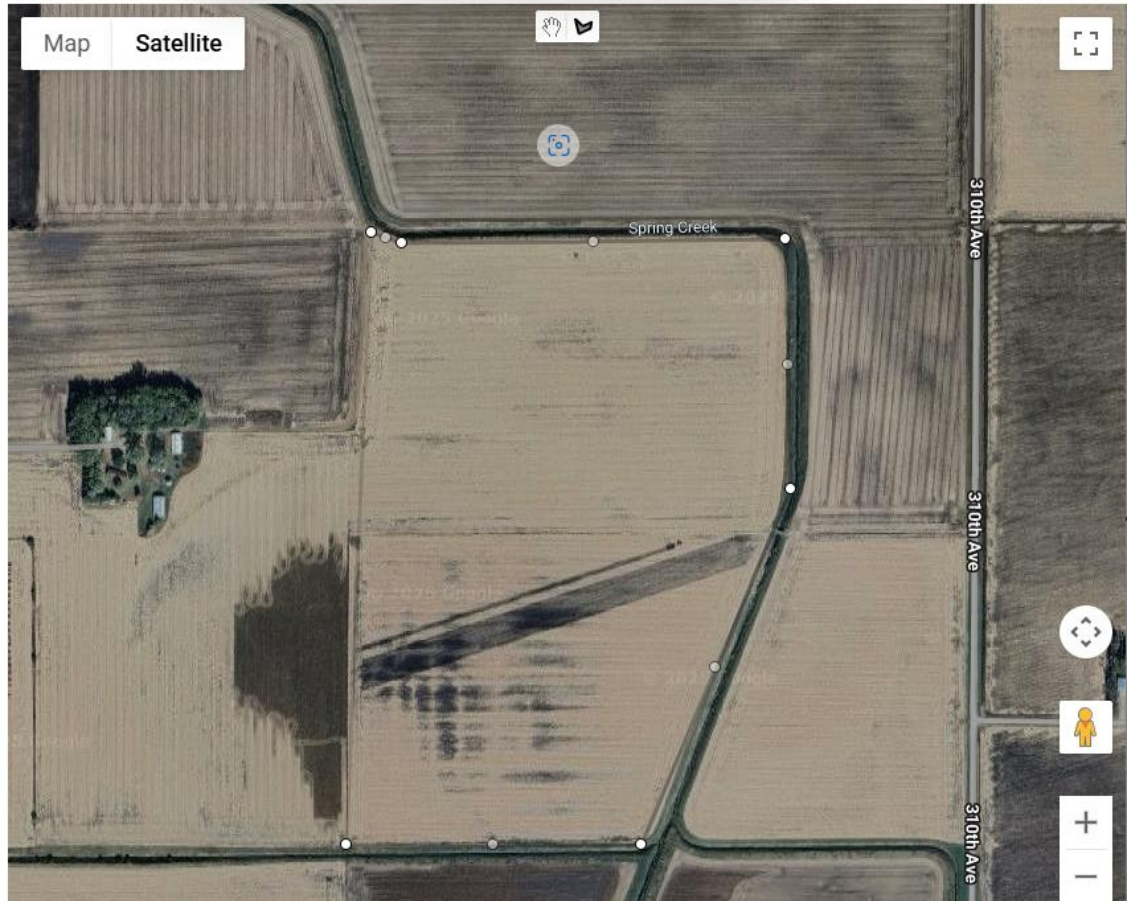
2. **Draw your Area of Interest (AOI):** Once you are zoomed in on your area of interest, click the polygon button  at the top center of the map. Next, use your mouse and click to define the corners of your polygon as shown in the figure below. Keep in mind that **a field is considered an area of interest (AOI)**. After drawing the field, a message will pop up telling the user to enter the name of the AOI as shown below. Enter the name of the field and click **OK**. As the user enters the name, it will replace the default name in the text box for the field as shown in the following figure. From this point on, the field name entered will refer to the selected location. You may create multiple AOIs/fields for your project. Simply click on the polygon button  again to create additional AOIs.

Please enter the AOI name:

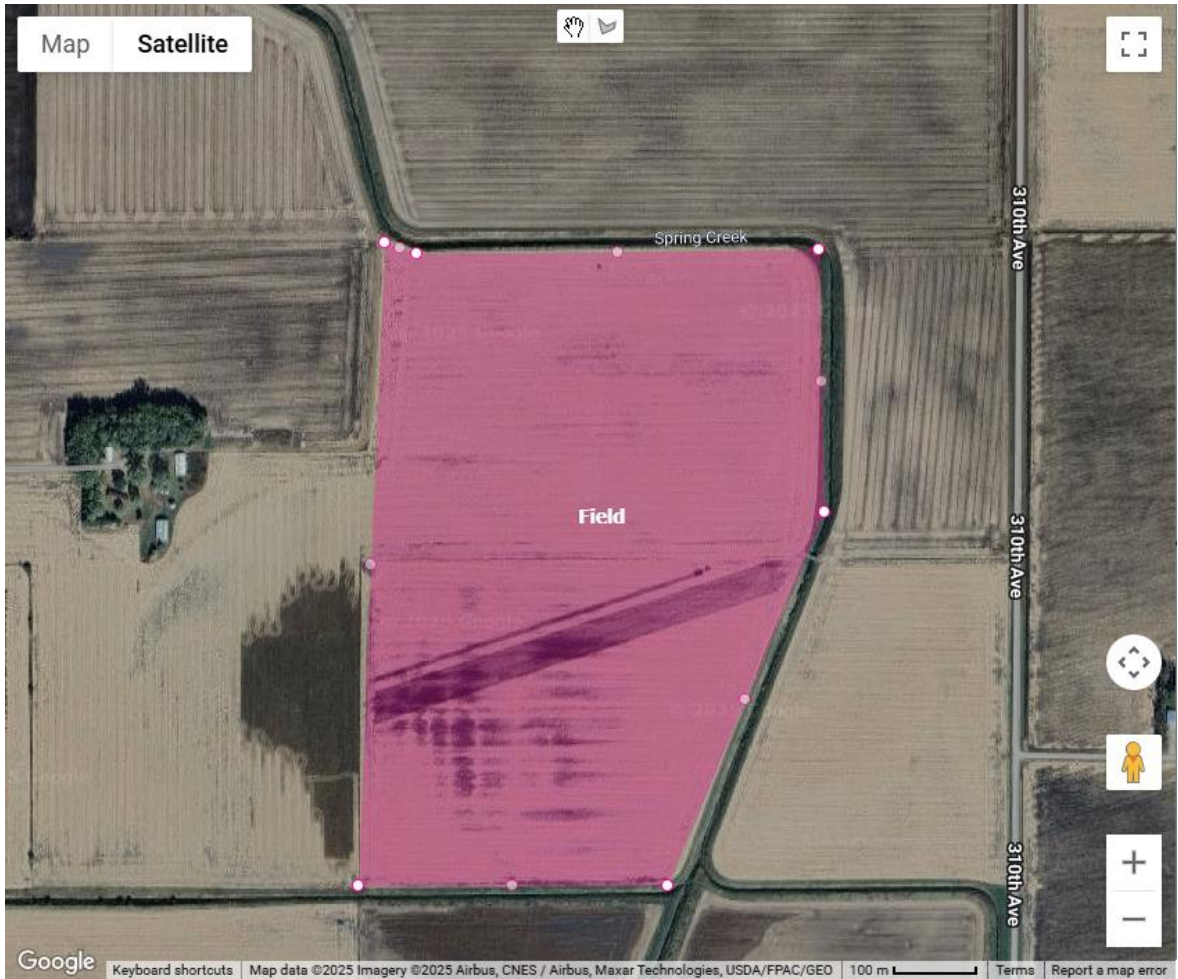
OK

Cancel

Area of Interest






Once the user clicks OK, the field location will be highlighted as shown below.



3. **Submitting AOIs:** Once you have one or more AOIs, you **MUST** click the **Submit** button. The actual map is a different program that is being ran within NTT. By clicking Submit, the drawings are actually submitted to NTT.

### Drawing Tools

#### How to Draw AOIs ?

- Remove AOI** **Submit**
-  Use to draw a field.
-  Use to move the map.
-  Use to zoom in or out.

4. **Deleting AOIs:** To remove an AOI, first select the field that you would like to delete, and then click the **Remove AOI** button.

# Fields Page

The Fields page displays the AOIs/fields that you have defined for your project. From the Fields page, you can begin entering scenario and management information for each field. You may also delete fields/AOIs from your project on this page.

If you selected the **Mapping System**, the fields that you drew or uploaded will already be on the Fields page.


The Fields page simply lets users view and verify the field(s). Clicking on a field name allows users to proceed to the field-level (Soils, Management Scenarios) pages for each field.

## Fields

*Click on the Field Name to continue to Soils page.*

Field Name ^	Field Area	Actions
Field	96.1927	 

### Deleting a Field

To delete field(s), simply click the  icon in the Actions column.


### Define Field Management

To begin defining management scenarios for your field, click on the hyperlinked field name. You will advance to the field-level **Soils** page for your field where you will begin defining field characteristics and management scenarios. The Soils page is also where you will be able to change the field/AOI name as well as revise the field/AOI area. (See Soils page for more information.)

### Add Fields/AOIs

To add more fields or AOIs to your project you must navigate back to the Location page using the left-hand menu. From the Location page you can draw and submit additional AOIs which will then appear on the Fields page.

### Changing Field Name and Area

The field name and area can be changed on the **Fields** page. Simply click on the  icon name which will take you to the **Editing Field** page. On this page, you may change the field name and modify the field

area if you desire. (See Soils page for more information.) <-- *This is a Hyperlink*

## Editing Field

---

Field Name

Field Area

---

# Soils Page

After clicking on a field to begin editing on the **Fields** page, the user will be directed to the **Soils** page. The Soils page is a field-level page. The Soils page allows the user to verify, modify or delete soils returned from the SSURGO Soils database and add/edit layers for the field selected in the Fields page. NTT returns a maximum of 3 soils for every field. These soils represent the most predominant soils in AOI. NTT is limited to 3 soils to minimize model processing time.

## Manage/Modify Soils

Between 1 and 3 soils will appear in the list of soils returned for your field. These represent the most predominant soils in your field as returned by the SSURGO Soils database.

NTT will return the **soil name** and the **soil group** for each soil. This data is derived from the SSURGO soils database.

The **soil slope** for each soil is calculated dynamically by NTT using the 30-meter Digital Elevation Model (DEM) layers associated with your field.

The default **soil organic matter (%)** value returned by the SSURGO soils database is displayed for each soil in the soils list. However, if the user has more precise data, they may enter it here.










**Percentage** represents the adjusted coverage area of the soil for your field. Because NTT selects only the 3 most predominant soils, the coverage area of each is proportionally expanded to equal 100% coverage of the field.

Users may **Add new soil(s)** by clicking the button **Create New Soils**.

## Soils

The soils information are coming from the SSURGO database from NRCS web page. For more information or see the soils information directly in NRCS Web Soil Survey page use this link: [websoilsurvey.usda.gov](http://websoilsurvey.usda.gov)

[Create New Soils](#) [Add Soil Test](#)

Name	Group	Slope	Drainage	Percentage	Actions
Klossner muck, 0 to 1 percent slopes	C/D	0.255	Poorly Drained	61.24	  
Webster clay loam, 0 to 2 percent slopes	C/D	0.677	Poorly Drained	21.64	  
Okoboji silty clay loam, 0 to 1 percent slopes	C/D	0.39	Poorly Drained	17.13	  

[Continue to Scenarios](#)

## Add Soil Test

This allows you to input data from your soil phosphorus (P) Tests.

**Soil Test:** This is a dropdown menu where you can select the specific type of soil test that was conducted. Currently, the default selection is "None." Click on the dropdown to see a list of available soil test options.

**Soil Test P (STP) in ppm:** In this field, you should enter the result of your soil phosphorus test, specifically the Soil Test Phosphorus (STP) value, measured in parts per million (ppm). You will need to select the available Soil P Test to set your STP.

**Measured STP Depth (in):** This is another dropdown menu where you need to specify the depth in inches at which the soil sample was taken for the STP measurement. Click on "Select" to view and choose the appropriate depth from the available options. You will need to select the available Soil P Test to set your STP Depth.

Once you have entered the information for all three fields, click the blue button labeled **Save Soil Test P** to save the data.

### Soil P Test Information ✖

---

Soil P Test None ▾

---


Soil Test P (STP) in ppm 20

---

Measured STP Depth (in) Select ▾











---

[Save Soil Test P](#)


Users may **add/delete soil layer** from their soils list if they do not wish for it to be used in the model run. To get to the Layers page for a particular soil, simply click the  icon in the Actions column of the soil you wish to add/delete layer from.

## Layers





[Create New Layer](#)

Depth (in)	Soilp (ppm)	Bulk Density (Mg/m3)	Sand (%)	Silt (%)	Clay (%)	Organic Matter (%)	Ph	Actions
3.94	0.0	1.35	30.0	47.0	23.0	4.0	6.7	 
16.14	0.0	1.35	30.0	47.0	23.0	4.0	6.7	 
23.62	0.0	1.4	30.0	47.0	23.0	3.0	6.7	 
33.07	0.0	1.45	55.0	24.0	21.0	1.5	6.7	 
78.74	0.0	1.45	55.0	24.0	21.0	1.5	6.7	 

[Continue to Management Scenarios](#) [Back To Soils](#)

Users may **edit soil** from their soils list if they wish to change some values. Simply click the  icon in the Actions column of the soil you wish to edit.

## Editing Soil

Key	<input type="text" value="407035"/>
Symbol	<input type="text" value="198B"/>
Group	<input type="text" value="B/D"/>
Name	<input type="text" value="Floyd loam, 1 to 4 percent"/>
Albedo 	<input type="text" value="0.16"/>
Slope 	<input type="text" value="2.848"/>
Percentage 	<input type="text" value="47.91"/>
Drainage 	<input type="text" value="Somewhat Poorly Drained"/>

[Save](#) [Back](#)

# Weather Page

Depending on the particular method that was chosen in the previous (Location) page, the user has different options available when choosing the weather. Only the options that are actually available to the user (depending on the method selected) will show up as selections. Once the user has selected a method for weather information selection, the user will need to select the period to simulate, or the time period for which the user would like to perform the simulation.

## Selecting Weather Information

There are three different methods to select the weather information.

### Weather

43.2942, -92.4411, N43.29167W92.45833.wth  
 Weather Information Using PRISM Data  
 Load your Own Weather File  
 Load Using Specific Coordinates (USA only)

Update Weather

This method takes weather data from a weather station inside of near the State/County that was selected in the page and uses that data to do the simulation. First the user must select Weather Station Using PRISM Data and then select Update Weather and continue to the next page.

## Load Your Own Weather File

### Weather

43.2942, -92.4411, N43.29167W92.45833.wth  
 Weather Information Using PRISM Data  
 Load your Own Weather File  
 Load Using Specific Coordinates (USA only)

Choose the file to Upload or Copy Weather from other Field

Every line must contain one(1) whitespace between each column. For more information, please see the Page Instructions.

Choose File No file chosen

OR

Copy Weather

Update Weather

This method of weather selection is always available regardless of the method used for selecting an area of interest (AOI). This option is also the only option that is available when using the NTT tool for **locations outside of the mainland United States**. To use this method, please follow the instructions below:

1. **Create a Weather File:** In order to upload a weather file, the user must first create one. The weather file needs to be in a text file, and it should have the following format: blanks (columns 1-2), year (columns 3-6), month (columns 7-10), day (columns 11-14), solar radiation (columns 15-20; could be blank or zero), maximum temperature in Celsius (columns 21-26), minimum temperature in Celsius (columns 27-32), precipitation in millimeters (columns 33-38). This is for

the first year/month/day as shown in the figure below.

The same pattern is used for the rest of the days that you want to add to the simulation. Specific weather information for each day can simply be added by adding new records. Each record should contain the weather information for a specific day.

The information above, for example, would show weather information for January 1, 1981 (where the solar radiation was 0, the max temperature was 10.1 degrees Celsius, the min temperature was -0.9 degrees Celsius, and precipitation was 0.00 millimeters), and the weather information for January 2, 1981 (where the solar radiation was 0, the max temperature was 5.7 degrees Celsius, the min temperature was -5.9 degrees Celsius, and precipitation was 0.00 millimeters). Ideally, you would have a file that contains detailed information for the weather for an extended period. This would look like the following:



The screenshot shows a Notepad window titled "weather\_file.txt - Notepad". The menu bar includes File, Edit, Format, View, and Help. The text content consists of two lines of data, each with eight columns of values separated by spaces:

Year	Month	Day	Solar Radiation	Max Temp (C)	Min Temp (C)	Precipitation (mm)
1981	01	1	0	10.1	-0.9	0
1981	01	2	0	5.7	-5.9	0

Even though the file is significantly larger, all of the days for which we have data follow the same format.

2. **Upload the Weather File:** Once the weather file has been created, the user needs to upload the file to the NTT program. First the user needs to select the **Choose File** button to select a file to be uploaded. This will **open** a file explorer window where the user can search their computer for the weather file. After you have selected the file, click **Open**. A progress bar will be displayed as the system uploads the information.



The screenshot shows a web interface for uploading a weather file. It features a header "Choose the file to Upload or Copy Weather from other Field" and a sub-header "Every line must contain one(1) whitespace between each column. For more information, please see the Page Instructions." Below this is a "Choose File" button with the text "No file chosen". There is also an "OR" section with a "Copy Weather" option.

**Update Weather**

The records will have been uploaded when 100% of the records have been uploaded, and a green message will come up on the top of the screen. Once this has happened the user needs to select the **Simulation Period** (which is explained below under *Period to Simulate*) and then click **Update Simulation Period**. Then the user can click **Update Weather** to save the information and the **Continue** button to advance to the next page

**NOTE:** It is important to note that when you click **Update Weather** after uploading a weather file, the weather information is saved temporarily for the current session. This means that the weather information from uploaded weather files **IS NOT SAVED** when you save the project. Because of this, after opening a saved project where the user previously uploaded the weather

file, the user needs to upload the weather file again, and to ensure that the simulation results are accurate, run the simulations again.

## Load Using Specific Coordinates (U.S.A only)

This method of weather selection will always appear as available regardless of the location method that was selected in the Location page (this method will work for the User Input method). However, the coordinates selected must be coordinates within the United States. This means that while the option will appear as available if the user selected “User Input” in the Location page, if they are looking at an area of interest that is outside the mainland United States, an error message will come up.

### Weather

44.1724, -95.0875, N44.16667W95.08333.wth  
 Weather Information Using PRISM Data  
 Load your Own Weather File  
 Load Using Specific Coordinates (USA only)

---

Enter Coordinates

Latitude  Longitude

[Update Weather](#)

To use this method, first select Load Using Specific Coordinates (U.S.A only) and then enter the desired coordinates. You will (like in all the other methods) need to select a period to simulate (which is discussed below) and after this has been done, you can click Update Weather to save the information and the Continue button to advance to the next page.

## Period to Simulate

The period to simulate tool allows you to select the number of years that you would like to simulate. You can type in the years that you would like to simulate for, as shown below. However, the program will simulate five years before the year that you selected as a method to warm up and give the user more accurate simulation results. Because of this, the user must select a start year that is at least five years after the initial year for which weather information is available. For example, if weather information is available from 1981 to 2012, the user must select a start year for the period to simulate that is 1986 or later. In the Results page, the last twelve years that are simulated are shown on the graphs. However, if there were less than twelve years in the Period to Simulate, then all of the years are accounted for in the graphs. The Simulation Period information is required for all weather options.

Simulation period

Years of Weather Information: 1987-2021  
The period to simulate is the same as the period in the weather information. The simulation years can be changed but it should be between the weather initial and final years.

Simulation period: Initial year  Final year  [Update Simulation Period](#)

# Management Scenarios

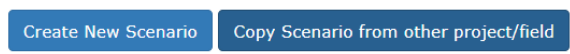
After clicking **Save and Continue** on the Soils page, users will be advanced to the **Management Scenarios** page. The Management Scenarios page is a field-level page where the user creates, manages and simulates management scenarios for each field. Users may create multiple scenarios for each field in order to compare how different crop management and conservation practices will impact nutrient losses and yields.

It is recommended to choose a baseline scenario with the status quo management on the operation page, copy the baseline scenario and edit the scenario name in the management page, and change one management scenario at a time in the operation page.

## Creating a Field Scenario

The user can create a scenario by clicking on the **Create New Scenario** button. Users will be asked to name the scenario, for example “Baseline” or “Alternative” or “Auto-Irrigation

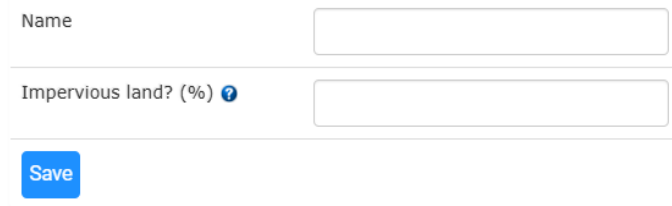
### NTT Management Scenario Input and Simulation



After adding a name to the scenario, the next section allows you to define a new land use scenario. Enter a descriptive **Name** for this scenario to easily identify it later. If the land use you are defining includes impervious surfaces (such as roads, buildings, or parking lots), indicate the percentage of the total area that is impervious in the **Impervious land? (%)** field. This information helps the tool accurately estimate nutrient runoff associated with different land cover types. Once you have entered the necessary information, click the **Save** button which will create the scenario and advance the user to the Operations page, where the user will begin to define the crop schedule and conservation practices. (see Operations Page) <-- *This is a hyperlink*




#### New Scenario



*If this land use is impervious, enter the percentage of the area that is impervious in the "Impervious land? (%)" field.*

A screenshot of a form titled 'New Scenario'. It has two input fields: 'Name' and 'Impervious land? (%)'. Below the fields is a blue 'Save' button. There is a red 'x' icon in the top right corner of the form area. A help icon is next to the 'Impervious land? (%)' label.

## Mange Field Scenarios


The Management Scenarios page includes a list of the scenarios created for the field. Each scenario has a scenario Name as well as fields for Weather, Soils, Operations and Simulation date in addition to the options (Download APEX, Edit, Copy, Remove) under the Actions column.


A  icon will appear in the **Weather, Soils, Layers** and **Operations** columns when these are present for the scenario. In order to successfully simulate a scenario, all four of these elements must display the  icon. The **Weather, Soils** and **Layers** should be checked when a management scenario is first created, as these elements are derived from the map and are automatically associated with each field. However, the **Operations** column will be blank until the user enters management information for the scenario. A  icon will appear in the **Operations** column once management information is present for the field.


The **Simulated** field indicates whether or not the scenario has been simulated. The Simulated field will have a  icon if the scenario has never been simulated. Once the scenario has been simulated, the  icon will appear.


The **Simulation date** field indicates the date on which the scenario was last simulated by the model. If the Simulation date field is blank, it means that the scenario has not been simulated. Otherwise, the most recent simulation date will be present. (See **Simulating Field Scenarios** to learn more about how to simulate a scenario or multiple scenarios.)

The **Actions** column contains four different icons, representing different actions.

After simulating a scenario, the  APEX icon allows you to download APEX files (This feature is generally for advanced users who may wish to save these files to run in another version of APEX. Alternately, this feature can be used for those who wish to store project files locally rather than on the server. APEX files can be uploaded and viewed on the Project Management page).


The edit  icon allows you to modify the name of the scenario.


The copy  icon creates a copy of your management scenario.

The delete  icon will delete the management scenario.

## Simulating Field Scenarios

Once you have created one or more scenarios for your field, you must simulate the scenarios to obtain results. By simulating the scenarios, you are running the project through the APEX model which will return results for estimated nutrient and sediment losses as well as crop yields. To simulate a scenario, check the box next to the scenario(s) you wish to run and then click the **Simulate** button.

Before attempting to simulate a scenario, please make sure that the  icon is displayed in **Weather, Soils, Layers** and **Operations** columns. Each of these elements must be present in the scenario before the scenario can be successfully simulated by the APEX model. Simulation of the scenarios may take up to several minutes.

Once a scenario has been successfully simulated, the **Simulated** field will have a  icon and the **Simulation date** field will show the date and time of the most recent simulation.







**Note:** If you **modify** a management scenario, you will need to **re-simulate** the scenario to view results of the updated scenario. If the scenario was copied into other fields before modifications, the simplest solution is to copy and re-simulate.

Water Quality Simulation Economic & Water Quality Simulation Water Quality Simulation-Bacteria

To see the scenario operations click the name of the scenario in the list below.

To download a simulation folder click, under actions column and in front of the scenario you want to download to, 

View Results View Economic Results

Select	Name	Weather	Soils	Layers	Operations	Simulated	Simulation date	Actions
<input type="checkbox"/>	Baseline	✓	✓	✓	✓	✓	2025 06, 03 11:56 AM	 Apex  Fem  
<input type="checkbox"/>	Alternative	✓	✓	✓	✓	⚠		 Apex  Fem  

## Viewing Results

Click the **View Results** button to view results of simulated scenarios. You will be advanced to the Results page where you may select up to three scenarios to compare at a time. (See Viewing Results for more details.) *<-- This is a hyperlink*

## Operation Page

Once a scenario has been created on the **Management** page, the user is advanced to the **Operations** page to begin inputting the management characteristics such as the crop schedule, tillage, fertilizer, harvest, and grazing operations.

A cropping system is **REQUIRED** for the user to be able to advance and simulate the NTT. The user can add rotations that are one year in length or much longer. A field may have a single crop or multiple crops.

Listed below are different options available in the **Operation Page** for manipulating a cropping system.

### Add Crop to Rotation

To add a crop to the rotation, click **Add Crop to Rotation**. The user is then asked to select a crop from the pick list, a tillage type (No-till, reduced till, or intensive till), and planting year. The crop list is customized according to the region in which the project is located. The planting year indicates the sequence of the crop within the crop schedule, it does not represent the calendar year. Once the user has selected a crop type, tillage type and rotation year, clicking **Upload** will add the crop to the crop schedule.

## Operations

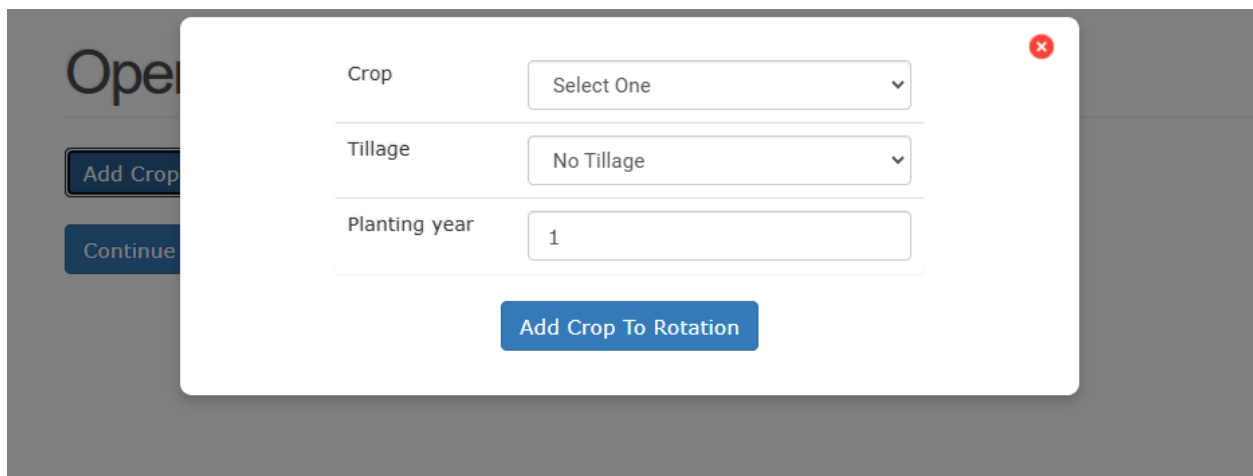
Add Crop to Rotation

Add New Operation

Add Cover Crop

Continue to Conservation Practices

Back to Management Scenarios



The screenshot shows a modal window titled "Add Crop to Rotation" with a close button (red 'x') in the top right corner. The form contains three input fields: "Crop" with a dropdown menu showing "Select One", "Tillage" with a dropdown menu showing "No Tillage", and "Planting year" with a text input field containing the number "1". A blue button labeled "Add Crop To Rotation" is positioned at the bottom center of the modal.

Once a crop is added to the crop schedule, the operations list for each crop can be rolled up or expanded by clicking the ▶ or ▼ buttons next to the crop name, respectively.

Add Crop to Rotation   Add Cover Crop   Switch to Simple View

Continue to Conservation Practices   Back to Management Scenarios

▶ Corn Add New Operation

▶ Soybeans Add New Operation

Clicking ▶ to expand the operation list will display several default management characteristics including a planting date, fertilizer applications, tillage schedule, and harvest. These operations can be modified or deleted as needed and new operations can be added.

▶ Corn Add New Operation

▼ Soybeans Add New Operation

Planting

Date	Type	Seeding (seeds/ft2)(*optional)	Actions
Year 2, May 15	No-till Planter 6 Row	7.06	

Add Planting Operation

Fertilizer

## Add New Operation

Users can add operations to their rotations or build a cropping system from scratch using the **Add New Operation** button (located to the right of every crop in the operations list). You will be asked to select the crop, operation type, year, and date. The year indicates the position of the crop in the crop schedule, for example, CORN year 1 and SOYBEAN year 2.

## New Operation

Operation Select Operation

Crop Corn

Date Year Month Day

Add more Finish Back

Depending on the operation type there will be additional fields to enter. Below are descriptions of the different operation types and the additional required fields for each.

### Planting

- Plant method: User must indicate the planting method using the pick-list of planting equipment provided.
- Seeding Amount (seeds/ft<sup>2</sup> or trees/ac): This field is pre-filled with standard seeding rates for each crop type. If the user has more specific information on seeding rate, they may enter it here.

### Fertilizer

- Fertilizer category: User must indicate the fertilizer category (commercial, liquid manure, or solid manure).
- Fertilizer Type: The fertilizer type pick list will vary depending on the fertilizer category selected. For manure fertilizer, a pick list will contain types of animal manure.
- Application Rate: User needs to indicate the amount of fertilizer applied. Units will vary depending on the type of fertilizer selected (lbs/ac, tons/ac, 1000 gals/ac).
- Optimum Yield: If optimum yield checked no need for fertilizer amount. The model will calculate the optimum fertilizer to use.
- Depth: If the fertilizer is incorporated, the user should indicate the depth of incorporation here. If fertilizer is not incorporated, this field can be left blank.
- Ammonia N: Percentage of ammonia N in the nutrient selected.
- Fertilizer Composition (commercial fertilizer only): For commercial fertilizer, these fields indicate the N and P composition. These fields are pre-filled based on the fertilizer type selected but can be modified if needed.
- Total N concentration (solid/liquid manure only): For manure fertilizer, the user should indicate the total N content per ton of solid manure or per 1000 gallons of liquid manure. Typical values are pre-filled for the user but can be modified.
- Total P concentration (solid/liquid manure only): For manure fertilizer, the user should indicate the total P content per ton of solid manure or per 1000 gallons of liquid manure. Typical values are pre-filled for the user but can be modified.
- Moisture content (solid/liquid manure only): For manure fertilizer, this is the percentage, by weight, of moisture content in the manure. Typical values for each manure type are provided but can be modified by the user.

### Tillage

- Tillage Type: User must indicate the tillage method using the drop-down selection.

### Harvest Only

- Harvest Only requires only the crop, year, and date information from the user.

### Harvest and End of Season

- Harvest and End of Season requires only the crop, year and date information from the user.

### End of Season

- End of Season requires only the crop, year and date information from the user.

**Note:** End of season indicates to the model that the crop is removed from the field. If an End of Season operation is not present, then the model assumes that the crop is left growing. End of season should be used for all annual crops. For certain perennial crops like hay and pasture, End of Season operations may be absent from the crop schedule.

### Manual Irrigation

- Irrigation Type: The user indicates the type of sprinkler system that is being used.
- Volume: User indicates the volume of water applied in this irrigation event in inches.
- Irrigation efficiency: This field defaults to a typical irrigation efficiency value (as a fraction) based on the irrigation method that is selected. This value can be modified.

Note: On the Conservation Practices page there is an option for **autoirrigation** and **autofertigation** which automates irrigation in your field based on user parameters. Please see autoirrigation/autofertigation more information.

### Continuous Grazing

- Start/End Grazing dates: User indicates the start and end dates of grazing on the field.
- Animal Type: User indicates the type of animals being grazed on the field.
- Total Animal Units: User indicates the total animal units being grazed on the field. Animal units represent 1,000 lbs of live animal weight.
- Access to stream: User indicates if animals have access to a stream while grazing.
- Hours in Field: User indicates the total hours per day that animals are grazed in the field.

### Rotational Grazing

- The rotational grazing operation, unlike continuous grazing, assumes that the pasture is divided into paddocks and that livestock are moved through the paddocks as needed. Thus, each paddock is given a recovery period between grazing events, improving vegetative cover.
- Start/End Grazing dates: User indicates the start and end dates of grazing on the field.
- Animal Type: User indicates the type of animals being grazed on the field
- Total Animal Units: User indicates the total animal units being grazed on the field. Animal units represent 1,000 lbs of live weight.

- Hours in Field: User indicates the total hours per day that animals are grazed in the field.
- Access to stream: User indicates if animals have access to a stream while grazing.
- Number of consecutive days grazed at a time (in each paddock): User indicates the number of days livestock will spend in each paddock before being rotated to a new paddock.
- Pasture rest time (days) between grazing: User indicates the number of days that the pasture is rested between rotational grazing cycles.

#### Burn

- No additional data required by users beyond crop, year and date

#### Liming

- Amount: User must indicate amount of lime applied (lbs/ac).

### Add a Cover Crop

To add a cover crop, click **Add Cover Crop** button at the top of the Operations page. Users will indicate the type of cover crop, cover crop year, planting date, and planting method. The cover crop year should indicate the year within the rotation that the cover crop is planted. NTT will automatically add the harvest date for the cover crop based on the next crop in the rotation. Cover crops are not fertilized and are not harvested, rather they are chopped prior to planting of the next crop in the rotation.

## Operations

Add Crop to Rotation
Add New Operation
Add Cover Crop

Continue to Conservation Practices
Back to Management Scenarios

Crop

---

Planting Date

---


Planting Method

Add Cover Crop

Note: If you wish to add a commercial cover crop, please do so as you would add another crop to your crop schedule. For example, add “Winter Wheat” to your crop schedule by clicking **Add Crop to Rotation** and selecting from the crop picklist (**NOT** using the **Add Cover Crop** button).

Adding a crop this way will allow users to apply fertilizer, tillage, harvest operations, etc.

## Edit Operation


Users may change the values or any other information in an operation by clicking on the **Edit**  icon in the **Actions** column next to the operation. Once the operation has been edited, click **Finish** to save and return to the Operations page. Clicking **Back** will return the user to the Operations page without saving changes to the operation. Clicking **Add More** will save change to the current operation and allow the user to continue adding additional operations without returning to the Operations page.

## Editing Operation

Operation	Planting
Crop	Alfalfa
Date	1 May 5
<b>Planting</b>	
Planting Method	No-till Planter 6 Row
Plant Population (seeds/ft2)(*optional)	7.25

[Add more](#) [Finish](#) [Back](#)

## Deleting an Operation

To delete an operation, click the Delete  icon in the Actions column of the operation you wish to delete.

## Switch View

By clicking **Switch to Simple View** at the top of the page, you can switch your view from one that is organized by crop and operation type to one that is organized by date.

Once you are satisfied with your crop schedule, click **Continue to Conservation Practices** at the top of the page. You will be advanced to the Conservation Practices page where you can indicate any conservation practices that are present in the field.

# Structural Conservation Practices

The Structural conservation practices are group into six (6) categories. Below are the descriptions of the different BMPs that are available under NTT.

## Auto Irrigation and Fertigation

### Auto Irrigation:

Automatic irrigation systems are irrigation systems that are controlled by a computerized controller. These types of systems are convenient. Auto irrigation overall can greatly increase crop yield. However, if auto irrigation is applied to a region where there is no need (such as an area with ample rainfall), adding auto irrigation will cause little to no change from the baseline. The user needs to input in the information of the auto irrigation system, including:

1. **Irrigation Type:** Irrigation type is the kind of auto irrigation that the user will be using. They include sprinkle, furrow/flood, drip, furrow diking, pads and pipes – tailwater irrigation. If you select furrow diking, you also must input the safety factor (#6 on this list).
2. **Irrigation Efficiency:** This value is the fraction of irrigation application that is not lost to runoff. This must be a value that is greater than or equal to 10 and less than or equal to 95%. The closer the value is to 0, the greater the percentage of water lost to runoff. A value of 100 means that no water is lost to runoff.
3. **Irrigate a Maximum of every (0-365) day:** This field is asking for the maximum frequency (in days) that irrigation can take place. Frequency is the days in between which auto irrigation takes place (if the value is 1, this means that there is auto irrigation every day; two means every other day; three means every three days; etc.) The value can be any whole number greater than zero and less than or equal to 365.
4. **Plant Water Stress Level/Factor:** This is the value that is used to trigger the start of auto irrigation. It is set to a default value of 0.8. The plant water stress factor can be of any value greater than 0 and less than or equal to 1. While a value of 0 is not permitted, it would signify manual irrigation (no automatic irrigation). The closer the value is to 100, the less water stress is allowed before the automatic irrigation is turned on. If the value is equal to 1, water stress is not allowed.
5. **Maximum Single Application:** This value signifies the amount of water that can be applied in a single day. It is in inches, and it can be any number greater than 0. However, it is set to a default value of 3.
6. **Rigidity:** Describe if the irrigation amount is a fixed value.
7. **Add irrigation schedule for crop rotations:** You also can select the start and the end date of auto-irrigation/fertigation within a rotation year.

### Auto Fertigation:

Fertigation is the application of fertilizers, soil amendments, or other water-soluble products through an irrigation system. Auto Fertigation is an automatic fertilization process in which fertilizer is dissolved and

distributed along with water in your drip or spray irrigation system\*. This makes Auto Fertigation very similar to Auto Irrigation. In fact, all of the inputs into Auto Irrigation are in Auto Fertigation. To see these inputs, see Auto Irrigation. However, there is one additional input in Auto Fertigation:

1. **Concentration of Nitrogen in irrigation Water (ppm):** The amount of nitrogen in the Automatic Fertigation in parts per million.

## Drainage Water Management System

### Tile Drain:

Tile drainage is a practice for removing excess water from the subsurface of soil intended for agriculture. Drainage brings excessive soil moisture levels down for optimal crop growth. Tile drainage is often the best recourse for reducing high subsurface water levels to improve crop yields. Too much subsurface water can be counterproductive to agriculture by preventing root development and inhibiting the growth of crops. Excessive water also can limit access to the land, particularly by farm machinery.

For NTT applications, underground drainage systems are simulated in APEX. The depth of the drainage system to reduce plant stress is a key parameter used in simulating tile drainage systems in NTT. Tile drainage simulation in NTT increases subsurface flow, which may provide an avenue for increased nutrient losses in subsurface flow. The input for Tile Drain is:

1. **Depth:** This is the depth in feet at which the drainage system is installed. It is any number that is between 0.0 and 4.0.
2. **Tile Bioreactors:** The primary purpose of a bioreactor is to remove nitrates from subsurface tile drainage water at the edge of a field.
3. **Drainage Water Management:** The process of managing the drainage volume and water table elevation by regulating the flow from a surface or subsurface agricultural drainage system.
  - **Tile Drain Open Period:** The period of time of the year when the tile drain is open. Otherwise, it is open all year.
4. **Saturated Buffer:** A saturated buffer is a relatively new edge-of-field conservation practice to reduce nitrate loads from tile-drained areas, where rather than drainage water flowing directly to the stream or ditch through the outlet pipe, the drainage water is diverted to flow as shallow groundwater through a vegetated buffer's soil.

**NOTE:** This practice needs to be paired with a Grass or Forest buffer.

  - **Estimated fraction of annual tile flow:** Estimated fraction of drainage water passing through saturated buffer (0.0-1.0).
5. **Oxbow:** It is a **U-shaped bend** or abandoned meander of a river or stream that has become cut off from the main flow

## Water Bodies Management

This category entails Wetlands, Ponds/Water & Sediment Control Basin and Reservoir

## Wetlands:

Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

The wetland area is simulated as a shallow reservoir (1 ft. depth) with growing wetland vegetation – it is essentially simulated as an artificial wetland and not a natural wetland. The slope of wetland area is set to one percent. Simulated wetlands trap sediment, reduce runoff, increase infiltration, and also increase uptake of water and nutrients by the vegetation in the area covered by the wetland. The only input(s) required for wetlands is:

1. **Area:** The area of the wetland is input in acres. Since this area is no longer able to be used for crop production, there may be a lower total crop yield (although there may be a greater crop yield/acre).
2. **Is the wetland area included in your AOI?:** Here user indicates if the wetland being described is currently included in interest/field as outlined in the map. If it is included in the outline, then NTT will subtract the wetland acres from the field. If it is not included in the outline, then NTT will assume it is adjacent to the field.

## Ponds/Water & Sediment Control Basins:

Ponds are used to provide water for livestock, fish and wildlife, recreation, fire control, develop renewable energy systems, and other related uses, and to maintain or improve water quality by retaining the runoff from upland fields. Only one input is required for ponds:

1. **Fraction of Area Controlled by Ponds/WASCB:** This is the fraction (a value between 0 and 1) and is simply the fraction of the subareas which flows through (is controlled by) ponds. This only affects only the hydrology that originates in this subarea. Inflow from other subareas is not routed through the ponds in this subarea. The exact location of the ponds, however, is unknown. A greater value could help improve water quality by retaining runoff from the upland fields.

## Stream and Riparian Management

### Stream Fencing (Livestock Access Control):

Access control means the temporary or permanent exclusion of animals from an area to achieve and maintain the desired resource conditions. \* If it is only a temporary exclusion, the user can enter information regarding how much time the animals spend within the fenced area. Because excluding the animals from the stream allows a grassed area to grow, the user must also add the information for a filter strip.

**NOTE:** For stream fencing to show up among BMPs, you must add **Continuous or Rotational grazing** as an operation.

The following are the inputs for Stream Fencing:

1. **Distance from the stream to the fence(ft):** The value zero (0) means no buffer is created.

### Streambank Stabilization:

Stabilization of streambanks is done to prevent the loss of land or damage to land uses or facilities adjacent to the banks of streams or constructed channels of properties. Streambank stabilization results in:

1. Maintaining the flow capacity of streams or channels;
2. Reducing the offsite or downstream effects of sediment resulting from bank erosion; and
3. Improving or enhancing the stream corridor for fish and wildlife habitat, aesthetics, and recreation.

The input(s) for Streambank Stabilization include:

**Width (ft):** This is the width, in feet, including both sides of the vegetated channel. This can be any number greater than 0.

### Grass Buffer:

Grass buffers, also known as a filter strips, are an area of vegetation, generally narrow in width and long across the downslope edge of a field, that slows the rate of runoff, allowing sediments, organic matter, and other pollutants that are being conveyed by the water to be removed by settling out. Filter strips reduce erosion and the accompanying sediment-bound pollution.

In NTT, filter strips function by providing better infiltration of soluble nutrients, trapping of sediment, and increased uptake of water and nutrients by the filter strip vegetation. The saturated conductivity value is also modified for filter strip simulation in NTT.

The inputs for grass buffers are the same as for forest buffers (see Forest Buffer), with the additional requirement that the user specify type of vegetation.

1. **Vegetation Type:** This is the type of grass or vegetation that will be present in the buffer section. Select one from the drop-down list of options.
2. **The Oxbow area included in your field (acres):** This is the area of the buffer in acres and is simulated as a separate field. It must be a number greater than 0.
3. **Grass Strip Width (ft):** This is the width of the filter strip. Filter Strips are typically narrow in width. This can be any value greater than 0.
4. **Fraction of field treated by buffer:** This is the estimated fraction (0.00-1.00) of the runoff from the field that is routed through the buffer.
5. **Is the buffer area included in your AOI?:** Here the user indicates if the wetland being described is currently included in interest/field as outlined in the map. If it is included in the outline, then NTT will subtract the wetland acres from the field. If it is not included in the outline, then NTT will assume it is adjacent to the field.

### Riparian Forest Buffer:

Forest buffers are linear wooded areas with well-developed root systems, an organic surface layer, and understory vegetation. When they are adjacent to open water, they are referred to as riparian forest

buffers. Non-riparian buffers are linear wooded areas along down-slope field edges. Forest buffers trap sediment and increase infiltration, thereby reducing sediment and nutrient losses. Forest buffers often include a grass buffer between the field and the forested buffer. If present, please also include the width of the grass buffer.

The input(s) for Forest Buffer are the following:

1. **Area (Acres):** This is the area of the buffer in acres and is simulated as a separate field. It must be a number greater than 0.
2. **Grass Strip Width (ft):** This is the width of the filter strip. Filter Strips are typically narrow in width. This can be any value greater than 0.
3. **Forest Strip Width (ft.):** This is the width of the mix of grass and trees in the portion of the forest buffer (not including the grass strip).
4. **Fraction of field treated by buffer:** This is the estimated fraction (0.00-1.00) of the runoff from the field that is routed through the buffer.
5. **Is the buffer area included in your AOI?:** Here the user indicates if the wetland being described is currently included in interest/field as outlined in the map. If it is included in the outline, then NTT will subtract the wetland acres from the field. If it is not included in the outline, then NTT will assume it is adjacent to the field.

**Grass Waterway:**

Waterways are vegetated channels that conduct and dispose of overland flow from upstream areas. Waterways typically work by increasing the surface roughness (with vegetation) which reduces the velocity of flow.

The inputs for Waterways are the following:

1. **Vegetation Type:** This is the type of grass or vegetation that is used in the channel.
2. **Grass Strip Width (ft):** This is the width, in feet, including both sides of the vegetated channel. This can be any number greater than 0.
3. **Length (ft): This is the width, in feet, of the waterway. This can be any number greater than 0.**
4. **Estimated fraction of average annual tile flow released to:** The fraction of the field that drains to the grass waterway. A number between 0.00 and 1.00. In NTT, this fraction is set as 1, assuming that all the runoff from field passes through grass waterway.

**Streambank Restoration:**

**Contour Buffer (Stream Farming)**

**Contour Buffer (Strip Farming):**

A contour buffer strip is an area of land maintained in permanent vegetation that helps to control air, soil, and water quality and other environmental problems primarily on land that is used for agriculture.

Buffer strips trap sediment and enhance filtration of nutrients and pesticides by slowing down runoff that could enter the local surface waters.

The buffer strip is simulated based on the width of the buffer and main crop, and the vegetation planted in the buffer. The number of strips and area are calculated according to the total field area and the widths of buffer and main field, which are inputs to the model.

The inputs for Contour Buffer are:

1. **Crop:** This is the type of grass or vegetation that will be present in the buffer section. Select one from the drop-down list of options.
2. **Grass Buffer Width (ft):** This is the width, in feet, of the buffer strips. It can be any number greater than 0. Buffer width, along with crop width, determines the number of buffer and crop strips in the field.
3. **Crop strip width (ft):** This is the width of the commercial (main) crop strips.

## Land Grading and Management

### Land Leveling:

Land leveling is used to reduce the slope on very high soil slopes. By reducing the slope, the surface land is better able to retain irrigation and soil water. The input for land leveling is:

1. **Slope reduction:** To simulate this management practice in NTT, users need to provide a percent reduction of original field slope after the land treatment.

### Terrace System:

A terrace system is a leveled section of a hill cultivated area, designed as a method of soil conservation to slow or prevent the rapid surface runoff of water. Terraces decrease hill slope-length, reduce formation of gullies, and intercept and conduct runoff to a safe outlet thereby reducing sediment content in runoff water. Often, in application the landscape is formed into multiple terraces, giving a stepped appearance. Terraces are simulated by reducing the practice factor (PEC). If you would like to apply a terrace system, click on the **Select** button.

### Reservoir:

1. **Elevation at Emergency Spillway (ft):** This is the height to the top of the reservoir.
2. **Surface Area at Emergency Spillway (ac):** Total reservoir surface area at emergency spillway elevation.
3. **Volume at Emergency Spillway (in):** Runoff volume from reservoir catchment area at emergency spillway elevation.
4. **Elevation at Principal Spillway (ft):** This is the height to the base of the reservoir.
5. **Surface Area at Principal Spillway (ac):** Total reservoir surface area at principal spillway elevation.
6. **Volume at Principal Spillway (in):** Volume at principal spillway elevation.

7. **Initial Volume (in):** This should be 0 in most cases.
8. **Average Principal Spillway Release (days):** This is the rate at which the water seeps through the straw bale, sandbags, etc.
9. **Initial Sediment Concentration (ppm):** Initial sediment concentration in reservoir.
10. **Normal Sediment Concentration (ppm):** Normal sediment concentration in reservoir.
11. **Hydraulic conductivity of reservoir bottoms (mm/h):** Hydraulic conductivity of reservoir bottom.
12. **Time Sediment to Return to Normal (days):** Time for sediment concentrations to return to normal (days) following a runoff event.
13. **Bulk Density of Sediment (t/m<sup>3</sup>):** Bulk density of sediment in reservoir.

#### Auto Lime Application:

Auto lime application enables the user to simulate the application of agricultural limestone to increase soil pH and/or reduce soil aluminum saturation. By default, NTT automatically applies Lime. (Check the box to automatically apply lime as needed).

#### Reference

\* See USDA

website: [http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/?&cid=nrcs143\\_026849](http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/?&cid=nrcs143_026849) for more detailed term descriptions.

# Results Page

The results page allows you to view the results for the field/scenario combinations that you simulated. You cannot review the results unless the field/scenario has been simulated. Please see simulating scenarios for more information.

## Viewing the Results

To view the results on one or more field scenarios, the user may click the **View Results** button on the Management Scenarios page.

After clicking on View Results, the user will be directed to the Tabular View page as default. Users may also choose to view data in graphical view by clicking Annual-Chart or Monthly-Chart on the side navigation menu.

## Tabular View

To compare the results of field scenarios in the tabular view, use the drop down to select any desired initial year, then select one final year, and finally each field scenario. Click View when you are finished.

## Average Annual Results (All Years)

All Years Tabular Results | Dry Years Tabular Results | Wet Years Tabular Results | Monthly Graphical Results | Annual Graphical Results

Download PDF | Download Excel

Select Initial Year | Select Final Year

Per Acre |  Total Field Area

(±) = Confidence Interval

Select Scenario +

HINT: the Initial year and the Final year can be changed at any time to view different results from the selected years, and if you only have one or two scenarios you wish to compare, select the same scenario multiple times so that there is a scenario selected for each column of the tabular display.

The user may toggle between two different units in the tabular view. The user may view results in units/acre (e.g., lbs/acre) or total units summed across the area of the field (e.g., lbs).

After clicking View, the table will populate with the results of each scenario. Users have the option of downloading the results as a XLSX file, or as a PDF file.

## Interpreting Tabular Results

	Baseline	Baseline 2		Alternative	
Description	Losses (±)	Losses (±)	Change (%)	Losses (±)	Change (%)
<b>▼ Hydrology (in)</b>					
Surface Runoff (in)	1.42 (0.47)	0.84 (0.27)	-0.58 (-40.85%)	1.42 (0.46)	0.0 (0.0%)
Subsurface Flow (in)	4.94 (0.9)	5.3 (0.89)	0.36 (7.29%)	4.92 (0.91)	-0.02 (-0.4%)
Tile Drain Flow (in)	0.0 (0.0)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)
Irrigation Applied (in)	0.0 (0.0)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)
Deep Percolation (in)	3.24 (0.65)	3.47 (0.65)	0.23 (7.1%)	3.22 (0.65)	-0.02 (-0.62%)
Precipitation (in)	30.23 (2.16)	30.94 (2.04)	0.71 (2.35%)	30.23 (2.16)	0.0 (0.0%)
<b>▼ Nutrients Applied (lbs)</b>					
Mineral N (lbs)	180	0	-180.0 (-100.0%)	180	0.0 (0.0%)
Organic N (lbs)	0	0	0.0 (NaN%)	0	0.0 (NaN%)
Mineral P (lbs)	60	0	-60.0 (-100.0%)	60	0.0 (0.0%)
Organic P (lbs)	0	0	0.0 (NaN%)	0	0.0 (NaN%)
<b>▼ N Losses (lbs)</b>	8.93 (5.07)	5.13 (2.79)	-3.8 (-42.55%)	9.32 (5.22)	0.39 (4.37%)
Organic N (lbs)	4.89 (3.52)	1.75 (1.32)	-3.14 (-64.21%)	4.72 (3.29)	-0.17 (-3.48%)
Runoff N (lbs)	2.61 (1.19)	2.37 (1.22)	-0.24 (-9.2%)	3.56 (1.73)	0.95 (36.4%)
Subsurface N (lbs)	1.29 (0.32)	0.98 (0.25)	-0.31 (-24.03%)	1.0 (0.2)	-0.29 (-22.48%)
Tile Drain Soluble N (lbs)	0.0 (0.0)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)
N <sub>2</sub> O (lbs)	0.14 (0.04)	0.03 (0.0)	-0.11 (-78.57%)	0.04 (0.0)	-0.1 (-71.43%)
<b>▶ Deep Percolation (lbs)</b>	6.63 (2.0)	4.42 (1.43)	-2.21 (-33.33%)	4.56 (1.13)	-2.07 (-31.22%)
<b>▼ P Losses (lbs)</b>	0.82 (0.39)	0.37 (0.17)	-0.45 (-54.88%)	0.82 (0.38)	0.0 (0.0%)
Organic P (lbs)	0.49 (0.3)	0.18 (0.12)	-0.31 (-63.27%)	0.49 (0.29)	0.0 (0.0%)
Surface Soluble P (lbs)	0.33 (0.09)	0.19 (0.05)	-0.14 (-42.42%)	0.33 (0.09)	0.0 (0.0%)
Tile Drain Soluble P (lbs)	0.0 (0.0)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)
<b>▼ Total Sediment (t)</b>	0.331 (0.27)	0.109 (0.09)	-0.222 (-67.07%)	0.329 (0.26)	-0.002 (-0.6%)
Surface Erosion (t)	0.331 (0.27)	0.109 (0.09)	-0.222 (-67.07%)	0.329 (0.26)	-0.002 (-0.6%)
Manure Erosion (t)	0.0 (0.0)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)
<b>▼ Soil Health Indicators</b>					
C Sequestration Rate At 12in (t)	0.0	0.021	0.021 (Infinity%)	0.0	0.0 (NaN%)
CO <sub>2</sub> Equivalent (t)	0.0	0.076	0.076 (Infinity%)	0.0	0.0 (NaN%)
Climate Impact (t)	0.019	-0.072	-0.091 (-478.95%)	0.005	-0.014 (-73.68%)
<b>▼ Bacteria CFU</b>					
Bacteria CFU	0.00e+00	0.00e+00	0.0 (NaN%)	0.00e+00	0.0 (NaN%)
<b>▼ Crop Yield</b>					
CORN (bu)	203 (8.27)	211 (9.29)	8.0 (3.94%)	195 (8.44)	-8.0 (-3.94%)
<b>▶ N Stress</b>					
<b>▶ P Stress</b>					
<b>▶ Temperature Stress</b>					
<b>▶ Water Stress</b>					

The scenario results presented in your table represent AVERAGE annual edge of field losses across the period of simulation. NTT simulates over a period of the years selected by the user. To view year by year results, the user can view using the Graphical results feature (See View Graphical Results). The name of Scenario 1 will appear at the top of the first Losses column. This column displays the nutrient, sediment and flow losses at the edge of the field for Scenario 1 in addition to the estimated yields. Scenario 1 is the first column of data, Scenario 2 results are represented in the next column and highlighted in a different color. In addition to displaying results in the “Losses” column, Scenario 2 also has a “Change” column that represents the change in losses between scenario 1 and scenario 2. Scenario 3 results are

also highlighted in another color. The Change column represents the change in losses between scenario 1 and scenario 3.

NTT is designed to compare a baseline scenario (present) with an alternative scenario (future). Because of this, it is assumed that the user will be looking for improvements in the alternative scenario. This means that negative numbers in the difference and reduction % represent an undesirable result (e.g: increased losses as compared to scenario 1) and positive numbers indicate a desired result (e.g. reduced losses as compared to scenario 1).

## Expanding Results

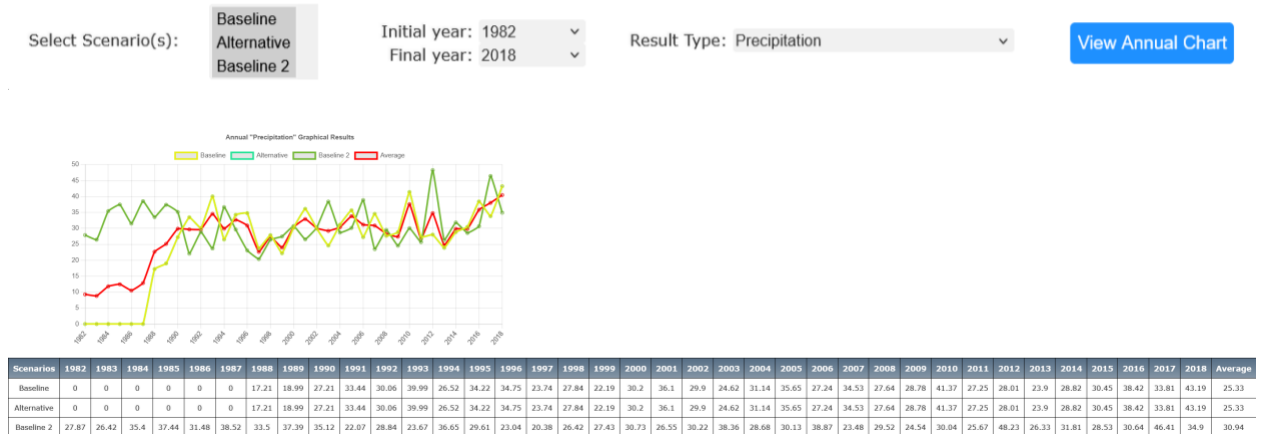
In the Tabular view, results for Total Nitrogen, Total Phosphorus, surface/subsurface & Tile Drain flow, Other Water info, Total sediment, and yield are summarized. To drill down, click the arrow ►, next to the row of interest. For instance, when expanding the Total Nitrogen row, users will be able to view the results for Organic N, Runoff N, Subsurface N and Tile Drain N, which comprise the Total Nitrogen losses value.

	Baseline	Baseline 2	Change (%)	Alternative	Change (%)
Description	Losses (±)	Losses (±)	Change (%)	Losses (±)	Change (%)
▼ Hydrology (in)					
Surface Runoff (in)	1.42 (0.47)	0.84 (0.27)	-0.58 (-40.85%)	1.42 (0.46)	0.0 (0.0%)
Subsurface Flow (in)	4.94 (0.9)	5.3 (0.89)	0.36 (7.29%)	4.92 (0.91)	-0.02 (-0.4%)
Tile Drain Flow (in)	0.0 (0.0)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)
Irrigation Applied (in)	0.0 (0.0)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)
Deep Percolation (in)	3.24 (0.65)	3.47 (0.65)	0.23 (7.1%)	3.22 (0.65)	-0.02 (-0.62%)
Precipitation (in)	30.23 (2.16)	30.94 (2.04)	0.71 (2.35%)	30.23 (2.16)	0.0 (0.0%)
► Nutrients Applied (lbs)					
► N Losses (lbs)	8.93 (5.07)	5.13 (2.79)	-3.8 (-42.55%)	9.32 (5.22)	0.39 (4.37%)
► Deep Percolation (lbs)	6.63 (2.0)	4.42 (1.43)	-2.21 (-33.33%)	4.56 (1.13)	-2.07 (-31.22%)
► P Losses (lbs)	0.82 (0.39)	0.37 (0.17)	-0.45 (-54.88%)	0.82 (0.38)	0.0 (0.0%)
► Total Sediment (t)	0.331 (0.27)	0.109 (0.09)	-0.222 (-67.07%)	0.329 (0.26)	-0.002 (-0.6%)
► Soil Health Indicators					
► Bacteria CFU					
► Crop Yield					
► N Stress					
► P Stress					
► Temperature Stress					
► Water Stress					

## Viewing Results Graphically

In addition to being able to view your results in tabular form, NTT also provides the option of viewing results graphically. There are two graphical views for the user to select from: annual and monthly results. The user can select these views by clicking on the preferences at the top of the page.

- Annual Graphical Charts:** Annual Charts allow users to view the annual average losses for a specific constituent (for example flow or sediment) for the years selected for the simulation. To select the annual view, click **Annual Graphical Chart** button. Once this option has been selected, the user selects the scenarios they would like to compare, and the constituent they would like to view, as shown below. This will bring up the selected results on the graph. In addition to the graph, the annual results are displayed below the graph in tabular form and can also be exported.



- Monthly Graphical Results:** The monthly chart view allows users to view monthly averages losses for the constituents over the period of the simulation. To view the monthly chart view, click Monthly Graphical Results from the above buttons. Monthly charts are limited to constituents that APEX summarizes monthly (see drop-down list of options below).

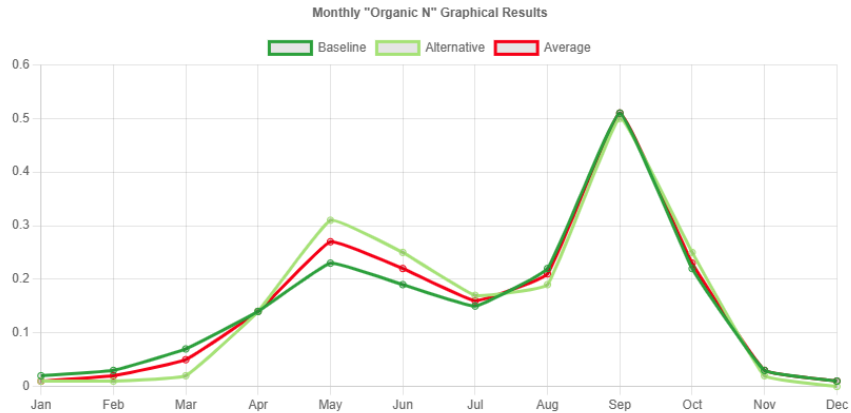
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After selecting the result type, click on the **View Monthly Chart** button to view monthly results.

## Monthly Graphical Results

*Select the scenarios you want to compare. You can select multiple scenarios by clicking on each one.  
 Then, choose a result type and click 'View Monthly Chart'.  
 To download the graph, right-click on the graph and select 'Save image as'. The image will be downloaded to your device.*

Select Scenario(s): 
 Result Type:



Scenarios	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Baseline	0.02	0.03	0.07	0.14	0.23	0.19	0.15	0.22	0.51	0.22	0.03	0.01	0.15
Alternative	0.01	0.01	0.02	0.14	0.31	0.25	0.17	0.19	0.5	0.25	0.02	0.0	0.16

- Dry Years Tabular Results:** The Dry years chart view allows users to view the dry years averages losses for the constituents over the period of the simulation. To view the Dry Years Results, click **Dry Years Tabular Results** from the above buttons.
- Wet Years Tabular Results:** The Wet years chart view allows users to view the wet years averages losses for the constituents over the period of the simulation. To view the Wet Years Results, click **Wet Years Tabular Results** from the above buttons.

## Field Routing (Watershed) Scenarios

The field routing/watershed feature allows users to simulate routing between fields. Alternately, users can use the field routing function to simulate a watershed, where instead of fields, the area of interests (AOIs) represents sub-basins. A routing scenario will run off, sediment, and nutrients from one field to the next (or from one sub-basin to the next if used to stimulate watershed) in the specified order. For each routing scenarios/watershed created by the user, the user will need to list the field-scenario routing order. When viewing the results, you may note that the load at the outlet of the watershed is less than the sum of the edge of field loads for each individually simulated field/sub-basin. This is because NTT simulates attenuation effects of water and nutrients as they flow over the landscape.

### Create/Name Your Watershed

To begin creating a field routing scenario, click **Create New Watersheds** button. Once you do this, a text box will pop up where you can type in the name of the scenario:

Once you enter the name, click Save.

### Create New Watersheds (Field Routing)

Name

### Building a Watershed Scenario

Once you have created and named your field routing/watershed scenario, it will appear in the list of watershed scenarios. Click the watershed scenario name to begin defining your watershed scenario.

When building your watershed scenario, you will begin adding fields/scenarios in the order that you wish to route the flow between fields. You may not add a field more than once to the same watershed scenario (the idea is combining fields to simulate as one field).

### Watershed Scenario

*First, select a field. Then, choose a scenario from the populated list. Finally, click 'Add Field and Scenario'.*


Select Field:  Select Scenario:


Field Name	Routing	Scenario Name	Actions
AO11	Outlet <input type="text"/>	Baseline	<input type="button" value="x"/>

## Manage Watershed Scenarios

The list of watershed scenarios that you have created will appear on the Field Routing (Watershed) page.

To begin defining your watershed scenario, or to edit a watershed scenario that you have already defined, click on the scenario name to begin defining/editing the scenario.

To delete your watershed scenario, click the delete  icon.

To rename your watershed scenario, click the edit  icon.

## Simulating/Viewing Results for Field Routing

To simulate a watershed scenario, select the name(s) of the watershed to stimulate and click Stimulate Selected Field Routing (Watershed). Your watershed may take a few minutes to simulate. Once simulation is complete, a simulation date/time will appear in the simulation date field next to the watershed scenario name.

To view results for field routings, select the scenario(s) you wish to view and click **Watershed Water Quality Results** on the left side. Results of Field Routing/Watershed scenarios are displayed in the same way that results are displayed for individual fields with both tabular and graphical views.

## NTT FARM Economic Model (FEM)

NTT-FEM (Nutrient Tracking Tool – Farm Economic Model) is a user-friendly component of the NTT program that simulates economic costs and benefits of changes in farm management practices after the initial NTT model has been executed. The FEM model simulates entire representative farms holistically, so regardless of the size of the farm, the FEM model captures the full economic effect of the scenario. A set of representative farms is already included within the NTT-FEM program for this purpose. After economic simulations are completed by FEM, the output can be viewed in the NTT program. The FEM results screen displays total revenue, total cost, and net returns. The FEM model estimates Total Revenue from crop sales by using the crop yield produced by the NTT model and the per unit crop selling price. Total Costs are estimated by FEM, using a wide array of subroutines, functions, and algorithms (Osei et al., 2000; for more information regarding FEM please refer to FEM technical documentation available in NTT program). For crop enterprises, the costs are estimated using various activities associated with crop production, such as land ownership costs, labor costs, machinery and equipment expenses, electricity charges, fuel prices, and fertilizer application costs. The third variable displayed in the results screen, Net Returns (also referred to as Net Income), is just the difference between Total Revenue to Total Cost. FEM also includes capabilities for simulating a wide spectrum of livestock operations.

## The Economic Model Simulation

To estimate the economic effects of various crop management scenarios, users must select any scenario(s) by select the check box next to it, then click on the Economic & Water Quality Simulation tab to simulate both environmental and economic simulations. APEX must be run first in order to simulate the FEM program. The results obtained from APEX are used to evaluate economic impacts.

## NTT Management Scenario Input and Simulation

Create New Scenario
Copy Scenario from other project/field

Water Quality Simulation
Economic & Water Quality Simulation

*To see the scenario operations click the name of the scenario in the list below.*

View Results
View Economic Results

Select	Name	Weather	Soils	Layers	Operations	Simulated	Simulation date	Actions
<input checked="" type="checkbox"/>	Planting Corn	✓	✓	✓	✓	⚠		
<input checked="" type="checkbox"/>	Planting Alfalfa	✓	✓	✓	✓	⚠		
<input checked="" type="checkbox"/>	Planting Corn_continuous grazing	✓	✓	✓	✓	⚠		

## Economic Results

The diagram illustrates the selection of two scenarios to determine their economic effects for a Corn and Alfalfa crop rotation. The Economic Results can be viewed by selecting the **View Economic Results** button.

## Economic Evaluation

Planting Corn		Planting Alfalfa	
Description	Losses (±)	Losses (±)	Change (%)
▼ Total Revenue	1532.04	59.38	-1472.66 (-96.12%)
Crop/Feed Sales	1532.04	59.38	-1472.66 (-96.12%)
Livestock Sales	0	0	0.0 (NaN%)
▼ Total Cost	409.59	353.48	-56.11 (-13.7%)
Field Variable Cost	203.6	147.5	-56.1 (-27.55%)
Overhead Cost	153.48	153.48	0.0 (0.0%)
Other Cost	52.5	52.5	0.0 (0.0%)
► Net Results	1122.45	-294.11	-1416.56 (-126.2%)

The first column in Figure 30 lists the categories of economic impacts associated with crop management options: Total Revenue (crop/feed and livestock sales), Total Cost, and Net Results. The remaining columns display the revenue from crop sales per acre (Total Revenue), the cost required to produce the crops in a unit acre of land (Total Cost), and the per acre net returns (Total Revenue minus Total Cost) for the baseline scenario and alternative scenarios. The Economic Results page also provides Field Variable Cost that includes machinery variable costs, additional fertilizer costs, and field labor costs. Overhead Cost includes principal and interest payments, and depreciation and cost of equity capital. Other Costs include feed costs, facility maintenance costs, crop input costs, land lease costs, livestock purchase costs, manure hauling costs, and other costs depending on the farm type.

The economic costs, as described above, are estimated based on a national database developed by the NTT team at the Texas Institute for Applied Environmental Research (TIAER). However, since the specific economic input data varies from one location to another, NTT provides an option for users who wish to change certain input data to reflect their specific situations. Five tables are included in the “Economic Input Information” section of the NTT screen for editing input data. Users can change the values in each table as needed.

- The General Inputs table includes labor wages, land value, diesel and gasoline prices, and electricity price.
- The Commodity Prices table includes the purchase/selling price of feeds.
- The Equipment table includes equipment types and prices.
- The Facilities table presents the details of facilities used on the farm for various economic activities, such as barns, parlors, and feedlots.
- The Supplies table includes fertilizer and seed prices.

Location (Iowa, Hardin)

Fields

Watersheds (Field Routing)

**Economic Input Information**

### General Inputs

Facilities
Commodity Prices
General Inputs
Equipments
Supplies

Reset to default

Name	Unit	Value	Actions
Average labor wage	\$/hr	12.0	✎
Default land rental rate	\$/acre	30.0	✎
Default land value	\$/acre	2000.0	✎
Diesel price	\$/gallon	3.11	✎
Electricity price	cents/khr	0.15	✎
Electricity purchase price	cents/khr	0.0	✎
Electricity sale price	cents/khr	0.0	✎
Gas price	\$/gallon	3.39	✎
Haul to compost distance	mile	20.0	✎
Haul to spread distance	mile	5.0	✎
Time horizon	yrs	2.0	✎

After modifications of any of the FEM input tables, users need to re-simulate the Economic & Water Quality models to see the effect of their modification(s).

## Making Modifications

To make modifications to the APEX file, first select the file that you want to work with (under "Select File" dropdown box), and then (if applicable) select the field and scenario you want to manipulate (selecting the field and scenario may not be necessary), as shown below:

Then, click on Edit File to see the file. The variables shown have the same names as they appear in the APEX manual.

You do not need to run a simulation for the changes you made in previous pages to be reflected on the files in the Modification pages.

### Downloading APEX folder

The user can download the files corresponding to the LAST SIMULATION by clicking Downloading APEX Folder. However, for changes to be visible here, the user does need to run a simulation. Also, if you are running multiple scenarios or fields, the APEX folder will contain the files that were run in the last simulation. Since a different simulation is needed for different scenarios and fields, you can see which simulation was ran last by viewing the Simulation page, which will give you the time of simulation for all the scenarios/fields/subprojects. You can also change the order of simulation on the Simulation page. The last scenario/field/subproject added to the Simulation page will be the last to simulate and the last files that the APEX folder will contain.