# Development of a Web-Based APEX Tool, VT STAR, for Optimizing Best Management Practices and Conservation Planning on Vermont Farms: Final Report

Prepared for Vermont Natural Resources Conservation Service and Vermont Agency of Agriculture Food and Markets

October 13<sup>th</sup>, 2015



Prepared by:



Development of a Web-Based APEX Tool for Optimizing Best Management Practices and Conservation Planning on Vermont Farms: Final Report

Prepared by: Stone Environmental, Inc. 535 Stone Cutters Way Montpelier, VT 05602 802.229.4541



#### Contents

1.	Introduction1
2. Databa	Development of the VT STAR se and Application2
2.1.	Database Development2
2.1.1.	Spatial Datasets2
2.1.2.	Non-Spatial Datasets4
2.2.	Application Development6
2.2.1.	Conservation Plan Entry6
2.2.2.	Conservation Practices6
2.2.3.	Custom Soils7
2.2.4.	Output Reporting7
3. Evaluat	VT STAR Simulation Results ion8
3.1. Differen	Comparison of STAR Results across t Crop Practices and Field Conditions8
3.1.1.	Objectives8
3.1.2.	Methods8
3.1.3.	Results9
3.2. of Field	Comparison of STAR Results with Edge Monitoring Data10
3.2.1.	Objectives10
3.2.2.	Methods10
3.2.3.	Results14
4.	Conclusions16
5.	References17
6.	Appendix A: VT STAR Crop List
7. List	Appendix B: VT STAR Fertilizer
8. Manage	Appendix C: VT STAR ement Schedule List
9. Exercise	Appendix D: VT STAR Training • Workbook
10.	Appendix E: VT STAR Application

Manual

# 1. Introduction

This report documents the development and evaluation of a web-based APEX model simulation tool, Vermont Systematic Tool for Analyzing Resources (VT STAR), designed for the Vermont Natural Resources Conservation Service (NRCS). The VT STAR tool was developed to design conservation plans for Vermont farms using the United States Department of Agriculture's (USDA's) latest agricultural water quality modeling technology (APEX) and farm field specific topography, soil, weather, and agronomic management data sources. The tool was designed such that comparisons of multiple conservation management alternatives can be evaluated as part of a single conservation planning assessment in order to efficiently arrive at the best management practice choices for a specific field and farm. While VT STAR was targeted for use by NRCS conservation planners, the tool will be of value to additional Vermont stakeholders concerned with water quality and the optimal implementation of agricultural best management practices throughout the state.

The first section of this report describes the datasets that have been compiled for use in VT STAR and for populating the APEX model simulations generated for each assessment. This is followed in Section 2.2 by an overview of the VT STAR application development components that were implemented to meet the needs requirements for STAR use in Vermont. The testing and evaluation of VT STAR is covered in Section 3 and focuses on the APEX model simulation results over a range of crop management systems and field conditions. The objective of the testing and evaluation was to assess whether the results generated by APEX and reported in VT STAR fell within expectations based on our conceptual understanding of agricultural water quality in Vermont. The evaluation included both a relative comparison of multiple fields with and without conservation practices under similar cropping systems, as well as a comparison of STAR-predicted results with site specific edge-of-field monitoring data. Overall, the testing and evaluation of VT STAR provided increased confidence in the model predictions. The relative comparisons of sediment and nutrient load predictions followed the expected trends across the different fields and practices, and the comparisons of the model predictions with the monitoring data were reasonable. As the use and testing of VT STAR continues, it is quite possible that additional adjustments to the parameterization of some types of management schedules and conservation practices will occur. In the meantime, the conservation planning assessment data being generated by VT STAR has been found to be representative of a broad range of conditions important to Vermont agriculture.

Both the VT STAR Training Exercise Workbook and the VT STAR Application manual are included as appendices in this report. The training exercise workbook was used for VT STAR training that was conducted at the VT NRCS office on September 15<sup>th</sup>, 2015. This workbook guides new STAR users through the critical steps required when conducting a conservation planning assessment. It includes clear examples that provide users with a strong foundation for using VT STAR. The VT STAR Application Manual provides additional documentation of VT STAR features and functionality that were not touched upon in the Exercise Workbook.



# 2. Development of the VT STAR Database and Application

### 2.1. Database Development

The STAR database stores the spatial and non-spatial datasets required to run the APEX model. Vermont specific soils, weather, practices and operation schedules data were compiled and formatted for use in STAR.

#### 2.1.1. Spatial Datasets

The STAR database contains spatial datasets that are created by the user for use in the development of a STAR assessment and additional spatial layers that have been compiled for use as inputs to the APEX model.

#### 2.1.1.1. STAR Planning Land Unit and Field Layers

The conservation planning land unit feature class contains all the fields that make up a conservation plan and are created by the user either by importing NRCS Toolkit xml data, importing a conservation plan shapefile, or by creating a conservation plan through the STAR interface.

The field, or APEX subarea, feature class contains the fields being modeled in the current STAR assessment. These fields can be modified by practices that are selected by the user. The field layer is used in the spatial analysis to determine the predominant soil, slope, and weather station. The geometry of the fields is also provided as inputs to the APEX model.

#### 2.1.1.2. Topography

The USGS Vermont 10 meter statewide DEM (2012) was obtained from Vermont Center for Geographic Information (VCGI). This dataset was extracted from USGS National Elevation Dataset (NED) 1/3 arc second data. A slope grid was calculated from the elevation grid for use in the STAR application.

The elevation and percent slope grids were imported to a file geodatabase for use by STAR geoprocessing scripts prior to APEX execution. The scripts calculate the average percent slope for each field and the average elevation over all the fields in a STAR assessment.

#### 2.1.1.3. Land Use

The 2013 Cropland Data Layer (CDL) from the National Agricultural Statistics Service (NASS) was downloaded for Vermont. The CDL serves as a reference layer in the STAR application so that user can view crop data for the area of interest (Figure 2-1).





Figure 2-1. Cropland data layer (CDL) view in STAR

#### 2.1.1.4. Soils

The USDA/NRCS SSURGO data dataset is the foundational soils dataset used by STAR. A live map service of the SSURGO soil polygon layer is available as a reference layer in the STAR application (http://server.arcgisonline.com/ArcGIS/rest/services/Specialty/Soil\_Survey\_Map/MapServer), while the STAR backend database provides a local source of the spatial data for geoprocessing and APEX inputs parameterization. The spatial layer of SSURGO map units used by STAR was obtained from the NRCS as part of a national data request in March of 2012. The soil parameters required by the APEX model are very similar to those required by the Soil and Water Assessment Tool (SWAT). The SWAT developers have compiled a database of soil parameters by SSURGO "mukey" (available from: http://swat.tamu.edu/software/arcswat/), which was adapted for use in parameterizing the APEX soils inputs for VT STAR.

#### 2.1.1.5. Weather

The VT STAR application uses a database of monthly weather statistics to create synthetic daily time series of weather inputs required by APEX. These daily inputs include precipitation, temperature, relative humidity,

wind speed, and solar radiation. The statistical approach of generating daily time series abed on monthly climate normals is allows users to runs extended simulations of the APEX model (40 plus years) to evaluate long term water quality and field environmental conditions. The weather database was compiled by our partners at the Texas A&M Blackland Research and Extension Center, and is used with the most recent version of the iEPIC model. The national database includes 17 stations in Vermont, 24 stations in New Hampshire, 103 stations in New York, and 31 stations in Massachusetts. An APEX simulation with VT STAR will identify the closest monthly weather station to a given field, which can be pulled from neighboring states.

#### 2.1.2. Non-Spatial Datasets

The STAR database contains non-spatial datasets used by the STAR application to derive inputs for the APEX model. Stone worked with NRCS to develop appropriate crop lists, practices, and operation schedules for Vermont.

#### 2.1.2.1. Crop, Fertilizer, Pesticide, and Tillage

The APEX model contains an extensive national database. In order to simplify the STAR interface for Vermont, the crop, fertilizer, pesticide, and tillage datasets were reviewed by NRCS and Stone and modified to include only Vermont appropriate data. The Vermont crop list is contained in Appendix A and the Vermont fertilizer list is contained in Appendix B of this report.

Since manure is an important source of fertilizer application in VT, a VT specific dairy liquid manure record was added to the default APEX fertilizer database. A new fertilizer in the APEX database requires the fraction (kg/kg) of mineral and organic N and P. The main literature source for nutrient content in liquid dairy manure was based on manure samples analyzed by the University of Vermont Agricultural and environmental lab (Table 2-1). The manure values from lb/1000 gal were converted to dry weight assuming a manure density of 8.5 lb/gal. Also, it was assumed that 72.5% of manure P was in the mineral form and the rest in organic form. Based on these calculations, the mineral and organic P fractions were calculated to 0.00426 kg/kg and 0.00162 kg/kg, respectively. Similarly, the mineral and organic N fractions were set to 0.0202 kg/kg and 0.0218 kg/kg, respectively.

Table 2-1. Typical values for total nutrient content of manure (Source: Table 14, Nutrient Recommendations for Field Crops in Vermont, The University of Vermont)

Dry Matter	Total N	NH4-N	Organic N	P <sub>2</sub> O <sub>5</sub>
%		lb/100	)0 gal	
7	25	12	13	

#### 2.1.2.2. Conservation Practices

Conservation practices specific to Vermont that can be simulated in APEX were added to the STAR database. STAR handles conservation practices in one of the following three ways:

1. Prompts the user to draw the conservation practice on the field and then splits the field into the field and the practice area. APEX treats the two areas as separate fields (or subareas) and requires the user to define the routing accordingly.



- 2. Prompts the user to create a custom conservation operation schedule. For some practices, the operation schedule is assigned automatically.
- 3. Adjusts APEX parameters automatically.

Table 2-1 below contains a list of the conservation practices and how they are handled by STAR.

Table 2-2. List of conservation practices in STAR

NRCS Code	Practice Name	STAR User Info
328	Conservation Crop Rotation	Create a custom conservation operation schedule
329	Residue Management, No-till, Strip Till	Create a custom conservation operation schedule
330	Contour Farming	Create a custom operation schedule. APEX parameters will automatically be updated based on the contour farming.
382	Fence	Draw the fence using the STAR splitting tool and then create a custom operation schedule for each of the fields.
391	Riparian Forest Buffer	Draw the buffer using the STAR splitting tool. The operation schedule for the buffer is automatically assigned.
393	Filter Strip	Draw the filter strip using the STAR splitting tool. The operation schedule for the filter strip is automatically assigned.
412	Grassed Waterways	Draw the grass waterway using the STAR splitting tool. The operation schedule for the grass waterway is automatically assigned.
512	Pasture and Hayland Planting	An appropriate operation schedule has been added for this field.
528	Prescribed Grazing	Draw the grazing area using the STAR splitting tool. The operation schedule for the grazing area is automatically assigned.
590	Nutrient Management	Create a custom operation schedule following the nutrient management plan.
595	Pest Management	Create a custom operation schedule that includes pesticide applications.
633	Waste Utilization	Create a custom operation schedule following alternative manure management practices
340	Cover Crop	Add a cover crop using the crop mix tool in the planting operation editor.
362	Diversion	Create a custom operation schedule. APEX parameters will automatically be updated based on the diversion.
410	Grade Stabilization Structure	Create a custom operation schedule. APEX parameters will automatically be updated based on the grade stabilization structure.
386	Field Border	Create a custom operation schedule. APEX parameters will automatically be updated for the field border.

606 Subsurface Drain C	Create a custom operation schedule. APEX parameters will automatically be updated based on the subsurface drain.

#### 2.1.2.3. Management Schedules

The crop management schedules represent one of the most important inputs in an APEX simulation. The management schedules for VT STAR were derived from standard RUSLE2 database schedules, then filtered and modified for use with VT STAR. The RUSLE2 schedules were first exported from RUSLE2 and translated into an APEX database format by our partners at the Texas A&M Blackland Research and Extension Center. This resulted in 556 management schedules for Crop Management Zone 60. Working with VT NRCS scientists, this list of 556 schedules was reduced down to a more practical list of 68 schedules. A list of these schedules is provided in Appendix C. This list was selected to represent the crop rotations and management practices that are most important to agriculture in Vermont.

The management schedules derived from the RUSLE 2 database did not include mineral fertilizer of manure applications. To complete each of the selected schedules, Stone worked with VT NRCS scientists to derive the appropriate fertilizer/manure application amounts and timing for each schedule. In addition, the planting, tillage, and harvest operations within each schedule were evaluated both to identify errors and make adjustments if needed. The final crop management schedules were uploaded into the VT STAR database. These schedules serve as the foundation for APEX simulations, but can also be customized to match specific farmer practices.

### 2.2. Application Development

#### 2.2.1. Conservation Plan Entry

The STAR interface provides several options for creating a conservation plan which then serves as the basis for creating assessments. Initial development of STAR required import of an NRCS Toolkit xml file to create a conservation plan. While this option is still available, users can now also create a conservation plan within the STAR application.

The "Create New Conservation Plan" tool allows the user to create a Conservation Plan by specifying the plan name and land owner. The user can then either import a shapefile of field boundaries or create field boundaries using a drawing tool. The area of interest can be located using the Find Address tool. Both of these methods create fields in the STAR field layer and are associated with the Conservation Plan created by the user.

#### 2.2.2. Conservation Practices

The VT STAR interface has been developed to allow users to select specific practices to be simulated on each field in in a conservation plan. This listing of conservation practices available in VT STAR was provided in Section 2.1.2.2. The user interface and backend database were developed to provide users the feedback on how each practice will be implemented by STAR to parameterize APEX. As much as possible, the interface and database were designed to make the necessary parameter adjustments to APEX automatically, with limited



additional user interaction. For some types of practices, the user must provide additional information (such as the specific location of a grassed waterway) in order for APEX to be accurately parameterized. For these types of practices, STAR provides additional user feedback as guidance for properly setting the additional inputs.

#### 2.2.3. Custom Soils

The STAR application automatically determines the predominant SSURGO soil for each field after the user completes the operation schedule definition. The name of the predominant soil is then displayed in the soil panel. Users have the option of modifying soil parameters based on local knowledge of soil conditions on the field.

A tool was developed to provide users with the option of entering field specific soil test results for phosphorus. Users can choose from either the Modified Morgan test or the Mehlich test and are prompted to enter Soil P and pH. When the user selects Modified Morgan the interface also prompts the user for an Aluminum value. The Initial Soluble P Concentration using the Modified Morgan is then calculated using the following equation:

#### (6.718\*UserP)-(11.83\*pH)-32.757\*(UserP/Al)+90.73

The user has the option of modifying soil parameter values for each soil layer.

#### 2.2.4. Output Reporting

STAR provides the user with a summary of the APEX model inputs and results for each of the fields in the assessment. The user has the option of selecting a Baseline assessment and up to two alternative assessments. Table 2-3 contains the APEX parameters can be included in the STAR report.

Table 2-3. List of APEX output variables that can be included in the STAR report

Total Outflow (inches)
Total Sediment Yield (t/ac)
Total Soluble P in Outflow (lb/ac)
Total Sediment P in Outflow (lb/ac)
Tile Drain Phosphorus Loss (lb/ac)
Total Soluble N in Outflow (lb/ac)
Total Sediment N in Outflow (lb/ac)
Tile Drain Nitrogen Loss (lb/ac)
Total Soluble Pesticide in Outflow (lb/ac)
Total Sediment Pesticide in Outflow (lb/ac)
Nitrogen Volatilization (lbs/acre)
Forage Crop Yield (t/ac)
Grain Yield (t/ac)
Drought Stress (days)
Phosphorus Stress (days)
Nitrogen Stress (days)



# 3. VT STAR Simulation Results Evaluation

Several tests were conducted during the VT STAR development process, to not only test STAR functionality, but also to evaluate its output. This chapter documents the testing that was done to ensure that STAR outputs were reasonable.

#### 3.1.

# Comparison of STAR Results Across Different Crop Practices and Field Conditions

#### 3.1.1. Objectives

Cropping practices such as fertilizer application, tillage and cover crop play an important in the pollutant loss dynamics of any field. For instance, conservation tillage practices such no till, mulch, or strip till are known to reduce sediment and phosphorus (P) losses. In addition to cropping practices, field conditions such as topography and soil conditions can influence the transport capacity of pollutants from the fields. For example, we would expect fields with higher slopes to contribute to greater soil and P loss compared to fields in flatter areas, when managed under similar cropping practices. Similarly, fields with soils under hydrologic soil group (HSG) D are likely to have more runoff than a field with soil HSG B. In addition to cropping practices and field conditions, implementation of conservation practices can be beneficial. Practices such as field buffer and subsurface drainage, can reduce sediment and P losses.

This variability in pollutant losses resulting from different cropping practices, field condition, and conservation practices was considered an important aspect of STAR testing. The objective of this testing was to compare relative runoff, sediment and phosphorus loss simulated by STAR due to these factors.

#### 3.1.2. Methods

Three fields in Vermont were identified using STAR to provide variation in slope and soil hydrologic group. The first had a slope of 1.07% and soil hydrologic group B. The second field had 10.5% slope and soil hydrologic group B. Finally, the third field had same slope as field 2, but was under soil hydrologic group C. Once the fields were identified, two types of cropping practices were selected. These schedules were selected to provide variability in tillage practices. For each schedule, the baseline simulation was compared against those with 50 ft field buffer and subsurface drainage. While several conservation practices are available to a STAR user, only two practices (subsurface drainage and buffers) were considered to limit the scope of this testing.

For each run, the results for annual runoff, sediment loss, soluble P, tile drain P, and sediment P losses were recorded. Relative comparisons were made to check against our general conceptual understanding of how various factors described above could influence these outputs.



#### 3.1.3. Results

Table 3-1 provides key annual results from 12 STAR simulations that cover a range cropping practices, field conditions and conservation practices. The results are discussed for each of these factors below. The main difference between scenario 1 and 2 is the presence of tillage. Scenario 1 includes a mulch till applied just before planting in early May, while scenario 2 has no till throughout the year. Inclusion of tillage resulted in greater runoff, sediment, and sediment P losses. This was considered reasonable because no-till practices leave greater amount of residue on the field, which reduces transport of water and pollutants.

Scenarios 1 output was compared against similar scenarios when applied to high slope (10.5%) slope field and having soil hydrologic group C (scenario 3) and D (scenario 4). In other words, Scenario 1, 3, and 4 used the same cropping practice but different field conditions. Between scenarios 1 and 3, runoff increases slightly but sediment loss increases greatly from 0.2 t/ha to 7.4 t/ha. Similarly, total P increased almost five times from 0.8 kg/ha to 3.7 kg/ha. This can be attributed to increase in slope and change in HSG from B to C. Between scenarios 5 and 6, the runoff and sediment losses further increased, which highlights the role of soil properties in influencing off-field sediment and P transport. These results are consistent with our understanding of the relation between soil hydrologic groups and sediment loss/runoff.

Scenario	Cropping Practice (schedule <sup>1</sup> )	Field Condition	Practice	Runoff (mm)	Sediment (t/ha)	Soluble P Yield (kg/ha)	P in Tile Drain (kg/ha)	P in Sediment (kg/ha)	Total P (kg/ha)
	Corn silage,	1.070/	Baseline	42.582	0.212	0.091	0	0.68	0.771
1	Winter	slope,	Subsurface drainage	42.592	0.213	0.091	0.068	0.68	0.839
	Manure (A)	000	Buffer (50 ft)	39.693	0.164	0.084	0	0.701	0.785
	Corn silage,	1.070/	Baseline	34.531	0.024	0.09	0	0.502	0.592
2	No till, Winter	slope,	Subsurface drainage	34.541	0.024	0.09	0.084	0.502	0.676
	Manure (B)	000	Buffer (50 ft)	31.378	0.016	0.084	0	0.557	0.641
3	Corn silage,	10 50/	Baseline	48.234	7.392	0.104	0	3.62	3.724
	Winter	slope,	Subsurface drainage	19.579	2.771	0.036	0.102	1.622	1.76
	Manure (A)	1150 C	Buffer (50 ft)	45.818	2.18	0.102	0	1.759	1.861
	Corn silage,	10 50/	Baseline	82.138	12.552	0.194	0	6.216	6.41
4	Winter	slope,	Subsurface drainage	19.579	2.771	0.036	0.102	1.622	1.76
	Manure (A)	1130 0	Buffer (50 ft)	78.045	3.892	0.184	0	3.342	3.526

Table 3-1. STAR output for annual runoff, sediment, and phosphorus (P) loss under different condition of cropping practice, field conditions and conservation practice.

<sup>1</sup>(A) Corn Silage\Corn, silage; mulch till, SC, wintercover, manure, Z60; (B) Corn Silage\Corn, silage; no till, SC, wintercover, manure, Z60; (C) Corn Grain\Corn, grain; mulch till, SC, spring manure, Z60, 4Corn Grain\Corn, grain; No Till, Z60, (D) Corn Silage\Corn, silage; mulch till, SC, wintercover, manure, Z60

The conservation practices tested were subsurface drainage and field buffer to compare against baseline. The default depth of subsurface drain in STAR is 1067 mm (3.5 ft), while the field buffer width was set to 50 ft. Results showed that the subsurface drainage was most effective in reducing runoff on poorly drained, higher slope fields. For higher slope fields, erosion and sediment bound P reduced greatly when subsurface drains

were implemented. However, implementation of subsurface drain provided a new transport pathway for P through the tile drains. The P loss in tile drains ranged from 0.07 kg/ha to 0.1 kg/ha

Placement of a 50 ft buffer consistently reduced runoff and sediment loss across all scenarios. The benefits, however, were higher for higher slope fields. For example, the reduction of sediment was highest for scenarios 3 and 4, due to it higher slopes. These results are consistent with our conceptual understanding that higher sloped fields are most prone to high sediment and sediment P losses and buffers placed for such fields can provide the greatest benefits.

#### 3.2.

## Comparison of STAR Results with Edge of Field Monitoring Data

#### 3.2.1. Objectives

APEX is a complex agricultural water quality model that simulates a field's hydrology, crop growth, and nutrient cycling. It uses well-established, peer-reviewed mathematical equations to perform the simulations on a daily basis. Based on a default parameterization, the model provides reasonable output, which was also verified in the previous section of this report. When site-specific data is available, such as cropping practices and monitoring data, the model can be refined to more closely represent regional conditions. The most common use of a site-specific calibrated model is to evaluate alternative scenarios (e.g. implementation of cover crops) for that particular site.

Although calibration is considered valuable for model usability, over conditioning for a single site can make it less useful for other sites. For STAR, which was developed to be applicable to any field in VT, a generalized set of parameter values - one that provides acceptable simulations over a range of conditions in topography, soils and cropping conditions – is more desirable than those conditioned for a single farm.

To evaluate if the current set of parameters could be further refined, the APEX model inputs generated through STAR were further calibrated. Calibration of environmental models traditionally involves adjusting parameter to reflect site-specific conditions and to match output recorded for every monitoring event. However, for this testing, the model was not evaluated for every event, but rather focused on the longer term (annual) runoff, sediment, and nutrient transport predictions across multiple fields.

The main objective was to identify broad parameters value adjustments that could improve overall simulations in STAR. In a multi-parameter model like APEX, a set of parameters values that match monitoring output at one site, perform less ideally at other sites. Therefore, caution was exercised to not over-condition the existing parameter values to one site, but identify parameter values that generally improved simulations for all sites.

#### 3.2.2. Methods

To develop a regionally specific calibration of APEX, water quality data is required. Stone has been conducting edge-of-field monitoring in several corn and hay fields in VT since the fall of 2012. Data from five such fields located in Ferrisburgh (FER; 4.6 acres), Shoreham (SHO; 5.9 acres), Shelburne (SHE; 6.8 acres), Pawlet (PAW; 6.0 acres), and Williston (WIL; 4.3 acres) were used to evaluate STAR predictions. At the time this testing began, monitoring data from 2012 and 2013 was available. Detailed information from farmer-reported cropping schedules was also available and included in the APEX models (Table 3-2 through Table 3-6).

Year	Month	Day	Activity
1	4	12	Apply tillage 820 ROLLHRRW (Roller Harrow 15 FT)
1	4	16	Plant red clover using "drill, air deliver" on straight row cover type
1	7	4	Harvest without kill using "Baler, Harvest Forage" Method
1	9	1	Harvest without kill using "Baler, Harvest Forage" Method
2	6	19	Harvest without kill using "Baler, Harvest Forage" Method
2	7	24	Harvest without kill using "Baler, Harvest Forage" Method
2	8	25	Harvest without kill using "Baler, Harvest Forage" Method
2	9	19	Harvest without kill using "Baler, Harvest Forage" Method
2	10	11	Fertilizer application (WoodAsh @ 4400 lb/acre using "Fertilizer app surface broadcast no incorp")
2	10	17	Fertilizer application (Manure @ 4000 gal/acre using "Fertilizer app surface broadcast no incorp")
2	12	6	Fertilizer application (Manure @ 4000 gal/acre using "Fertilizer app surface broadcast no incorp")

#### Table 3-2. Crop schedule at the Ferrisburgh field

#### Table 3-3. Crop schedule at the Shorham field

Year	Month	Day	Activity
1	1	1	Plant alfalfa and tal fescue using "drill, air deliver"on straight row cover type
1	3	25	Fertilize "45-0-0 Urea" using "Fertilizer app surface broadcast no incorp" @ 150 lb/acre
1	5	18	Harvest without kill using "Baler, Harvest Forage" Method
1	7	2	Fertilizer application (Dairy Fresh Manure @ 5000 gal/acre using "Fertilizer app surface broadcast no incorp")
1	7	4	Harvest without kill using "Baler, Harvest Forage" Method
1	8	21	Harvest without kill using "Baler, Harvest Forage" Method
1	11	20	Harvest without kill using "Baler, Harvest Forage" Method
2	4	15	Fertilize "45-0-0 Urea" using "Fertilizer app surface broadcast no incorp" @ 150 lb/acre
2	5	18	Harvest without kill using "Baler, Harvest Forage" Method
2	7	12	Harvest without kill using "Baler, Harvest Forage" Method
2	7	20	Fertilizer application (Dairy Fresh Manure @ 4500 gal/acre using "Fertilizer app surface broadcast no incorp")
2	8	16	Harvest without kill using "Baler, Harvest Forage" Method
2	9	29	Harvest without kill using "Baler, Harvest Forage" Method
2	10	14	Fertilizer application (Dairy Fresh Manure @ 4300 gal/acre using "Fertilizer app surface broadcast no incorp")

#### Table 3-4. Crop schedule at the Shelburne field

Year	Month	Day	Activity	
1	1	1	Plant Timothy, plant with drill using "drill, air deliver", straight row cover type	
1	6	9	Harvest without kill using "Baler, Harvest Forage" Method	
<u>ال</u> لا	STONE ENVIRONMENTAL			

1	7	24	Harvest without kill using "Baler, Harvest Forage" Method
1	9	3	Fertilizer application (Dairy Fresh Manure @ 5561 gal/acre using "Fertilizer app surface broadcast no incorp")
2	7	13	Harvest without kill using "Baler, Harvest Forage" Method
2	8	2	Fertilizer application (Dairy Fresh Manure @ 7300 gal/acre using "Fertilizer app surface broadcast no incorp")
2	9	3	Harvest without kill using "Baler, Harvest Forage" Method

#### Table 3-5. Crop schedule at the Pawlet field

Year	Month	Day	Activity
1	5	12	Fertilizer application (Dairy Fresh Manure @ 4000 gal/acre using "Fertilizer app surface broadcast no incorp")
1	5	12	Tillage using equipment "Chisel plow 6i"
1	5	29	Plant corn silage using "Planter 32 inch"
1	6	1	Fertilize (30-10-20 using "Fertilizer app attached to implement" @ 200 lbs/acre)
1	9	27	Harvest without kill using "Combine Self-prop 4WD" and kill
2	5	2	Fertilizer application (Dairy Fresh Manure @ 4500 gal/acre using "Fertilizer app surface broadcast no incorp")
2	5	3	Apply tillage "Chisel plot 6i"
2	5	8	Plant corn using "Planter 32 inch". Fertilize (27-9-18 using "Fertilizer app attached to implement" @ 225 lbs/acre)
2	10	1	Harvest corn without kill, using "cSilage Harvestor, kill on next day
2	10	15	Plant Winter Wheat, plant in drill using "broadcast seeder", straight row cover type

#### Table 3-6. Crop schedule at the Williston field

Year	Month	Day	Activity
1	4	29	Fertilizer application (Dairy-Solid Manure @ 15 ton/acre using "Fertilizer app surface broadcast no incorp")
1	5	1	Tillage using equipment "Chisel plow 6i"
1	5	24	Apply tillage 820 ROLLHRRW (Roller Harrow 15 FT)
1	5	26	Plant corn grain using "Planter 32 inch"
1	9	8	Planting winter rye (Equipment: Broadcast aerial)
1	11	9	Harvest corn without kill, using "combine self-prop 4wd", kill on next day
1	12	8	Fertilizer application (Dairy-Solid Manure @ 15 ton/acre using "Fertilizer app surface broadcast no incorp")
2	5	7	Fertilizer application (Dairy Fresh Manure @ 9485 gal/acre using "Fertilizer app surface broadcast no incorp")
2	5	9	Apply tillage "Finishing harrow LT15FT" (3.9" inch depth)
2	5	16	Plant corn silage using "Planter 32 inch"
2	9	1	Plant winter rye using "broadcast seeder"
2	10	9	Harvest corn without kill, using "combine self-prop 4wd", kill on next day
2	11	10	Fertilizer application (Dairy Fresh Manure @ 9485 gal/acre using "Fertilizer app surface broadcast incorp")



A new conservation plan was setup for each field in STAR. The field drainage boundaries – that is the area of the field that drains to the monitoring station - were available in a GIS shapefile format and were uploaded to STAR to delineate the fields. For each conservation plan, an existing STAR baseline assessment was chosen. Then edits were made to each schedule based on site-specific conditions. Finally, the automatic soils processing was conducted within STAR to identify the representative soils for each field. Once the baseline conservation plan was established for each field, the APEX model was run within STAR and the output folder was downloaded to further refine the model, analyze the output, and conduct calibration as necessary.

Refinements for the model of each site included incorporating custom soil and weather data. For all the fields, soil sample data were available. The parameters sampled included texture (sand/silt/clay/gravel), pH, organic matter, cation exchange capacity, aluminum, and soil test phosphorus (Table 3-7). Organic carbon (C) was calculated from organic matter by dividing by 1.72. Organic nitrogen (N) was assigned assuming that the C:N ratio for humic materials is 14:1 (Neitsch et al., 2011). Organic P values were assigned assuming that the N:P ratio for humic materials is 8:1 (Neitsch et al., 2011). Soil test phosphorus, which was obtained based on modified Morgan method for each field, was converted to Mehlich 3 equivalent using the following equation (Winchell et al., 2011).

$$Mehlich3 = 6.718 \times Modified \ Morgan - 11.83 \times pH - 32.757 \times \frac{Modified \ Morgan}{Aluminum} + 90.73$$

The Mehlich 3 values were then halved to parameterize the soluble P values in APEX. The phosphorus sorption ratio (PSP) parameter in APEX was calculated as follows (Vadas and White, 2010).

$$PSP = -0.053 \times \log(Clay) + 0.001 \times Soluble P - 0.029 \times Organic C + 0.42$$

Field	Sand (%)	Silt (%)	Gravel (%)	рН	Organic C (%)	CEC (cmol/kg)	Soluble P (g/Mg)	PSP	Organic P (g/Mg)	Organic N (g/Mg)
Pawlet	35.0	49.6	18.8	7.9	2.1	18.8	19.4	0.2	186.9	1495.0
Ferrisburgh	10.1	57.9	8.7	6.4	1.8	12.2	23.1	0.2	160.9	1287.4
Shelburne	43.9	25.5	8.4	7.3	2.3	20.0	18.9	0.2	207.6	1661.1
Williston	24.1	63.6	1.4	7.2	2.9	11.3	68.4	0.3	259.6	2076.4
Shorham	7.6	26.5	9.2	6.1	2.7	17.3	13.6	0.1	244.0	1951.8

Table 3-7. Soil properties of the fields simulated by STAR

By default, STAR generates weather data based on historical weather patterns at a nearby weather station relative to the location of the user-defined field. For this testing, however, site-specific daily precipitation and temperature data were organized for the 2010-2013 period. The data sources for this time-series data included both on-site weather stations as well as data from nearby National Weather Service gages.

Although APEX provides numerous outputs, calibration was restricted to flow, sediment and total phosphorus outputs only. The monitoring data provided the average depth of water, mass of sediment and phosphorus leaving the field for several events during the 2012-2013 season. A script was written using the R language to automatically read and sum APEX output, from output files, for the dates corresponding to each event. Then, the flow, sediment, and total phosphorus were aggregated for the entire 2012-2013 monitoring

period. This two-step aggregation simplified calibration and provided a single value, per field, for each of the three outputs to compare against corresponding totals from monitoring data.

The four models were simulated for the period between 2010 and 2013. The period of 2010 and 2011 was used as a model warm-up, while event-specific data from 2012-2013 was used for model calibration. Table 3-8 provides a summary of the parameters that were calibrated in the APEX models that were built from STAR.

Parameter	Description	Default Value	Calibrated Value
PARM(15)	Runoff CN residue adjustment parameter	0.5	0.05
PARM(46)	C-factor coefficient in exponential residue function in residue factor	0.5	1.5
PARM(47)	C-factor coefficient in exponential crop height function in biomass factor	1	0.2
PARM(59)	P upward movement by evaporation coefficient	0.1	5
PARM(62)	Manure erosion equation coefficient	0.25	0.35
PARM(76)	Standing dead crop fall rate coefficient	0.001	0.03
PARM(96)	Soluble P leaching partition coefficient	1	10
ITYP	Peak runoff rate estimator flag. A value of 3 indicates SCS TR55 type 2 rainfall pattern	0	3
NVCN	Non-varying curve number flag. A value of 0 indicates a variable daily nonlinear CN weighted by depth of soil water	4	0
ISLF	Slope length steepness factor. A value of 1 indicates the MUSLE slope length/steepness factor	0	1
DRV	Equation for water erosion. When set to a value of 4, the model uses the MUSLE method.	0	4

Table 3-8. Parameters calibrated in the APEX model

#### 3.2.3. Results

Figure 3-1 shows the comparison of STAR/APEX output with the monitoring data from five field sites. Parameters were adjusted such that reasonable results were simulated at all sites. The graphs below indicate that applying a single set of parameters to all sites results in trade-offs for model performance. At some sites the model over predicts, while at other sites it under predicts. For example, the water yield output showed a modest under prediction at three out of the five fields, but over predicted at the Williston field. Similarly, phosphorus loss was slightly over predicted at two sites (PAW, WIL), slightly under predicted at two sites (FER, SHE), and nearly matched at one site (SHO). The monitoring data for sediments showed wider variability, with nearly no sediment loss at Shorham and Shelburne to much larger loss at Pawlet. The APEX model captured a similar trend from low to high, although simulated loss at Pawlet is higher than what was observed.

An adjustment of APEX parameters to lower sediment yield at Pawlet was successful, but when these refined parameters were transferred to other fields, the results there were unsatisfactory. It is also likely that

monitoring data may not have captured some events completely. Overall, the model performance was considered very reasonable and there appears to be no systematic bias in model predictions. Most importantly, the relative differences between the model predictions of total phosphorus and sediment closely match the monitoring data.



Figure 3-1. STAR output comparison with monitoring data (2012-2013) at fields located in Ferrisburgh (FER), Shorham (SHO), Shelburne (SHE), Pawlet (PAW), and Williston (WIL) in Vermont



# 4. Conclusions

The Vermont STAR tool has been developed to allow NRCS conservation planners and other agricultural water quality stakeholders to conduct farm and field specific assessments to identify management practice alternatives that help reduce sediment and nutrient losses from farms. VT STAR provides a simplified, web-based interface to the APEX model, enabling a broader group of scientists and planners to access the model's agronomic and water quality simulation capabilities than would otherwise be possible. This pilot project to develop and evaluate VT STAR with the Vermont NRCS has exposed approximately two dozen conservation planners and interested scientists to how the APEX model can be used to address agricultural water quality challenges in Vermont. Documentation of the VT STAR tool in the form of a Training Exercise Workbook and Application Manual are provided in Appendix D and E of this report. These documents will introduce others interested in agricultural best management practices in Vermont to STAR's capabilities. It is anticipated that the use of VT STAR will increase both within and outside of NRCS after the completion of this initial pilot project. An increase in STAR's use will allow for further refinement of the tool and increase its value in the conservation planning process throughout Vermont and beyond.



# 5. References

- Neitsch, S. L., J. G. Arnold, J. R. Kiniry and J. R. Williams. 2011. Soil and Water Assessment Tool Theoretical Documentation Version 2009. Technical Report No. 406. College Station, TX: Texas Water Resources Institute.
- Vadas, P. A. and M. J. White. 2010. Validating soil phosphorus routines in the SWAT model. *Trans. ASABE* 53(5):1469-1476.
- 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.



# Appendix A: VT STAR Crop List

Alfalfa	Alfalfa HAY	Annual Rye Grass
Apple Tree	Artichokes	Asparagus
Barley all	Barley feed	Barley feed or malt
Barley malt	Beans dry edible	Bermuda hay
Big Blue Stem grass	Blueberries	Broccoli
Brome grass	brome grass mountain	brome grass smooth
Buckwheat	Cabbage fresh	Camelina
Canadian Oats	Canadian Spring Wheat	Canadian Sunflowers
Canadian Winter Pasture	Canola	Cantaloupe
Carrots	Cauliflower	Celery
Cheat Grass	Chicory	Christmas tree
Cilantro	Clover	Clover Alsike
Clover Crimson	Clover White	Collard Greens
Corn all	Corn grain	Corn seed
Corn silage	Corn white	Cucumbers for pickles processed
Cucumbers fresh	Duram Wheat	EasternGamagrass
Eggplant	Emmer Spelt	Fallow
Fava beans	Flax	Forage Oats
Forage Sorghum	Garlic	Ginseng
Gladiola	Grape	Green Beans
Green peas fresh	Honey Dew Melon	Horseradish
IMPERVIOUS	Kale	Ladino Clover
Lettuce Head	Lettuce other	Lettuce romaine
Lima beans dry	LittleBluestemGr	Meadow Fescue
med grass	Millet	Musk Melon
MustardGreens	Oats	Onions dry
Onions green	Orchard grass	PEAS
Peas Austrian winter	Peas cowpeas	Peas Dry
Peas Field	Peppers bell	Peppers chile all excluding bell
Perennial Ryegrass	Pinto Beans	Potatoes
Pumpkin	Radish	Raspberry

### STONE ENVIRONMENTAL

VT STAR Final Report / October 13, 2015

		1
Red Beets	Red Clover	Reed Canarygrass
Rice	Rye	sage
short grass	Silage & haylage	Smooth Brome Grass
Snap Beans	Snap beans fresh	Sorghum all
Sorghum grain	Sorghum hay	Soybeans
Spinach fresh	Spinach processes	squash
Strawberries	Suden grass	Sugar Maple Trees
Summer Pasture	Sunflower seed oil	Sweet corn fresh
Sweet potatoes	Sweetclover	Switch Grass
Tall fescue	Tall grass	Tillage Radish
timothy	Tomatilla	Tomatoes fresh
Triticale	Turnips	Velvetleaf
Vetch	Watermelon	Wheat durum
Wheat other spring	Wheat winter	Winter Pasture
Winter Peas	Winter Rye	



# Appendix B: VT STAR Fertilizer List

11-46-00	14-46-00	16-00-00 Nitrate Of Soda
16-20-00	16-20-00	18-18-00
18-46-00	19-00-00	20-00-00
20-10-10	21-00-00	22-00-00
23-00-00	26-00-00	28-00-00
28-10-10	28-14-00	30-00-00
32-00-00	32-02-10	33-00-00
34-00-00	39-00-00	45-00-00 Urea
46-00-00	Elemental N	Elemental P
Elemental K	Anhydrous Ammonia - 82% N	Aqua Ammonia - 20.5% N
Ammonium Nitrate - 34% N	Ammonium Nitrate Solution - 20% N	Ammonium Nitrate-Limestone Mixtures - 21% N
Ammonium Nitrate-Sulfate - 30% N	Ammonium Polysulfide - 20% N	Ammonium Sulfate - 21% N
Ammonium Sulfate Solution - 6% N	Ammonium Sulfate-Nitrate - 26% N	Ammonium Sulfate-Urea - 33.5% N
Ammonium Thiosulfate - 12% N	Sodium Nitrate -160% N	Sulfur Coated Urea - 36% N
Urea - 46% N	Urea Solution - 20% N	Ammonium Metaphosphate - 12% N, 22.3% P2o5
Ammonium Phosphate - 11% N, 20.9% P2o5	Diammonium Phosphate - 18% N, 20% P2o5	Ammonium Polyphosphate - 15% N, 26.2% P2o5
Ammonium Phosphate Nitrate - 27% N, 6.1% P2o5	Ammonium Phosphate Sulfate - 16% N, 8.7% P2o5	Basic Slag - 3.9% P2o5
Monoammonium Phosphate - 11% N, 22.7% P2o5	Bone Meal, Raw - 3.9% N, 9.6% P2o5	Bone Meal, Steamed - 2.2% N, 11.8% P2o5
Bone, Precipitated - 15.3% P2o5	Limestone, Phosphatic - 5.6% P2o5	Phosphate Rock - 1.3% P2o5
Superphosphate, Normal - 9.6% P2o5	Superphosphate, Enriched - 10% P2o5	Superphosphate, Triple - 20% P2o5
Superphosphoric Acid - 29.7% P2o5	Beef Composted Manure	Beef Liquid-Other
Beef Liquid-Runoff Storage Pond For Open Lot Runoff	Beef Liquid-Single Stage Lagoon Or Holding Pond	Beef Slurry-Concrete Or Steel Tank, Basin, Or Pit
Beef Slurry-Earthen Storage Facility	Beef Slurry-Other	Beef Solids-Barn, Shed, Or House 30% Ts
Beef Solids-Covered Slab 55% Ts	Beef Solids-Manure Pack 59 - 67% Ts	Beef Solids-Other 45% Ts
Beef Solids-Stacking Slab 50% Ts	Beef-Feedlot Pit Manure	Beef-Feedlot Scrapping Manure
Beef-Fresh Manure	Beef-No Storage	Biosolids Slurry All
Biosolids Solid All	Dairy Liquid-Other	Dairy Liquid-Runoff Storage Pond For Open Lot Runoff

Dairy Liquid-Single Stage Lagoon Or Holding Pond	Dairy Liquid-Two Stage Lagoon System	Dairy Slurry-Concrete Or Steel Tank, Basin, Or Pit
Dairy Slurry-Earthen Storage Facility	Dairy Slurry-Other	Dairy Solids-Barn, Shed, Or House 18% - 25% Ts
Dairy Solids-Covered Slab 30% Ts	Dairy Solids-Manure Pack 67% Ts	Dairy Solids-Other 45% Ts
Dairy Solids-Stacking Slab 35%Ts	Dairy-Fresh Manure	Dairy-Lagoon Liquid Manure
Dairy-Lagoon Solid Manure	Dairy-Lagoon-Efficient Water Use	Dairy-Liquid Manure
Dairy-No Storage	Dairy-Solid Manure	Equine Solids-Any Storage
Equine Solids-No Storage	Goat-Fresh Manure	Hog-Fresh Manure
Horse-Fresh Manure	Poultry Broilers-Fresh Manure	Poultry Layers -Deep Pit Manure
Poultry Layers -Fresh Manure	Poultry Layers -Liquid Manure	Poultry Solids-Litter In House (#4,5, Or 6 Solid Storage Types)
Poultry Solids-Stockplied Litter (#1, 2, Or 3 Solid Storage Types)	Poultry Turkeys -Fresh Manure	Sheep Solids-Barn, Shed, Or House
Sheep Solids-Manure Pack	Sheep-Fresh Manure	Swine Liquid All
Swine Slurry All	Swine Solids All	Swine Solids-No Storage
10-10-10	32-06-00	20-20-20
80-60-120	75-40-45	40-40-60
00-20-20	00-40-40	VT Manure



# Appendix C: VT STAR Management Schedule List

Corn Grain\Corn,grain; FC,SD,fall and spring manure, Z60
Corn Grain\Corn,grain; FP,fall and spring manure, Z60
Corn Grain\Corn,grain; mulch till,SC, spring manure, Z60
Corn Grain\Corn,grain; mulch till,SC, Z60
Corn Grain\Corn,grain; mulch till,SD, Z60
Corn Grain\Corn,grain; No Till, manure, Z60
Corn Grain\Corn,grain; No Till, Z60
Corn Grain\Corn,grain; SC, spring manure, Z60
Corn Grain\Corn,grain; SC, Z60
Corn Grain\Corn,grain; SD, Z60
Corn Grain\Corn,grain; SP, spring manure, Z60
Corn Grain\Corn,grain; SP, Z60
Corn Silage\Corn,silage; FC,fall and spring manure, Z60
Corn Silage\Corn,silage; FP,fall and spring manure, Z60
Corn Silage\Corn,silage; mulch till,SC, manure, Z60
Corn Silage\Corn,silage; mulch till,SC, wintercover, manure, Z60
Corn Silage\Corn,silage; No till, manure, winter rye cover, Z60
Corn Silage\Corn,silage; No till, manure, Z60
Corn Silage\Corn,silage; No till, Z60
Corn Silage\Corn,silage; SC, manure, Z60
Corn Silage\Corn,silage; SC, wintercover, manure, Z60
Corn Silage\Corn,silage; SC, Z60
Corn Silage\Corn,silage; SD, manure, Z60
Corn Silage\Corn,silage; SD, Z60
Corn Silage\Corn,silage; SP, Z60
Corn Silage\Corn,silage; SP, manure. Z60
Hay Crops\Alfalfa-Grass\Alfalfa-grass; 3 cuts,FP,manure applied,5 years,Z60
Hay Crops\Alfalfa\Alfalfa; 3 cuts,FP,manure applied,5 years, Z60
Hay Crops\Alfalfa\Alfalfa; 3 cuts,SD,manure applied,5 years, Z60
Hay Crops\Clover\Clover, spring seeded, SD, green chop 3 cuts, 2 years, manure, Z60
Hay Crops\Timothy-Red Clover\3 cuts\Timothy-Red Clover; 3 cuts,SD,spring spin seeded,cultipacker,manure applied,5 years,Z60

### STONE ENVIRONMENTAL

VT STAR Final Report / October 13, 2015

Hay Crops\Timothy-Red Clover\4 cuts\Timothy-Red Clover; 4 cuts,FD,fall seeded,5 years,Z60
Hay Crops\Timothy-Red Clover\4 cuts\Timothy-Red Clover; 4 cuts,SD,spring seeded,5 years,Z60
Hay Crops\Timothy-Red Clover\4 cuts\Timothy-Red Clover; 4 cuts,SD,spring seeded,manure applied,5 years,Z60
Hay Crops\Timothy\2 cuts\Timothy; 2 cuts,SD,spring seeded,manure applied,5 years,Z60
Hay Crops\Timothy\3 cuts\Timothy; 3 cuts,FD,fall seeded,manure applied,5 years,Z60
Hay Crops\Timothy\3 cuts\Timothy; 3 cuts,SD,spring seeded,manure applied,5 years,Z60
Small Grains\Oats,spring; FP,manure, Z60
Small Grains\Oats,spring; FP,Z60
Small Grains\Oats,spring; SD, manure, Z60
Small Grains\Oats,spring; SD,Z60
Small Grains\Rye,cereal; fall plant, drilled, Z60
Small Grains\Wheat,spring 7 inch rows; SD,manure, Z60
Small Grains\Wheat,spring 7 inch rows; SD,Z60
Sorghum-Sudangrass\Sorghum,silage; 1 cut, no-till, manure, Z60
Soybeans\Soybeans; 30in row, FD, Z60
Soybeans\Soybeans; 30in row, FP, Z60
Soybeans\Soybeans; 30in row, mulch till, SC, Z60
Soybeans\Soybeans; 30in row, SD, Z60
Soybeans\Soybeans; 30in row, SP, Z60
Soybeans\Soybeans; drilled, mulch till, SC, Z60
Vegetables\Sweet corn\Corn,sweet,cultivated; SD,Z60
Vegetables\Sweet corn\Corn,sweet; SP,Z60
Vegetables\Greens, Lettuce\Greens,spinach,chard,beet,kale,leaf lettuce; SD,3 cutsZ60
Vegetables\Greens, Lettuce\Greens,spinach,chard,beet,kale,leaf lettuce; SP,Z60
Vegetables\Peppers, Tomatoes\Peppers; SD, plastic mulch, Z60
Vegetables\Peppers, Tomatoes\Peppers; SD,Z60
Vegetables\Peppers, Tomatoes\Peppers; SP,Z60
Vegetables\Pumpkins, Squash\Pumpkin; SD,Z60
Vegetables\Pumpkins, Squash\Pumpkin; SP,Z60
Corn Grain - Hay(soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP, 3 cuts, manure, Z60
Corn Grain - Hay(soybeans,silage,etc.)\3 yrs Corn Grain,FP - 5 yrs legume-grass hay,FP, 3 cuts, manure, Z60
Corn Silage - Hay\Legume-grass Hay - 3 cuts\1 yr Corn Silage,FP - 5 yrs legume-grass Hay; 3 cuts, manure, Z60
Corn Silage - Hay\Legume-grass Hay - 3 cuts\1 yr Corn Silage,SC - 5 yrs legume-grass Hay; 3 cuts, manure, Z60
Corn Silage - Hay\Legume-grass Hay - 3 cuts\3 yrs Corn Silage,FP - 5 yrs legume-grass Hay; 3 cuts, manure, Z60
Corn Silage - Hay\Legume-grass Hay - 3 cuts\5 yrs Corn Silage,SC - 5 yrs legume-grass Hay; 3 cuts, manure, Z60
Vegetables\Corn,sweet,SD,cultivated - Tomatoes,SD,plastic - Squash,SD,plastic - Peas,SD,drilled; Z60
Grass Filter Strip

6. Appendix D:VT STAR Training Exercise Workbook



VT STAR Final Report / October 13, 2015

# APEX STAR Tool Exercise Workbook

Prepared for Vermont Natural Resources Conservation Service and Vermont Agency of Agriculture Food and Markets

September 15<sup>th</sup>, 2015



Prepared by:



802.229.4541 / info@stone-env.com / www.stone-env.com

An Exercise Manual for Training on the APEX Systematic Tool for Analyzing Resources (STAR)

Prepared by: Stone Environmental, Inc. 535 Stone Cutters Way Montpelier, VT 05602 802.229.4541



#### Contents

1.	Introduction 1
2. Assessr	Exercise 1, Running a Baseline nent with STAR 2
2.1.	Create a New Conservation Plan2
2.1.1.	Login to STAR and Locate Farm2
2.1.2.	Create New Conservation Plan4
2.1.3.	Create a PLU for the conservation plan 4
2.2.	Creating a New Baseline Assessment 5
2.2.1.	Choose Current Conservation Plan5
2.2.2.	Create a New Baseline Assessment6
2.3. Manage	Defining Practices and Default Crop ement Operations Schedule7
2.3.1.	Definition of Field Practices7
2.3.2.	Operation Schedule Definition9
2.4.	Defining Field Soils and Running APEX11
2.4.1.	Run Soils/Slope Characterization11
2.4.2.	Run APEX Model12
2.5.	Viewing Results Reports13
3. Alterna	Exercise 2, Simulating an tive Crop Schedule with STAR 16
3.1.	Alternative Crop Schedule Assessment16
3.1.1.	Create a New Alternative Assessment.16
3.1.2.	Definition of Field Practices17
3.1.3.	Operation Schedule Definition18
3.1.4. Operati	Specifying the Cover Type of Planting ons19
3.1.5.	Defining Field Soils and Bunning APEX20
3.1.6. Alterna <sup>.</sup>	Viewing Results Reports to Compare tive to Baseline
3.1.6. Alterna <sup>.</sup> 3.2. Assessn	Viewing Results Reports to Compare tive to Baseline
3.1.6. Alterna <sup>.</sup> 3.2. Assessn 3.2.1.	Viewing Results Reports to Compare tive to Baseline
3.1.6. Alterna <sup>-</sup> 3.2. Assessn 3.2.1. 3.2.2.	Viewing Results Reports to Compare tive to Baseline
3.1.6. Alterna <sup>•</sup> 3.2. Assessn 3.2.1. 3.2.2. 3.2.3.	Viewing Results Reports to Compare tive to Baseline

3.2.5. Operati	Remove Operations from the Crop ion Schedule	25
3.2.6.	Define Soils and Run APEX	26
3.2.7. Both Al	Viewing Results Reports to Compare Iternatives to Baseline	27
4. Alterna	Exercise 3, Simulating ative Practices with STAR	30
4.1. Assessr	Subsurface Drainage Alternative nent	30
4.1.1.	Create an Alternative Assessment	30
4.1.2.	Define the Field Practices	31
4.1.3.	Select Field Operation Schedule	32
4.1.4.	Define Soils and Run APEX	32
4.1.5.	View Report	33
4.2.	Filter Strip Alternative Assessment	35
4.2.1.	Create an Alternative Assessment	35
4.2.2.	Define the Field Practices	35
4.2.3.	Select Field Operation Schedule	38
4.2.4.	Define Soils and Run APEX	39
4.2.5.	View Report	40
4.3.	Cover Crop Alternative Assessment	42
4.3.1.	Create an Alternative Assessment	42
4.3.2.	Define the Field Practices	43
4.3.3.	Select Field Operation Schedule	44
4.3.4.	Add Cover Crop Planting Operation	45
4.3.5.	Add Cover Crop Kill Operation	46
4.3.6.	Define Soils and Run APEX	47
4.3.7.	View Report	48
5. Data	Exercise 4, Using Local Soils Test	49
5.1.	Create an Alternative Assessment	49
5.1.1.	Define the Field Practices	50
5.1.2.	Define Field Operations	50
5.1.3. Specific	Define Soils and Modify with Site Soil Test Data	50
5.1.4.	Run APEX and View Report	51

# 1. Introduction

The exercises in this workbook will walk through a conservation planning assessment performed on a single field of your choosing. Each exercise will utilize different features of STAR useful for conducting a conservation planning analysis. This will begin with an exercise demonstrating the development of a baseline assessment using current cropping practices. This will be followed by modification of current practices to evaluate the soil and nutrient conservation impacts of modifying the crop rotation and fertilizer applications. Next, several alternative BMPs will be assessed to characterize their site-specific benefits to sediment and nutrient load reductions. Finally, field specific soils information will be added to the assessment to refine the results of the conservation planning assessment.

An aerial view of the farm being assessed in the examples in this workbook is shown below. This workbook uses the field labeled "1" throughout. You are welcome to work with one of the other numbered fields on this farm, or pick a field from a location of your choosing. If you evaluate one of the fields from the farm below, first check in with the instructors for an assignment of a field to work with.



Figure 1.1: Aerial view of example farm.



# 2. Exercise 1, Running a Baseline Assessment with STAR

This exercise will walk through the process of running a baseline conservation planning assessment with STAR. The exercise will start with the creation of a new conservation plan using on-screen sketching of a field to be assessed. No special practices will be added to the baseline assessment. A crop operation schedule will be added from the VT STAR database of common operation schedules. STAR will then characterize the soil and slope conditions for the selected field, which will be viewed in the Soil Editor. The exercise will finish by running the APEX model and generating a report of the model results describing average annual flow, sediment, and nutrient loadings. Throughout this exercise, you may at times refer to the STAR User's Manual, in addition to this Exercise Workbook, for guidance on different steps in a STAR assessment.

### 2.1. Create a New Conservation Plan

In this step, you will login to STAR, create a new conservation plan, and create the field you will be assessing.

#### 2.1.1. Login to STAR and Locate Farm

STAR may be accessed at the following URL: http://tamudev.stone-env.com/star

It is best to use the Firefox web browser, however recent versions of Internet Explorer will work as well. Your username will be the first letter of your first name, followed by your last name. E.g., "mwinchell." Your password has already been provided to you in a previous email (it is most likely the first 5 letters of your last name).



Figure 2.1: STAR login screen.



Once you login to STAR, you will be brought to an aerial imagery view of Vermont, along with the STAR navigation pane on the left-hand side of the screen.



Figure 2.2: STAR initial map screen.

We will start the assessment by searching for an address using the address locator. Click on the **Find Address** button on the upper right hand corner of the map. This will open an input form where the address, city, and state can be entered. Type in the address of the farm you plan to assess. If you choose to evaluate the example farm, enter the address **"Boucher Rd., Highgate, VT,"** then click the **"Find"** button. STAR will then zoom into the location of the address specified. This is the approximate location of the farm.



Figure 2.3: Address location of farm.



#### 2.1.2. Create New Conservation Plan

Each group working on this exercise will choose their own field to work with. This may be a field of the group's choosing, or a field based on the map provided in Figure 1.1. This example will work on Field 1 from Figure 1.1.

Begin by clicking on the "**Create New Conservation Plans**" button on the STAR navigation panel. This action will launch the "**Conservation Plan Editor**."

Conversation Plan Editor	23
New Conservation Plan	?
Import Toolkit Data As New Plan	
Create New Plan Without Toolkit Data	

*Figure 2.4: Conservation plan editor.* 

Next, click on the "**Create New Plan Without Toolkit Data**" button. You will now be prompted to enter information on the new conservation plan. Enter this information and then click "**Create & Define PLUs**" (PLUs stands for "Planning Land Units"). PLUs are equivalent to fields for this exercise.

Conversation Plan Editor	23
New Conservation Plan	?
Create New Plan Without Toolkit Data	
New Plan Name: Mike Training	
Land Owner Name: Mike	
Conservation Plan ID:	
Create & Define PLUs >>	
Cancel	

Figure 2.5: New conservation plan entry.

Clicking the "**Create & Define PLUs**" button will open another dialog where you will have 2 options for creating the PLUs: 1.) importing a shapefile and, 2.) drawing the field on-screen. In this exercise, you will draw the PLUs on screen.

#### 2.1.3. Create a PLU for the conservation plan

Make sure the field is visible on the map at a scale that you can trace, the click on the "**New PLU**" button to start sketching a field. Your cursor will now be active for sketching the field. Click along the border of the field, one vertex at a time, until you get all the way around the field, and then "double click" to complete the boundary.

If you are happy with your field boundary, click on the "**Save**" button. If you are not happy, and want to redo the boundary, then click on the "**Cancel**" button and redo the sketch. Note: Your original sketch may not disappear when you start redrawing the field boundary. That is fine, it will remove the old drawings once you "**Save**" the sketch. Once you click "**Save**," the field will turn a transparent purple, and you will be ready to move on with the assessment. Click the "**Close**" button on the "**Conservation Plan Editor**" to move on to the



next step. You can also click the "x" button at the top right-hand corner of any other open windows that remain. You now have created a new conservation plan to begin working with.



Figure 2.6: Sketching field boundaries on screen.

### 2.2. Creating a New Baseline Assessment

You have now created the foundation of a **Conservation Plan**. The next step is to create the inputs for a **Baseline Assessment**.

#### 2.2.1. Choose Current Conservation Plan

On the STAR navigation panel, you can click on the button **"Begin Conservation Plan Assessments"** or click on **"[1] Choose Plan."** You will now see the list of your current conservation plans (there should only be 1). Click on the current plan that you just created and click **"Load the Selected Conservation Plan."** 

> [0] Start Menu	
✓ [1] Choose Plan	
1. Choose Conservation Plan	?
Choose an Existing Conservation Plan From The Lists Below	
Your Plans	<b>^</b>
X 🔒 Y Mike Training \ Mike	^
	•
Plans Shared With You (Group Plans)	
Plans Shared With Everyone	-
Load the Selected Conservation Plan!	

Figure 2.7: Select conservation plan from STAR navigation pane.



#### 2.2.2. Create a New Baseline Assessment

A baseline assessment is designed to represent an APEX simulation of your "current" or "baseline" conditions on a field (or fields). All other assessments (called alternatives) will be derived from the baseline assessment. While baseline assessments can contain multiple fields, we will be working with a single field at a time. With the current version of STAR, assessing one field at a time is a good option.

Click on the "Create New Baseline Assessment" button. A new dialog will open and ask for the name of the assessment. You can call it "Baseline."



Figure 2.8: Creating baseline assessment.

Click on the "Create Baseline and Select Planning Land Units" button. A new "Field Selection Tools" dialog box will open that allows you to pick a field to add to the assessment. Use the left most (single hand) button to select a single field at a time. Only select YOUR field. When the "Gully Type" message box comes up, keep the "None" selection, and click "Confirm." To finish, click the "x" box in the upper right corner of the "Field Selection Tools" dialog.



Figure 2.9: Baseline assessment field selection.

Your selected field will now be shaded red and have a default name of "**Crop 1.0**" applied to it. You have now completed initial creation of the baseline assessment. Next will be setting up the field conditions.




Figure 2.10: Field selected for baseline assessment.

# 2.3. Defining Practices and Default Crop Management Operations Schedule

In STAR, "Practices" refer to special operations or characteristics of a planning land unit/field that are designed to improve natural resource conservation or crop management. Examples of practices include "Nutrient Management", "Subsurface Drainage", and "Filter Strips." In a Baseline Assessment, it is common for there not to be any special practices. However, it is still appropriate to visit the "Practices" component and indicate that no conservation practices are present. The selection of a crop management operations schedule is required for all STAR simulations and is a critical component to the assessment.

#### 2.3.1. Definition of Field Practices

After creating the baseline assessment, click on the "**Define Fields Practices** >>>" button to move to the practices portion on the STAR navigation pane.





Figure 2.11: Move to Field Practice Definition section.

The table at the bottom of the "**Field Practice Definition**" dialog indicates that definition of practices on this field is incomplete. To define the practices (and confirm the type of landuse) double click the "**Field Name**" (i.e., "Crop-1.0"). Note: Text is provided within the STAR navigation pane to explain what action needs to happen at the current step.

After double-clicking the "Field Name," a dialog will appear that asks to set the land use type. This is a generic land use, and specific crop or vegetation types will be defined in the operation schedule definition. Make sure that "Crop" is shown as the land use, and click "Save."

Field Land Use Determination	23
Define Land Use	
To set or modify the land use of this field, select the new land use from the list below:	?
Crop •	Save

Figure 2.12: Selection of land use.

The "Field Practices Editor" will show the collection of possible practices ("All Practices") as well as the "Selected Practices on Field." Since there are no practices assumed in this baseline assessment, simply click "Close" to exit the "Field Practices Editor." The STAR navigation pane will now show that the field practices definition is complete. Click the "Define Field Operation Schedule" button to move on to the operation schedule definition.





Figure 2.13: Field practice definition.

#### 2.3.2. Operation Schedule Definition

The **"Field Operations Definition"** portion of the STAR navigation pane will now show that the operations definition is incomplete. Double click in the **"Field Name"** table cell to define the operation schedule. The **"Operation Schedule Editor"** will open and provide several options for selecting an operation schedule.

	Operations Schedule Editor	23
	Auto Irrigation: No Auto Fertilization: No	
<ul> <li>&gt; [0] Start Menu</li> <li>&gt; [1] Choose Plan</li> <li>&gt; [2] Assessment Definition</li> <li>&gt; [3] Practices</li> <li>&gt; [4] Operations</li> <li>4. Field Operations Definition</li> <li>?</li> <li>Pouble-Click A Field's Name To View or Edit The Operations</li> </ul>	<b>1. Select an Operation Schedule:</b> Select a default operation schedule         Select a previously defined operation schedule         To filter the op. schedule         list, enter a search term:         Apply Prev. Defined         to Field	<b>?</b>
Schedule For That Field  Field Name Operations Status Crop-1.0 Practices: No Practices Define Soils >>	Crop Year Month Day Tillage Op. Tillage Equip. Rate Units PHU	Edited

Figure 2.14: Field operations definition entry.

We will select a "**default operation schedule.**" In VT STAR, the default operation schedules have been developed to represent typical crop rotations and management practices found in Vermont. This includes typical fertilizer and manure applications.



Choose the **"Select a default operation schedule"** option, and from the drop-down combo-box, select **"Corn Grain\Corn, grain; SP, spring manure, Z60."** The specifics of this operation schedule are shown in the table at the bottom of the input form.

	Sched	ule Editor							Σ
Auto Iri Auto Ferti	rigatio ilizatio	on: No on: No							
1. Select	t an C	Operatio	on Sch	redule:					?
<ul> <li>Selection</li> </ul>	ct a def	fault oper	ation so	chedule					
Selection	ct a pre	eviously d	efined (	operation schedule					
To filter list, ente	the op er a sea	. schedule arch term	e :						
Co	orn Grai	n\Corn,gra	in; SP, :	spring manure, Z60					•
Apply F	Prev. D	efined						Customize (	Op.
t	to Field							Schedule	
Crop	to Field Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	Schedule	Edited
Crop Corn grain	Year	Month 5	Day 11	Tillage Op. Plow, cultivate, other	Tillage Equip. MOLDBOARD PLOW REG GE7B	Rate 0	Units NA	Schedule PHU NA	Edited
t Crop Corn grain Corn grain	Year 1	Month 5 5	Day 11 15	Tillage Op. Plow, cultivate, other Plow, cultivate, other	Tillage Equip. MOLDBOARD PLOW REG GE7B SOIL FINISHER	Rate 0 0	Units NA NA	Schedule PHU NA NA	Edited No No
t Crop Corn grain Corn grain Corn grain	Year 1 1	Month 5 5 5 5	Day 11 15 15	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize	Tillage Equip. MOLDBOARD PLOW REG GE7B SOIL FINISHER Fertilizer App - Truck spreader	Rate 0 0 3569.608667	Units NA NA Ibs/acre	Schedule PHU NA NA NA	Edited No No No
t Crop Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1	Month 5 5 5 5 5 5 5	Day 111 15 15 15	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize Fertilize	Tillage Equip.         MOLDBOARD PLOW REG GE7B         SOIL FINISHER         Fertilizer App - Truck spreader         Fertilizer app In furrow or with seed or band 1	Rate 0 0 3569.608667 99.92406166	Units NA NA Ibs/acre Ibs/acre	Schedule PHU NA NA NA NA	Edited No No No No
t Crop Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1 1	Month 5 5 5 5 5 5 5 5 5 5	Day 111 15 15 15 16	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize Fertilize Plant in rows	Tillage Equip.         MOLDBOARD PLOW REG GE7B         SOIL FINISHER         Fertilizer App - Truck spreader         Fertilizer app In furrow or with seed or band 1         Planter, 40 inch	Rate 0 0 3569.608667 99.92406166 0	Units NA NA Ibs/acre Ibs/acre plants/acre	Schedule PHU NA NA NA 2126.446216	Edited No No No No
t Crop Corn grain Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1 1 1 1	Month 5 5 5 5 5 5 5 7	Day 11 15 15 15 16 1	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize Fertilize Plant in rows Fertilize	Tillage Equip.         MOLDBOARD PLOW REG GE7B         SOIL FINISHER         Fertilizer App - Truck spreader         Fertilizer app In furrow or with seed or band 1         Planter, 40 inch         Fertilizer app Surface Broadcast no incorp 2	Rate 0 03569.608667 99.92406166 0 199.8481233	Units NA NA Ibs/acre Ibs/acre Ibs/acre	Schedule PHU NA NA NA 2126.446216 NA	Edited No No No No No No
t Crop Corn grain Corn grain Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1 1 1 1 1 1 1	Month 5 5 5 5 5 5 5 5 5 7 10	Day 111 15 15 15 16 1 1 20	Tillage Op.         Plow, cultivate, other         Plow, cultivate, other         Fertilize         Fertilize         Plant in rows         Fertilize         Harvest without kill.	Tillage Equip.         MOLDBOARD PLOW REG GE7B         SOIL FINISHER         Fertilizer App - Truck spreader         Fertilizer app In furrow or with seed or band 1         Planter, 40 inch         Fertilizer app Surface Broadcast no incorp 2         COMBINE SELF-PROP 4WD	Rate 0 03569.608667 99.92406166 0 199.8481233 0	Units NA NA Ibs/acre Ibs/acre Ibs/acre Ibs/acre NA	Schedule PHU NA NA NA 2126.446216 NA NA	Edited No No No No No No No

Figure 2.15: Selection of corn grain default operation schedule.

Next, click the "Customize Op Schedule" button. This step is necessary to save the operation schedule in your personal library of operation schedules, even if no changes are made. You are now prompted to "Enter Name for the Custom Operation Schedule". Name the schedule, "T1 Crop 1.0 Corn Grain\Corn, grain; SP, spring manure, Z60" (T1 stands for "training 1"). However, you can name the schedule anything you'd like to help remember what it represents.



Figure 2.16: Naming operation schedule.

After naming the schedule, click on the "**Apply Name & Start Customizing** >>>" button. You will now see all of the tabs of the "**Operation Schedule Editor**," however for this exercise, you do not need to make any changes to the operation schedule (we will show how to do that in a later example). Cick on the "**Complete Operation Schedule**" button to close the "**Operation Schedule Editor**."



Operat	tions Sch	iedule I	Editor							23
Auto Irrigation: No Auto Fertilization: No							Complete C	peration)	Schedule	
Tillag	ge Irrig	ation	Fertilize	r Pest	icide Planting Harvest/Kill Grazing	3				
Add	a Tilla	ge Op	eration	1						?
Υe (1-	ear -6): 1	Mon (1-12	th 2): 1	Day (1-31)	: 1					
Tillag	ge Type:	Plow,	cultivate	, other	•					
	Crop:	Alfalf	а		<ul> <li>Limit To Op. Sched. Cro</li> </ul>	ops				
Equ	uipment.				•					
Equ	uipment.				•					
Equ	uipment.				•					
Equ	upment.				•			(	+) Add Til	llage Op
Equ	op	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	+) Add Til PHU	llage Op
Equ Cri X Co	rop orn grain	Year 1	Month 5	Day 11	Tillage Op. Plow, cultivate, other	Tillage Equip. MOLDBOARD PLOW REG GE7B	Rate 0	Units NA	+) Add Til PHU NA	Edited
Critical Cri	rop orn grain orn grain	Year 1 1	Month 5 5	Day 11 15	Tillage Op. Plow, cultivate, other Plow, cultivate, other	Tillage Equip. MOLDBOARD PLOW REG GE7B SOIL FINISHER	Rate 0 0	(· Units NA NA	+) Add Til PHU NA NA	Edited No No
Cri X Co X Co	rop orn grain orn grain orn grain	Year 1 1 1	Month 5 5 5 5	Day 11 15 15	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize\VTManure	Tillage Equip. MOLDBOARD PLOW REG GE7B SOIL FINISHER Fertilizer App - Truck spreader	Rate 0 0 3569.608667	Units NA NA Ibs/acre	+) Add Til PHU NA NA NA	Edited No No No
Cri X Co X Co X Co X Co	rop orn grain orn grain orn grain orn grain	Year 1 1 1 1 1	Month 5 5 5 5 5 5	Day 11 15 15 15	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize\VTManure Fertilize\10-10-10	Tillage Equip. MOLDBOARD PLOW REG GE7B SOIL FINISHER Fertilizer App - Truck spreader Fertilizer app In furrow or with seed or band 1	Rate 0 0 3569.608667 99.92406166	Units NA NA Ibs/acre Ibs/acre	+) Add Til PHU NA NA NA NA	Edited No No No No
Equ Cri X Co X Co X Co X Co X Co	rop orn grain orn grain orn grain orn grain orn grain orn grain	Year 1 1 1 1 1 1	Month 5 5 5 5 5 5 5 5 5	Day 11 15 15 15 16	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize\VTManure Fertilize\10-10-10 Plant in rows	Tillage Equip. MOLDBOARD PLOW REG GE7B SOIL FINISHER Fertilizer App - Truck spreader Fertilizer app In furrow or with seed or band 1 Planter, 40 inch	Rate 0 0 3569.608667 99.92406166 0	Units NA NA Ibs/acre Ibs/acre plants/acre	+) Add Til PHU NA NA NA 2126.44	Edited No No No No Yes
Equ X Co X Co X Co X Co X Co X Co	rop orn grain orn grain orn grain orn grain orn grain orn grain	Year 1 1 1 1 1 1 1 1 1 1	Month 5 5 5 5 5 5 5 5 5 5 7	Day 11 15 15 15 15 16 1	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize\VTManure Fertilize\10-10-10 Plant in rows Fertilize\32-06-00	Tillage Equip. MOLDBOARD PLOW REG GE7B SOIL FINISHER Fertilizer App - Truck spreader Fertilizer app In furrow or with seed or band 1 Planter, 40 inch Fertilizer app Surface Broadcast no incorp 2	Rate 0 0 3569.608667 99.92406166 0 199.8481233	Units NA NA Ibs/acre Ibs/acre Ibs/acre	+) Add Til PHU NA NA NA 2126.44 NA	Edited No No No No Yes No
Cri X Co X Co X Co X Co X Co X Co X Co X Co	rop orn grain orn grain orn grain orn grain orn grain orn grain orn grain	Year 1 1 1 1 1 1 1 1 1 1 1 1	Month 5 5 5 5 5 5 5 7 7	Day 11 15 15 15 15 16 1 1 20	Tillage Op. Plow, cultivate, other Plow, cultivate, other Fertilize\VTManure Fertilize\10-10-10 Plant in rows Fertilize\32-06-00 Harvest without kill.	Tillage Equip. MOLDBOARD PLOW REG GE7B SOIL FINISHER Fertilizer App - Truck spreader Fertilizer app In furrow or with seed or band 1 Planter, 40 inch Fertilizer app Surface Broadcast no incorp 2 COMBINE SELF-PROP 4WD	Rate 0 3569.608667 99.92406166 0 199.8481233 0	Units NA NA Ibs/acre Ibs/acre Ibs/acre Ibs/acre NA	+) Add Til PHU NA NA NA 2126.44 NA NA	Edited No No No No Yes No No

Figure 2.17: Completing operation schedule definition.

The "Operation Status" in the STAR navigation pane will now read "Complete."

## 2.4. Defining Field Soils and Running APEX

The soils, slope, and nearest weather station will be identified based on STAR's back-end SSURGO, USGS NED DEM, and weather station databases. Users do have the opportunity to modify the soil characteristics of a field where local data is available.

#### 2.4.1. Run Soils/Slope Characterization

From the STAR navigation pane, click on the "**Define Soils** >>" button. This action will fire off background geo-processing operations that identify the dominant soil from SSURGO, the average slope from a NED DEM, and the nearest weather station. The processing takes a little time, so you will be given a message that indicates this. Be patient, and wait for the results to return. When finished, a message box will appear indicating that "**Soils Processing Is Complete.**"



[0] Start Menu		
[1] Choose Plan		
[2] Assessment Definition		
[3] Practices		
<ul> <li>[4] Operations</li> </ul>		
4. Field Operat	ions Definition 🛛 ?	
Double-Click A Field's Na Schedu	me To View or Edit The Operations Ile For That Field	Are you sure?
Field Name	Operations Status	
Crop-1.0	Complete	A process to determine the predominant soil for each field in your scenario will
Practices: No Practices	-	there will little sign of system activity. To return to the Field Operations Manager without processing the scenario's soils, hit Cancel.
De	fine Soils >>	OK Cancel

Figure 2.18: Definition of field soils from geo-processing operations.

After soils processing is complete, the "**Field Soil Parameter Editing**" section of the STAR navigation pane will become active. By double clicking on the "**Field Name**", the soil characteristics for the current field can be viewed or edited. For the baseline assessment, we will view the soil characteristics, but will not edit them. Click the "**x**" in the upper right hand corner of the form to go back to the STAR navigation pane.

Field Soils Editor	2		
Edit Soil Parameters	?		
Soil Name: Scantic			
Apply to all layers: WTMN: 0 WTMX: 0	HSG: 4	> [0] Start Menu	
Select Layer #: 1		> [1] Choose Plan	
Initial Soil P from Field Tests:		> [2] Assessment Definition	
Soil P Value: 0	PH: 5.5	> [3] Practices	
Z: 1.1811023 BD: 1.14 SAN: 19.7	SIL: 54.3	[4] Operations	
WOC: 3.4802784 CNDS: 0 SSF: 0		✓ [5] Soils	
CEC: 0 SATC: 1.0999984		5. Field Soil Parameter Editing	?
Default Soil Values	(+) Update Soil	Double-Click A Field's Name To View or Edit The Soil Parameters For That Field	
WTMN: 0 WTMX: 0 HSG: 4	PH: 5.5	Field Name Soil Name	-
Z: 1.1811023 BD: 1.14 SAN: 19.7	SIL: 54.3	Crop-1.0 Scantic	11
WOC: 3.4802784 CNDS: 0 SSF: 0			1
CEC: 0 SATC: 1.0999984			
		Run Apex >>>	

Figure 2.19: Field soils editor form.

#### 2.4.2. Run APEX Model

Now that the entire baseline assessment has been defined, and it is time to run APEX. Click the "**Run APEX**>>" button. A message box will appear, confirming your intention to run the simulation. Click the "**OK**" button and wait for a minute or two. The "**APEX Processing Status**" will update itself, indicating the progress of the APEX simulation.



	>	[0] Start Men	u		
	>	[1] Choose Pl	an		
	>	[2] Assessme	nt Definition		
	>	[3] Practices			
	>	[4] Operation	s		
	>	[5] Soils			
	~	[6] Run Apex			
Are you sure?	5	5. APEX	Processing St	atus	
Are you sure you want to submit this Assessment to APEX2 Hit OK to start		Name	Bup Time	Status	D/I
running the Scenario through the APEX model. Otherwise, hit Cancel to continue		Rasolino	Run Time	Status	D/L
Scenario definition.		baseline	9/11/2015 12:19:50 PM	5: inputs	
OK Cancel					

Figure 2.20: Running APEX and progress status.

When the simulation is complete a message will appear, indicating if the simulation was unsuccessful, and will ask if you would like to download a zip file of all the model input and output files. Advanced users may want to download these files, or these files can be downloaded and evaluated by Stone/Texas A&M to troubleshoot a failed simulation. Click "**Cancel**" for the download option for this baseline simulation.

APEX Run Completion Re	sults	×				
Execution Process Has Finished. The Message Was: "APEX Run Complete"						
Would you like to download the APEX source files?						
Click OK to download the fi or click Cancel to proceed	iles, without download	ing the files.				
	ОК	Cancel				

Figure 2.21: Download APEX results option dialog.

The STAR APEX simulation is now complete, and the results can be viewed in the STAR "Reports" section.

## 2.5. Viewing Results Reports

Clicking on the "[7] **Reports**" item on the STAR navigation pane will open up the "**Reports**" section of the STAR navigation pane.



7. Reports	?
Select one or more APEX parameters:	
Total Outflow (inches)	<b>^</b>
Total Sediment Yield (t/ac)	
Total Soluble N in Outflow (lb/ac)	-
Select the Baseline assessment to report on:	
	•
Optionally, select one or more Alternatives to compare Baseline:	e to the
Refresh List View Reports	;

Figure 2.22: Reports section of STAR navigation pane.

A list of APEX output parameters is provided in a list box at the top part of the pane. These outputs include flow (runoff), sediment, nutrient, pesticide, and yield information. Select all of the APEX outputs by clicking on the first item, then scrolling down and clicking on the last item with the "**shift**" key down. All of the items will now be highlighted.

From the "Select the Baseline assessment to report on:" drop down, select the "Baseline" assessment. Since there are no alternatives yet to report on for comparison with the baseline, click on "View Reports" to launch the report generator. It will take up to a minute or two for the report to complete. Once completed, a new web browser page with a pdf of the report will appear.

7. Reports	?
Select one or more APEX parameters:	
Forage Crop Yield (t/ac) Drought Stress (days) Grain Yield (t/ac)	
Select the Baseline assessment to report on:	
Baseline	•
Optionally, select one or more Alternatives to compare to the Baseline:	
Refresh List View Reports	

Figure 2.23: Selection of parameters and baseline assessment to report on.

The first section of the report describes many of the inputs to the APEX simulation. This includes field area, crop and operation schedule, soil and slope conditions, and nutrient inputs. The second section of the report summarizes all of the outputs. The items summarized in the output section include all of the outputs selected by the user from the STAR Reports interface. The outputs from each field will be different because STAR uses all the site specific conditions when parameterizing an APEX simulation. From this baseline assessment, alternatives can be created to evaluate the effects of modifying crop rotations, management operations, and practices.

		Assessments
Field Name		Baseline
Crop-1.0	Practices	
	Op Schedule	T1 Crop-1.0-Corn Grain \Corn,grain; SP, spring manure, Z60
	Dominant Soil	Scantic
	Field Acres	12.63
	Hydrologic Soil Group	D
	Slope	4.11%
	Slope Length (ft)	45.72
	Weather Station	ST ALBANS RADIO
	Avg Annual Precip (in)	36.87
	Total N Applied (lbs/ac)	199.69
	Total P Applied (lbs/ac)	27.66
	Total Irr Applied (in/ac)	0.00
	STIR Tillage Value	130.18

Figure 2.24: Inputs summary from STAR report.

Apex Parameter	Field Name	Baseline
Total Outflow (inches)	Crop-1.0	9.15
Total Sediment Yield (t/ac)	Crop-1.0	9.51
Total Soluble P in Outflow (lb/ac)	Crop-1.0	0.40
Total Sediment P in Outflow (lb/ac)	Crop-1.0	10.66
Tile Drain Phosphorus Loss (lb/ac)	Crop-1.0	0.00
Total Soluble N in Outflow (lb/ac)	Crop-1.0	206.85
Total Sediment N in Outflow (lb/ac)	Crop-1.0	82.62
Tile Drain Nitrogen Loss (lb/ac)	Crop-1.0	0.00
Total Soluble Pesticide in Outflow (lb/ac)	Crop-1.0	0.00
Total Sediment Pesticide in Outflow (lb/ac)	Crop-1.0	0.00
Nitrogen Volatilization (lbs/acre)	Crop-1.0	38.64
Forage Crop Yield (t/ac)	Crop-1.0	0.00
Grain Yield (t/ac)	Crop-1.0	2.43

Figure 2.25: Outputs summary from STAR.



## 3. Exercise 2, Simulating an Alternative Crop Schedule with STAR

This exercise will walk through the process of running two alternative conservation planning assessments and comparing them to the baseline. For the first alternative assessment, we will select a different crop schedule so that we can compare the baseline Corn grain\Corn rotation to a Corn Grain\Hay\legume-grass rotation. The second alternative will use the operation schedule from the first alternative, but we will remove the fall plowing. We will use the STAR reporting tool to compare the results of these assessments to the baseline and to eachother.

## 3.1. Alternative Crop Schedule Assessment

An alternative assessment is designed to allow for comparisons to the "baseline" conditions on a field (or fields) by adding conservation practices and/or modifying the crop schedule. Alternative assessments are always derived from the baseline assessment. This first alternative will assess changes by modifying the crop rotation from permanent corn grain to a corn grain/hay rotation.

#### 3.1.1. Create a New Alternative Assessment

If you have exited STAR you will want to select the conservation plan you created from "[1] Choose Plan" then select "Load the Selected Conservation Plan."

Click on **"Baseline"** assessment. When there is more than one baseline you want to make sure that you first select the baseline that you want to create an alternative from. Once you have selected the baseline, click on **"Create New Alternative of Selected"** button. A new dialog will open and ask for the name of the alternative assessment. You can call it **"Crop\_Alternative"**. Click on the **"Create Alternative"** button and a new assessment that is a copy of the baseline will be created.



[0] Start Menu     [1] Choose Plan	
<ul> <li>[2] Assessment Definition</li> </ul>	the state of the s
2. APEX Assessments	Part Market
Create New Baseline Assessment	
OR Select An Existing Assessment Below	
Baseline X	
Deselect	Create a New Alternative Assessment
and Create New Alternative Of Selected	Name the Alternative Assessment:
For Baseline and Alternative Assessments	Crop_Alternative
Define Field Practices >>>	Create Alternative

Figure 3.1: Creating an alternative assessment.

To start using the alternative, click on the small arrow to the left of the Baseline to expand the list of alternative assessments associated with it. Then select the **"Crop\_Alternative."** The active assessment is always highlighted with a yellow boudary. You have now completed initial creation of the alternative assessment. Next will be setting up the field conditions

<ul> <li>[2] Assessment Definition</li> </ul>					
2. APEX Assessments					
Create New Baseline Assessment					
OR Select An Existing Assessment Below					
Baseline X Crop_Alternative X					
and Create New Alternative Of Selected	- 1				
For Baseline and Alternative Assessments					
Define Field Practices	>>>				

Figure 3.2: Selecting the alternative assessment.

### 3.1.2. Definition of Field Practices

After creating the alternative assessment, click on the "**Define Fields Practices** >>>" button to move to the practices portion on the STAR navigation pane.

It is not necessary to select any practices at this point, however, land use should be confirmed. Refer to Exercise 1 for the detailed steps.

Continue to the Operation Schedule Definition by selecting the button "**Define Field Operation** Schedule>>>>."



#### 3.1.3. **Operation Schedule Definition**

The "Field Operations Definition" portion of the STAR navigation pane will now show that the operations definition is incomplete. Double click in the "Field Name" table cell to define the operation schedule. The "Operation Schedule Editor" will open and provide several options for selecting an operation schedule.

	Operations Schedule Editor	23
	Auto Irrigation: No Auto Fertilization: No	
	1. Select an Operation Schedule:	?
[0] Start Menu     [1] Choose Plan	Select a detail operation schedule     Select a previously defined operation schedule     To filter the opt schedule	
[2] Assessment Definition	list, enter a search term:	
> [3] Practices		-
✓ [4] Operations		
4. Field Operations Definition Double-Click A Field's Name To View or Edit The Operations Schedule For That Field	Apply Prev. Defined to Field Customize Op. Schedule	
Field Name Operations Status		
Crop-1.0 Incomplete Practices: No Practices Define Soils >>	Crop Year Month Day Tillage Op. Tillage Equip. Rate Units PHU Ec	lited

Figure 3.3: Field operations definition entry.

We will select a different "default operation schedule" for this alternative to compare to our baseline. Choose the "Select a default operation scheule" option, and from the drop-down combo-box, select "Corn Grain-Hay(soybeans,silage,etc.) 2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,3 cuts, manure, Z60." The specifics of this operation schedule are shown in the table at the bottom of the input form.



On another and C										572
Operations Se	cnedule	eEditor								235
Auto Irrig Auto Fertiliz	jation: zation:	: No : No								
			-							
1. Select a	an Op	eration	Sche	dule:						2
<ul> <li>Select</li> </ul>	a defau	ult operat	ion sch	edule						
Select	a previ	ously def	ined op	eration schedule						
To filter th	ne op. s	chedule	_							-
list, enter	a searc	ch term:								
Corn	Grain -	Hay(soyb	eans,sil	age,etc.)\2 yrs Corn Grain,FP - 7 yrs legur	ne-grass hay,FP, 3 cuts, manure, Z60				•	1
									-	1
Apply Pre	ev. Defi Field	ned						Sched	e Op.	
	i leiu							Bened	ure	J
Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	PHU	Edited	
Corn grain	1	5	15	Fertilize	Fertilizer app - Truck spreader	00 02/06166	lbs/acre	NA	No	
Corn grain	1	5	16	Plant in rows	Planter 40 inch	0	nlants/acre	2126 446216	No	
Corn grain	1	10	20	Harvest without kill.	COMBINE SELE-PROP 4WD	0	NA	NA	No	- 1
Corn grain	1	10	21	Kill crop	KILL	0	NA	NA	No	
Corn grain	1	10	30	Plow, cultivate, other	MOLDBOARD PLOW REG GE7B	0	NA	NA	No	
Corn grain	2	5	11	Plow, cultivate, other	TANDEM DISK PLW 14-18FT	0	NA	NA	No	
Corn grain	2	5	15	Plow, cultivate, other	SOIL FINISHER	0	NA	NA	No	
Corn grain	2	5	15	Fertilize	Fertilizer app In furrow or with seed or band 1	99.92406166	lbs/acre	NA	No	
Corn grain	2	5	15	Fertilize	Fertilizer App - Truck spreader	1785.250423	lbs/acre	NA	No	
Corn grain	2	5	16	Plant in rows	Planter, 40 inch	0	plants/acre	2126.446216	No	
Corn grain	2	10	20	Harvest without kill.	COMBINE SELF-PROP 4WD	0	NA	NA	No	
Corn grain	2	10	21	Kill crop	KILL	0	NA	NA	No	
Corn grain	2	10	30	Plow, cultivate, other	MOLDBOARD PLOW REG GE7B	0	NA	NA	No	
Alfalfa HAY	3	4	15	Fertilize	Fertilizer app Banded or side dressed	99.92406166	lbs/acre	NA	No	
Alfalfa HAY	3	5	24	Plow, cultivate, other	SOIL FINISHER	0	NA	NA	No	
Alfalfa HAY	3	5	29	Plow, cultivate, other	FLEX-TINE HARROW CL LT20F	0	NA	NA	No	
Brome grass	3	6	1	Plant with drill	DRILL, AIR DELIVER	0	plants/acre	2160.000000	No	
Alfalfa HAY	3	6	1	Plant with drill	DRILL, AIR DELIVER	0	plants/acre	2160.000000	No	
Alfalfa HAY	3	6	5	Fertilize	Fertilizer App - Truck spreader	1785.250423	lbs/acre	NA	No	_
Brome grass	3	9	1	Harvest without kill.	BALER, SELF-PROPELLED	0	NA	NA	No	-
Altalta HAY	3	9	1	Harvest without kill.	BALER, SELF-PROPELLED	0	NA	NA	NO	- 1
Alfalfa HAY	3	9	5	Fertilize	Fertilizer App - Truck spreader	1785.250423	Ibs/acre	NA	NO	-
Alfalfa HAY	4	6	1	Harvest without kill.	BALER, SELF-PROPELLED	0	NA	NA	No	-
Alfalfa HAV	4	6	1	Fortilize	BALER, SELF-PROPELLED	1795 250422	Ibs/acro	NA	No	-
Brome grass	4	7	15	Harvest without kill		0	NA	NA	No	-
Alfalfa HAY	4	7	15	Harvest without kill.	BALER, SELF-PROPELLED	0	NA	NA	No	
Alfalfa HAY	4	7	19	Fertilize	Fertilizer App - Truck spreader	1785,250423	lbs/acre	NA	No	
Brome grass	4	9	1	Harvest without kill.	BALER, SELF-PROPELLED	0	NA	NA	No	
Alfalfa HAY	4	9	1	Harvest without kill.	BALER, SELF-PROPELLED	0	NA	NA	No	

Figure 3.4: Selection of corn grain\hay\corn grain\legume alternative operation schedule.

Click the "Customize Op Schedule" button. This is a necessary step to save the operation schedule in your personal library of operation schedules, even if no changes are made. You are now prompted to "Enter Name for the Custom Operation Schedule". Name the schedule, "T2 Crop 1.0 Corn Grain-Hay(soybeans,silage,etc.) 2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,3 cuts, manure, Z60" (T2 stands for "training 2"). However, you can name the schedule anything you'd like to help remember what it represents.

Click on the "**Apply Name & Start Customizing** >>>" button. You will now see the planting operations that need editing.

#### 3.1.4. Specifying the Cover Type of Planting Operations

All planting operations with more than one possible cover type need to be reviewed individually. The operation schedule we selected has a Brome grass planting in year 3 that needs review.

Auto Fertili	Auto Irrigation: No uto Fertilization: No							
2. Edit in	. Edit individual operations by double clicking in					?		
the gr Plantin appropri	id bel g oper iate co	ow. ations M	<b>IUST b</b> ennent or	e edited to select an practice before Continuin	q.			
appropriate cover readment of practice before continuing.								
						Ne	ext >>	
						Ne	ext >:	
						Ne	ext >:	
						INE	ext >>	
			2				ext >>	

Figure 3.5: The Brome grass planting operation needs to be edited.

Double click the record to open the "**Update Planting Operation**" form. Any of the planting operation fields can be modified but for this exercise we will only edit the Cover Type. Select "**Not Contoured** >75% ground cover lightly or only occasionally grazed" from the Cover Type drop down list.

Operations S	chedul	e Editor						23
Auto Irrig Auto Fertili	gation: zation:	: No : No						
Update Pl	Update Planting Operation							?
Year (1-6): 3	Year (1-6): 3 Month 6 Day 1 Crop Name: [Brome grass] (1-12): 6 (1-12): 1 Tillage Operation: [Plant with drill]							_
Crop	Bron	ne grass		Limit to	Op. Sched. Crops			
Planting Type	e: Plant	t with drill		Cover Type	(*Required*)			
Equipment		L, AIR DEI	IVER .	or Practice:	· · ·	-		
					Not Contoured 50% t	o 75% ground cover not heavily grazed		
Density	: 0	(plan	its/acre	) PHU:	Not Contoured <50%	ground cover or heavily grazed with no mulch		
					Not Contoured >75%	ground cover lightly or only occasionally grazed		
Cancel							Upo	late
Crop	Year	Month	Day	Tillage Op.		Tillage Equip.	PHU	Edited
Brome grass	3	6	1	Plant with drill		DRILL, AIR DELIVER	2160.000000	No

Figure 3.6: There are 3 possible cover types for the Brome grass operation.

Click the **"Update"** button and then on the next screen click on the **"Complete Operation Schedule"** button to close the **"Operation Schedule Editor."** The **"Operation Status"** in the STAR navigation pane will now read **"Complete."** 

#### 3.1.5. Defining Field Soils and Running APEX

For each APEX assessment, the soils processing needs to be re-run before executing APEX since STAR does not automatically determine if the field has been split by practices. After soils processing is complete select **"Run APEX."** 

For information on re-running and reviewing the soils and running APEX see Exercise 1.



After the APEX simulation is complete, the successful run will be listed in APEX Processing Status table. At any time, you can download a zip file of all the model input and output files by returning to this panel and selecting the paper clip. You can now view the results of both assessments in the STAR **"Reports"** section.

۷.	[6] Run Apex							
6. APEX Processing Status								
	Name	Run Time	Status	D/L				
	Crop_Alternative	9/13/2015 5:59:16 PM	complete	Ø				
	baseline	9/13/2015 5:19:47 PM	complete	Ø				

Figure 3.7: APEX Processing Status.

#### 3.1.6. Viewing Results Reports to Compare Alternative to Baseline

Clicking on the "[7] **Reports**" item on the STAR navigation pane will open up the "**Reports**" section of the STAR navigation pane.

In the APEX parameters list, select all of the APEX outputs by clicking on the first item, then scrolling down and clicking on the last item with the "shift" key down. All of the items will now be highlighted.

From the "Select the Baseline assessment to report on:" drop down, select the "Baseline" assessment. This will refresh the list of completed Alternative Assessments. Select the "Crop\_Alternative" assessment and then click on "View Reports" to run the STAR report for the selected parameters.

✓ [7] Reports	
7. Reports	?
Select one or more APEX parameters:	
Tile Drain Nitrogen Loss (lb/ac)	•
Nitrogen Volatilization (lbs/acre)	
Total Soluble P in Outflow (lb/ac)	
Total Sediment P in Outflow (lb/ac)	
Total Soluble Pesticide in Outflow (lb/ac)	
Total Sediment Pesticide in Outflow (lb/ac)	
Forage Crop Yield (t/ac)	
Drought Stress (days)	
Grain Yield (t/ac)	•
Select the Baseline assessment to report on:	
baseline	•
Optionally, select one or more Alternatives to compare to th Baseline:	e
Crop_Alternative	
Refresh List View Reports	

Figure 3.8: Selection of parameters and the baseline and alternative assessments for the STAR report.

The report will have an added column for comparing the "**Crop\_Alternative**" assessment to the "**Baseline**." The first section of the report describing inputs to the APEX simulation shows a small decrease in the total nitrogen total phosphorus applied. As expected, many of the field inputs did not changesince there were no changes to the field dimensions.

		sments	
Field Name		Baseline	Crop_Alternative
Crop-1.0	Practices		
	Op Schedule	T1 Crop-1.0-Corn Grain \Corn,grain; SP, spring manure, Z60	T2 Crop-1.0-Corn Grain Hay (soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,
	Dominant Soil	Scantic	Scantic
	Field Acres	12.63	12.63
	Hydrologic Soil Group	D	D
	Slope	4.11%	4.11%
	Slope Length (ft)	45.72	45.72
	Weather Station	ST ALBANS RADIO	ST ALBANS RADIO
	Avg Annual Precip (in)	36.87	36.87
	Total N Applied (lbs/ac)	199.69	167.35
	Total P Applied (lbs/ac)	27.66	25.42
	Total Irr Applied (in/ac)	0.00	0.00
	STIR Tillage Value	130.18	51.43

Figure 3.9: STAR Report output, comparison of baseline and alternative field inputs.

In the second half of the report, you can see the effects of the alternative assessment. Total outflow and sediment yield are approximately half of what they were in the baseline assessment. Significant reductions can also be seen in phosphorus and nitrogen outputs.



Apex Parameter	Field Name	Baseline	Crop_Alternativ
Total Outflow (inches)	Crop-1.0	9.15	5.52
Total Sediment Yield (t/ac)	Crop-1.0	9.51	4.68
Total Soluble P in Outflow (lb/ac)	Crop-1.0	0.40	0.17
Total Sediment P in Outflow (Ib/ac)	Crop-1.0	10.66	4.98
file Drain Phosphorus ₋oss (lb/ac)	Crop-1.0	0.00	0.00
Fotal Soluble N in Outflow (Ib/ac)	Crop-1.0	206.85	83.86
Total Sediment N in Outflow (Ib/ac)	Crop-1.0	82.62	35.50
File Drain Nitrogen Loss Ib/ac)	Crop-1.0	0.00	0.00
Total Soluble Pesticide n Outflow (lb/ac)	Crop-1.0	0.00	0.00
Total Sediment Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00
Nitrogen Volatilization (Ibs/acre)	Crop-1.0	38.64	30.76
Forage Crop Yield t/ac)	Crop-1.0	0.00	5.28
Grain Yield (t/ac)	Crop-1.0	2.43	0.62
Drought Stress (days)	Crop-1.0	31.07	67.89
Phosphorus Stress days)	Crop-1.0	0.00	0.00
Nitrogen Stress (days)	Crop-1.0	0.00	0.00

Figure 3.10: STAR Report output, comparison of baseline and alternative APEX outputs.

## 3.2. Creating a Second Alternative Assessment

We now want to create a second alternative assessment to further evaluate how changes in the crop operation schedule affect APEX outputs. In this second alternative, we will be modifying the default operation schedule for corn grain/hay by removing the fall plowing and looking at the effects of this change.

#### 3.2.1. Create a Second Alternative Assessment

Click on "[2] Assessment Definition" to open up the assessment panel. Click on the "Baseline" assessment and then "Create New Alternative of Selected" as you did for the first alternative. Name the alternative "Crop\_Alternative Tillage Mod" since will be modifying the previous default operation schedule.



<ul> <li>[2] Assessment Definition</li> </ul>	
2. APEX Assessments	?
Create New Baseline Assessment	
OR Select An Existing Assessment Below	
Baseline X	
Crop_Alternative	
Crop_Alternative Tillage Mod 🗶	
Deselect	J
and Create New Alternative Of Selected	
For Baseline and Alternative Assessments	
Define Field Practices >:	>>

Figure 3.11: Creating a second alternative assessment

#### 3.2.2. Definition of Field Practices

After finishing the alternative assessment creation, click on the "**Define Fields Practices >>>**" button to move to the practices portion on the STAR navigation pane.

It is not necessary to select any practices at this point, however, land use should be confirmed. Double click the "Field Name" to begin the selectin of the field practices. Set the land use to "Crop", and "Save". Continue to the "Operation Schedule Definition" by selecting the button "Define Field Operation Schedule>>>>."

#### 3.2.3. Operation Schedule Definition

The "Field Operations Definition" portion of the STAR navigation pane will now show that the operations definition is incomplete. Double click in the "Field Name" table cell to define the operation schedule. The "Operation Schedule Editor" will open and provide several options for selecting an operation schedule.

We will select the option "Select a previously defined operation schedule" for this alternative to compare to our baseline and first alternative. From the drop-down combo-box, select the schedule you created for the first alternative: "T2 Crop-1.0-Corn Grain- Hay(soybeans,silage,etc.) \2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,3 cuts, manure, Z60."

Operations Schedule Editor	X
Auto Irrigation: No Auto Fertilization: No	
1. Select an Operation Schedule:	?
$\bigcirc$ Select a default operation schedule	
$\odot$ Select a previously defined operation schedule	
To filter the op. schedule list, enter a search term:	
X T2 Crop-1.0-Corn Grain - Hay(soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,	•
Apply Prev. Defined to Field	Customize Op. Schedule

Figure 3.12: Selecting a previously created operation schedule.



Next, click the "Customize Op Schedule" button. Again, this is a necessary step to save the operation schedule in your personal library of operation schedules, even if no changes are made. You are now prompted to "Enter Name for the Custom Operation Schedule". Name the schedule, "T3-Crop-1.0-Corn Grain - Hay(soybeans,silage,etc.) 2 yrs Corn Grain, FP - 7 yrs legume-grass hay, FP, No fall plow." However, you can name the schedule anything you'd like to help remember what it represents.

Click on the "**Apply Name & Start Customizing** >>>" button. You will now see the planting operations that need editing.

#### 3.2.4. Specifying the Cover Type of Planting Operations

As we did in the first alternative, we need to update the Brome grass planting in year 3. Double click the record to open the "**Update Planting Operation**" form. Any of the planting operation fields can be modified but for this exercise we will only edit the "**Cover Type.**" Select "**Not Contoured** >75% ground cover lightly only occasionally grazed" from the Cover Type drop down list. Click the "**Update**" button to finish the planting operation editing and open the full operation schedule editor.

Operations S	Dperations Schedule Editor									
Auto Irrig Auto Fertiliz	Auto Irrigation: No Auto Fertilization: No									
2. Edit in	divid id bel	ual ope	ratior	ns by double clicking in			?			
Planting	g oper ate cov	<b>ations M</b> ver treatn	UST be	e edited to select an practice before Continuing						
						Ne	ext >>>			
Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	PHU	Edited			
Brome grass	3	6	1	Plant with drill	DRILL, AIR DELIVER	2160.000000	No			

Figure 3.13: The Brome grass planting operation needs to be edited.

#### 3.2.5. Remove Operations from the Crop Operation Schedule

In this alternative we are going to delete the fall plow operations for corn on year 1 and year 2 which occur on 10/30.

Click on the red X to the left of the Plow operation on 10/30 in Year 1. A confirmation will open asking you if you are sure you want to delete the operation schedule record. Click **"OK"**. Do the same for the plow operation on 10/30 in Year 2.



tuto Irriga	Eduic Lui	tor	-				1.0		
Auto Irriga uto Fertilizat	tion: No		Copy	Ops to Other Years			Con	nplete Opera	ation Sche
illage Irriga	ation F	ertilizer	Pestic	cide Planting Harvest/Kill G	razing				
dd a Tillag	ge Oper	ration							
Year 1	Month	110	Day	-0					
(1-6):	(1-12):	10 (	1-31):	10					
fillage Type:	Plow, cr	ultivate,	other	•					
Crop:	Alfalfa			• Limit To Op. Sche	d. Crops				
Equipment:				•					
			_						
								(+) A	dd Tillage
Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	PHU	Edited
Corn grain	1	5	11	Plow, cultivate, other	TANDEM DISK PLW 14-18FT	0	NA	NA	No
Corn grain	1	5	15	Plow, cultivate, other	SOIL FINISHER	0	NA	NA	No
Corn grain	1	5	15	Fertilize\VTManure	Fertilizer App - Truck spreader	1785.250423	lbs/acre	NA	No
Corn grain	1	5	15	Fertilize\10-10-10	Fertilizer app In furrow or with seed or band 1	99.92406166	lbs/acre	NA	No
Corn grain	1	5	16	Plant in rows	Planter, 40 inch	0	plants/acre	2126.44	Yes
Corn grain	1	10	20	Harvest without kill.	COMBINE SELF-PROP 4WD	0	NA	NA	No
Corn grain	1	10	21	Kill crop	KILL	0	NA	NA	No
Corn grain	1	10	30	Plow, cultivate, other	MOLDBOARD PLOW REG GE7B	0	NA	NA	No
Delete This Re	ecord	5	11	Plow, cultivate, other	TANDEM DISK PLW 14-18FT	0	NA	NA	No
Corn grain	2	5	15	Plow, cultivate, other	SOIL FINISHER	0	NA	NA	No
Corn grain	2	5	15	Fertilize\10-10-10	Fertilizer app In furrow or with seed or band 1	99.92406166	lbs/acre	NA	No
Corn grain	2	5	15	Fertilize\VTManure	Fertilizer App - Truck spreader	1785.250423	lbs/acre	NA	No
Corn grain	2	5	16	Plant in rows	Planter, 40 inch	0	plants/acre	2126.44	Yes
Corn grain	2	10	20	Harvest without kill.	COMBINE SELF-PROP 4WD	0	NA	NA	No
Corn grain	2	10	21	Kill crop	KILL	0	NA	NA	No
Corn grain	2	10	30	Plow, cultivate, other	MOLDBOARD PLOW REG GE7B	0	NA	NA	No
Alfalfa HAY	3	4	15	Fertilize\75-40-45	Fertilizer app Banded or side dressed	99.92406166	lbs/acre	NA	No
Alfalfa HAY	3	5	24	Plow, cultivate, other	SOIL FINISHER	0	NA	NA	No
Alfalfa HAY	3	5	29	Plow, cultivate, other	FLEX-TINE HARROW CL LT20F	0	NA	NA	No
Brome grass	s 3	6	1	Plant with drill	DRILL, AIR DELIVER	0	plants/acre	2160.00	Yes
Alfalfa HAY	3	6	1	Plant with drill	DRILL, AIR DELIVER	0	plants/acre	2160.00	Yes
1									

Figure 3.14: Remove the fall plow operations.

Delete Record		×
Are You Sure You Want To	Delete This Operation Schedu	le Record?
	ОК	Cancel

Figure 3.15: Remove the fall plow operations.

Click on the "**Complete Operation Schedule**" button to close the "**Operation Schedule Editor**." The "**Operation Status**" in the STAR navigation pane will now read "**Complete**."

#### 3.2.6. Define Soils and Run APEX

Each time a new alternative is created, the soils processing must be re-run. This is because new assessments may contain modifications to the field boundaries if practices such as buffers or grass waterways are added. Click the "**Define Soils**" button.



<ul> <li>[4] Operations</li> <li>4. Field Operations Definition</li> <li>Pouble-Click A Field's Name To View or Edit The Operations Schedule For That Field</li> </ul>						
Field Name Operations Status						
Crop-1.0	Complete					
Pefer Seilerra						
Define Soils >>						

Figure 3.16: Define Soils.

Click on "Run APEX >>>" to run the current alternative assessment.

<ul> <li>[5] Soils</li> <li>E. Field Soil Parameter</li> </ul>	r Editing					
Double-Click A Field's Name To View or Edit The Soil Parameters For That Field						
Field Name	Soil Name					
Crop-1.0	Scantic					
	*					
Run Apex >>>	)					

Figure 3.17: Run APEX.

#### 3.2.7. Viewing Results Reports to Compare Both Alternatives to Baseline

Clicking on the "[7] **Reports**" item on the STAR navigation pane will open up the "**Reports**" section of the STAR navigation pane.

In the APEX parameters list, select all of the APEX outputs by clicking on the first item, then scrolling down and clicking on the last item with the "shift" key down. All of the items will now be highlighted.

From the "Select the Baseline assessment to report on:" drop down, select the "Baseline" assessment. This will refresh the list of completed Alternative Assessments and both alternatives will now be listed. Select both the "Crop\_Alternative" assessment and the "Crop\_Alternative\_ Tillage\_Mod" alternative and then click on "View Reports" to run the STAR report for the selected parameters.



✓ [7] Reports					
7. Reports					
Select one or more APEX parameters:					
Tile Drain Nitrogen Loss (lb/ac)	•				
Nitrogen Volatilization (lbs/acre)					
Total Soluble P in Outflow (lb/ac)					
Total Sediment P in Outflow (lb/ac)					
Total Soluble Pesticide in Outflow (lb/ac)					
Total Sediment Pesticide in Outflow (lb/ac)					
Forage Crop Yield (t/ac)					
Drought Stress (days)					
Grain Yield (t/ac)	-				
Select the Baseline assessment to report on:					
Baseline	•				
Optionally, select one or more Alternatives to compare to the Baseline:					
Crop_Alternative Tillage Mod					
Crop_Alternative					
Refresh List View Reports					

Figure 3.18: Run reports.

The new alternative appears as a third column in the report. (The current formatting of the reports only allows for 3 assessments to be compared side by side. Additional assessments can be added to the report but they will appear on separate pages).

There are almost no changes in the field inputs between the two alternatives except for a reduction in the STIR tillage value.

			Assessments	
Field Name		Baseline	Crop_Alternative	Crop_Alternative_Tilla ge Mod
Crop-1.0	Practices			
	Op Schedule	T1 Crop-1.0-Corn Grain \Corn,grain; SP, spring manure, Z60	T2 Crop-1.0-Corn Grain - Hay (soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,	T3 Crop-1.0-Corn Grain Hay (soybeans,silage,etc.)\'. yrs Corn Grain,FP - 7 yr legume-grass hay,FP,
	Dominant Soil	Scantic	Scantic	Scantic
	Field Acres	12.63	12.63	12.63
	Hydrologic Soil Group	D	D	D
	Slope	4.11%	4.11%	4.11%
	Slope Length (ft)	45.72	45.72	45.72
	Weather Station	ST ALBANS RADIO	ST ALBANS RADIO	ST ALBANS RADIO
	Avg Annual Precip (in)	36.87	36.87	36.87
	Total N Applied (lbs/ac)	199.69	167.35	167.35
	Total P Applied (lbs/ac)	27.66	25.42	25.42
	Total Irr Applied (in/ac)	0.00	0.00	0.00
	STIR Tillage Value	130.18	51.43	34.09

Figure 3.19: Report Field Input summary for baseline and 2 alternatives.

In reviewing the APEX outputs, we see that the total sediment load and sediment P load have been significantly reduced by removing the fall plow operation. There other default operation schedules in the STAR database that include much more limited plow operation compared to our original baseline assessment.

Apex Parameter	Field Name	Baseline	Crop_Alternativ e	Crop_Alternativ e_Tillage Mod
Total Outflow (inches)	Crop-1.0	9.15	5.52	5.11
Total Sediment Yield (t/ac)	Crop-1.0	9.51	4.68	0.88
Total Soluble P in Outflow (lb/ac)	Crop-1.0	0.40	0.17	0.11
Total Sediment P in Outflow (lb/ac)	Crop-1.0	10.66	4.98	1.41
Tile Drain Phosphorus Loss (Ib/ac)	Crop-1.0	0.00	0.00	0.00
Total Soluble N in Outflow (lb/ac)	Crop-1.0	206.85	83.86	77.41
Total Sediment N in Outflow (lb/ac)	Crop-1.0	82.62	35.50	9.85
Tile Drain Nitrogen Loss (lb/ac)	Crop-1.0	0.00	0.00	0.00
Total Soluble Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00	0.00
Total Sediment Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00	0.00
Nitrogen Volatilization (lbs/acre)	Crop-1.0	38.64	30.76	28.00
Forage Crop Yield (t/ac)	Crop-1.0	0.00	5.28	5.37
Grain Yield (t/ac)	Crop-1.0	2.43	0.62	0.62
Drought Stress (days)	Crop-1.0	31.07	67.89	65.58
Phosphorus Stress (days)	Crop-1.0	0.00	0.00	0.00
Nitrogen Stress (days)	Crop-1.0	0.00	0.00	0.15

Figure 3.20: Report APEX output summary for baseline and 2 alternatives.

## 4. Exercise 3, Simulating Alternative Practices with STAR

This exercise will build upon the baseline and alternative crop schedule assessments that we have evaluated up to this point. Now, the focus will be on evaluating the effects of adding specific conservation or field management practices to the assessment. The practices that will be included in this exercise (subsurface drainage, filter strips, and cover cropping) are common to Vermont farms. For each alternative assessment, we will be able to compare the predicted sediment and nutrient outputs with our baseline assessment.

## 4.1. Subsurface Drainage Alternative Assessment

In exercise 2, an alternative assessment was created that modified the crop rotation from permanent corn grain to a corn grain/hay rotation, as well as a modification to the tillage operations during the corn years. For the first alternative practices assessment, we will add subsurface drainage to the alternative with the custom corn/hay operation schedule (with modified tillage).

#### 4.1.1. Create an Alternative Assessment

In the **"Assessment Definition"** item from the STAR navigation pane, select the **"Baseline"** assessment and click **"Create New Alternative of Selected."**Name the

alternative "Crop\_Alternative\_Tillage\_Mod\_Drainage" and click, "Create Alternative."



Figure 4.1: Create alternative assessment with subsurface drainage.

Select the new alternative assessment created, and click on the "Define Field Practices >>>" button.

2. APEX Assessments						
Create New Baseline Assessment						
OR Select An Existing Assessment Below						
Baseline						
Crop_Alternative						
Crop_Alternative_Tillage Mod X						
Crop_Alternative_Tillage Mod_Drainage						
and Create New Alternative Of Selected						
For Baseline and Alternative Assessments						
Define Field Practices >>>						

Figure 4.2: Select new drainage alternative.

#### 4.1.2. Define the Field Practices

Double click the "Field Name" to begin the selection of the field practices (you can refer to Exercise 1 for the detailed steps). Set the land use to "Crop", and "Save". From the list of practices in the "Field Practices Editor," select "Subsurface Drain (606)" and click "Add to Field." The "Subsurface Drain (606)" practice will now be shown in the list of "Selected Practices on Field." Close the "Field Practices Editor" and click the "Define Field Operation Schedule >>>" button to move on to the next step.

Field Practices Editor	23
[Field Name: Crop-1.0]	
Review and Select Practices	
Select one or more practices to add to the APEX Assessment for this field:	?
Display All Practices	•
Residue Management, No-till, Strip Till (329) Riparian Forest Buffer (391) Subsurface Drain (606) Waste Iltilization (633) Comparison (633) Co	Add To > Field
Subsurface Drain (606)	Remove Practice From Field
	Close

Figure 4.3: Add subsurface drainage practice to field.



#### 4.1.3. Select Field Operation Schedule

Double click the **"Field Name"** to open the **"Operation Schedule Editor,"** then choose the **"Select a previously defined operation schedule"** option. From the drop-down list, choose the operation schedule created in the previous exercise where the fall plow operation was removed from the corn/hay rotation (T3).

Operations Schedule Editor	×
Auto Irrigation: No	
1. Select an Operation Schedule:	<b>.</b>
Select a default operation schedule	
$\odot$ Select a previously defined operation schedule	
To filter the op. schedule	
list, enter a search term:	
X T3 Crop-1.0-Corn Grain - Hay(soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,	•
Apply Prey, Defined	Customize Op.
to Field	Schedule

Figure 4.4: Select previously defined operation schedule.

Click the "**Apply Prev. Defined to Field**" button to apply this schedule to the current alternative assessment. Next, click the "**Complete Operation Schedule**" button to finish the operation schedule definition.



Figure 4.5: Complete operation schedule definition.

#### 4.1.4. Define Soils and Run APEX

Each time a new alternative is created, the soils processing must be re-run. This is because new assessments may contain modifications to the field boundaries if practices such as buffers or grass waterways are added. Click the **"Define Soils"** button.

<ul> <li>[4] Operations</li> </ul>						
4. Field Operations Definition ?						
Double-Click A Field's Name To View or Edit The Operations Schedule For That Field						
Field Name	Operations Status					
Crop-1.0	Complete					
Define Soils >>						

Figure 4.6: Define Soils.

Click on **"Run APEX >>>"** to run the current alternative assessment.



<ul> <li>✓ [5] Soils</li> <li>5 Field Soil Parameter</li> </ul>	r Editing	2		
Double-Click A Field's Name To View or Edit The Soil Parameters For That Field				
Field Name	Soil Name	^		
Crop-1.0	Scantic			
Run Apex >>>	]	Ŧ		

Figure 4.7: Run APEX.

#### 4.1.5. View Report

In the "Reports" section of the STAR navigation pane, select the "Baseline" assessment to report on. You will now see that there are 3 alternative assessments to report on. Choose all of the APEX parameters, and the "Crop\_Alternative\_Tillage Mod" and "Crop\_Alternative\_Tillage Mod\_Drainage" alternatives. Then, click "View Reports."

✓ [7] Reports	
7. Reports	?
Select one or more APEX parameters:	
Forage Crop Yield (t/ac)	
Drought Stress (days)	
Grain Yield (t/ac)	•
Select the Baseline assessment to report on:	
Baseline	•
Optionally, select one or more Alternatives to compare to the Baseline:	
Crop_Alternative	
Crop_Alternative_Tillage Mod	
Crop_Alternative_Tillage Mod_Drainage	
Refresh List View Reports	

Figure 4.8: Selection of inputs for report.

The output summary shows that the reduction in the outflow (runoff) that occurs with the addition of the subsurface drainage leads to a lowering of the sediment losses as well as the soluble and sediment P. However, the soluble P in the tile drainage now makes up a significant proportion of the total P losses. The sum of total P (soluble, sediment, and tile) is actually higher with the subsurface drainage practices than without it.



			Assessments	
Field Name		Baseline	Crop_Alternative_Tilla ge Mod	Crop_Alternative_Tilla ge Mod_Drainage
Crop-1.0	Practices			Subsurface Drain
	Op Schedule	T1 Crop-1.0-Corn Grain \Corn,grain; SP, spring manure, Z60	T3 Crop-1.0-Corn Grain - Hay (soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,	T3 Crop-1.0-Corn Grain Hay (soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,
	Dominant Soil	Scantic	Scantic	Scantic
	Field Acres	12.63	12.63	12.63
	Hydrologic Soil Group	D	D	D
	Slope	4.11%	4.11%	4.11%
	Slope Length (ft)	45.72	45.72	45.72
	Weather Station	ST ALBANS RADIO	ST ALBANS RADIO	ST ALBANS RADIO
	Avg Annual Precip (in)	36.87	36.87	36.87
	Total N Applied (lbs/ac)	199.69	167.35	167.35
	Total P Applied (lbs/ac)	27.66	25.42	25.42
	Total Irr Applied (in/ac)	0.00	0.00	0.00
	STIR Tillage Value	130.18	34.09	34.09

Figure 4.9: Report inputs summary for baseline and 2 alternatives.

Apex Parameter	Field Name	Baseline	Crop_Alternativ e_Tillage Mod	Crop_Alternativ e_Tillage Mod_Drainage
Total Outflow (inches)	Crop-1.0	9.15	5.11	2.02
Total Sediment Yield (t/ac)	Crop-1.0	9.51	0.88	0.21
Total Soluble P in Outflow (lb/ac)	Crop-1.0	0.40	0.11	0.03
Total Sediment P in Outflow (lb/ac)	Crop-1.0	10.66	1.41	0.42
Tile Drain Phosphorus Loss (lb/ac)	Crop-1.0	0.00	0.00	1.26
Total Soluble N in Outflow (lb/ac)	Crop-1.0	206.85	77.41	88.37
Total Sediment N in Outflow (lb/ac)	Crop-1.0	82.62	9.85	2.84
Tile Drain Nitrogen Loss (lb/ac)	Crop-1.0	0.00	0.00	34.04
Total Soluble Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00	0.00
Total Sediment Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00	0.00
Nitrogen Volatilization (lbs/acre)	Crop-1.0	38.64	28.00	27.96
Forage Crop Yield (t/ac)	Crop-1.0	0.00	5.37	5.39
Grain Yield (t/ac)	Crop-1.0	2.43	0.62	0.63

Figure 4.10: Report outputs summary for baseline and 2 alternatives.

## 4.2. Filter Strip Alternative Assessment

For the next alternative practice assessment, we will add a filter strip, or buffer, to the alternative with the custom corn/hay operation schedule (with modified tillage).

#### 4.2.1. Create an Alternative Assessment

In the "Assessment Definition" item from the STAR navigation pane, select the "Baseline" assessment and click "Create New Alternative of Selected." Name the alternative, "Crop\_Alternative\_Tillage\_Mode\_Filter" and click, "Create Alternative."

Select the new alternative assessment created, and click on the "Define Field Practices >>>" button.



Figure 4.11: Select new filter alternative.

#### 4.2.2. Define the Field Practices

Double click the "Field Name" to begin the selection of the field practices. Set the land use to "Crop", and click "Save." From the list of practices in the "Field Practices Editor," select "Filter Strip (393)" and click "Add to Field." A message box will open to tell you that you will need to use the "STAR Splitting Tool" to create this filter strip practice. Click "OK", and then click the "Locate Practices Boundaries" button to start defining the filter strip. You will be able to draw the location of the filter strip on the map.



	Field Practices Editor	-
	[Field Name: Crop-1.0]	
	Review and Select Practices	
	Select one or more practices to add to the APEX Assessment for this field:	
	Display All Practices	
	Diversion (362)	
	Fence (382) Add	р=1
1	Field Border (386)	
	Filter Strip (393)	
	dding this practice may require further action!	
2	Draw the filter strip using the STAR splitting tool. The operation schedule for the filter strip is automatically assigned.	
	OK	
The second	Close	141

Figure 4.12: Add subsurface drainage practice to field.

After clicking on "Locate Practice Boundaries," the "Field Split Manager" will open.

Field Split Manager		23			
Field Splitting:		?			
The practices liste split the current f	ed below require that you ield into separate fields.				
Double click a p below to divide	Double click a practice from the list below to divide the field:				
Practice	Splitting Complete?				
Filter Strip (393)	False				
(Re)Open Practice	Editor Finish & Close	e All			

Figure 4.13: Field practices editor.

Double click the **"Filter Strip**" practice to start the process. This will open a dialog to enter the width of the filter strip, and the **"Field Split Editor**." Type in a width of 25 ft and click **"Preview**." This will draw a 25 ft buffer along the inside of the field. This buffer, around the whole field, serves as a guide for the user to draw in a buffer along the desired portion of the field. We will draw a buffer along just one long edge of the field.





Figure 4.14: Field split editor preview.

If you select the **"Continue**" button, the **"Field Split Editor**" will become active. Click on the "Start" button to start drawing the filter strip. Sketch along the edge of the field where you'd like to place the filter, following the 25 ft guide (in black). The edge of the new filter will be in yellow. When finished drawing the filter, double click. Then, click the **"Finish**" button on the **"Field Split**" editor.

Assess	below to divide	the field:	and the second				
the first of the second	Practice	Splitting Complete?		2	A AND A	the delta	NY 25 m
	Filter Strip (393)	False		- APRIME		-	
	(Re)Open Practice	Editor Finish & Close /		Coop=140			
Field Split Editor		23					
Start Finish	Alter Cancel	?					
Field Name							

Figure 4.15: Sketch of buffer using the field split editor.



Now, we need to name the new filter and define the hydrologic connectivity from the field to the filter. Change the name of "**NewField [1]**" to "**Filter**". Set the "**Crop-1.0**" field to drain to the "**Filter**." The "**Filter**" should drain to the "**Outlet**."

Field Split Edito	r		23
Start Fin	ish Alter Cancel	?	
Field Name	Required Settings		
Crop-1.0	Land Use:	Drains To:	OVI
	Crop 🔹	Filter 🔹	UK:
Filter	Land Use:	Drains To:	OKI
	Conservation Area 🔹	outlet 🔹	OK:

Figure 4.16: Field Split Editor.

Click "**OK!**" for both the "**Crop-1.0**" and "**Filter**". Click the "x" to close out the "**Field Split Editor**". This will close the windows associated with the definition of the filter practice. Now, click the "**Define Field Operation Schedule** >>>" to go on to the selection of the operation schedules.

#### 4.2.3. Select Field Operation Schedule

The field operation schedule for the **"Filter**" is automatically set by STAR. To view the **"Filter**" operation schedule, double click the **"Field Name**" to open the **"Operation Schedule Editor**". You will see that there is fall-planted timothy grass for the filter. Exit out of the **"Operation Schedule Editor**" by clicking the **"x**" in the upper right hand corner of the form.

Appl	y Prev. to Fie	Defined eld					Cu	ustomize ( Schedule	Op.
Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	PHU	Edited
Crop timothy	Year 1	Month 6	Day 1	Tillage Op. Fertilize\10-10-10	Tillage Equip. Fertilizer app Surface Broadcast no incorp	Rate 99.92406166	Units Ibs/acre	PHU NA	Edited
Crop timothy timothy	Year 1 1	Month 6 8	Day 1 20	Tillage Op. Fertilize\10-10-10 Plow, cultivate, other	Tillage Equip. Fertilizer app Surface Broadcast no incorp MOWER COND, PTO	Rate 99.92406166 0	Units Ibs/acre NA	PHU NA NA	Edited No No

Figure 4.17: Filter operation schedule.

The operation schedule for the "**Crop-1.0**" field must be selected. We will select the schedule that we used for the "**Subsurface Drainage**" practice. Double click the "Crop1.0" under "**Field Name**," then choose the "**Select a previously defined operation schedule**" option. From the drop-down list, choose the operation schedule created in the previous exercise where the fall plow operation was removed from the corn/hay rotation (T3).



to Fertilization: No	
Select an Operation Schedule:	[
Select a default operation schedule	
Select a previously defined operation schedule	
To filter the op. schedule ist, enter a search term:	
X T3 Crop-1.0-Corn Grain - Hay(soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,	•
Apply Prev. Defined to Field	Customize Op. Schedule

Figure 4.18: Select previously defined operation schedule.

Click the **"Apply Prev. Defined to Field**" button to apply this schedule to the current alternative assessment. Next, click the **"Complete Operation Schedule**" button to finish the operation schedule definition.

#### 4.2.4. Define Soils and Run APEX

Click the "Define Soils" button. This will characterize the soils for the field and the filter strip.

<ul> <li>[4] Operations</li> </ul>				
4. Field Operations Def	inition 🛛 🗍	?		
Double-Click A Field's Name To View or Edit The Operations Schedule For That Field				
Field Name	Operations Status	٠		
Crop-1.0	Complete			
Practices: Filter Strip (parameters adjusted	by STAR)			
Filter	Complete	Ŧ		
Define Soils >>				

Figure 4.19: Define Soils.

Click on "**Run APEX >>>**" to run the current alternative assessment.

<ul> <li>[5] Soils</li> <li>5. Field Soil Parameter</li> </ul>	r Editing ?
Double-Click A Field's Name To V Parameters For That	iew or Edit The Soil t Field
Field Name	Soil Name
Filter	Georgia
Crop-1.0	Scantic
	-
Run Apex >>>	]

Figure 4.20: Run APEX.



#### 4.2.5. View Report

In the "Reports" section of the STAR navigation pane, select the "Baseline" assessment to report on. You will now see that there are 4 alternative assessments to report on. Choose all of the APEX parameters, and the "Crop\_Alternative\_Tillage Mod" and "Crop\_Alternative\_Tillage Mod\_Filter" alternatives. Then, click "View Reports."



Figure 4.21: Selection of outputs and alternatives for report.

The inputs section for the filter strip alternative show the characteristics of the filter "subarea," in addition to the cropped field. Note that the area of the field is now slightly smaller, due to the area that was taken out of production to create the filter strip. The soil type and the slope of the filter may also be different. In the example of Field 1, the field area was a hydrologic group D soil and the filer area was a hydrologic group C soil. The filter practice input information is only presented for the filter alternative, because it is not relevant for the baseline and the first alternative.

The STAR outputs report shows the loads (flow, sediment, nutrients) reflective of the "outlet" of the field. In the case of the alternative with the filter strip, these are the loads that make it from the field and through the filter strip. In the example shown in this workbook for field 1, the filter strip is effective at reducing the sediment P by almost 50%. The amount of reduction in sediment and sediment P loss will be different for each field, depending of the soil and slope conditions of the field and the filter strip.



#### Summary of Field Inputs:

Field Name			Assessments			
		Baseline	Crop_Alternative_Tilla ge Mod	Crop_Alternative_Tilla ge Mod_Filter		
Crop-1.0	Practices			Filter Strip		
	Op Schedule	T1 Crop-1.0-Corn Grain \Corn,grain; SP, spring manure, Z60	T3 Crop-1.0-Corn Grain - Hay (soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,	T3 Crop-1.0-Corn Grain - Hay (soybeans,silage,etc.)\2 yrs Corn Grain,FP - 7 yrs legume-grass hay,FP,		
	Dominant Soil	Scantic	Scantic	Scantic		
	Field Acres	12.63	12.63	12.20		
	Hydrologic Soil Group	D	D	D		
	Slope	4.11%	4.11%	4.15%		
	Slope Length (ft)	45.72	45.72	45.72		
	Weather Station	ST ALBANS RADIO	ST ALBANS RADIO	ST ALBANS RADIO		
	Avg Annual Precip (in)	36.87	36.87	36.87		
	Total N Applied (lbs/ac)	199.69	167.35	167.35		
	Total P Applied (lbs/ac)	27.66	25.42	25.42		
	Total Irr Applied (in/ac)	0.00	0.00	0.00		
	STIR Tillage Value	130.18	34.09	34.09		
Filter	Practices			Filter Strip		
	Op Schedule			Custom - Grass Filter Strip		
	Dominant Soil			Georgia		
	Field Acres			0.43		
	Hydrologic Soil Group			С		
	Slope			0.92%		
	Slope Length (ft)			10.00		
	Weather Station			ST ALBANS RADIO		
	Avg Annual Precip (in)			36.87		
	Total N Applied (lbs/ac)			8.91		
	Total P Applied (lbs/ac)			3.92		

Figure 4.22: Inputs from STAR report with filter practice.



Apex Parameter	Field Name	Baseline	Crop_Alternativ e_Tillage Mod	Crop_Alternativ e_Tillage Mod_Filter
Total Outflow (inches)	Crop-1.0	9.15	5.11	4.89
Total Sediment Yield (t/ac)	Crop-1.0	9.51	0.88	0.20
Total Soluble P in Outflow (lb/ac)	Crop-1.0	0.40	0.11	0.11
Total Sediment P in Outflow (lb/ac)	Crop-1.0	10.66	1.41	0.76
Tile Drain Phosphorus Loss (lb/ac)	Crop-1.0	0.00	0.00	0.00
Total Soluble N in Outflow (lb/ac)	Crop-1.0	206.85	77.41	77.45
Total Sediment N in Outflow (lb/ac)	Crop-1.0	82.62	9.85	3.95
Tile Drain Nitrogen Loss (lb/ac)	Crop-1.0	0.00	0.00	0.00
Total Soluble Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00	0.00
Total Sediment Pesticide in Outflow (Ib/ac)	Crop-1.0	0.00	0.00	0.00
Nitrogen Volatilization (lbs/acre)	Crop-1.0	38.64	28.00	27.67
Forage Crop Yield (t/ac)	Crop-1.0	0.00	5.37	5.23
Grain Yield (t/ac)	Crop-1.0	2.43	0.62	0.62
Drought Stress (days)	Crop-1.0	31.07	65.58	65.44

#### Summary of APEX Output

Figure 4.23: Outputs from STAR report with filter practice.

## 4.3. Cover Crop Alternative Assessment

A cover crop will be simulated for the third conservation practice alternative assessment. In this alternative, we will go back to the "baseline" crop rotation of permanent corn for grain to see what impact a fall-planted cover crop will have on the original crop rotation.

#### 4.3.1. Create an Alternative Assessment

In the "Assessment Definition" item from the STAR navigation pane, select the "Baseline" assessment and click "Create New Alternative of Selected." Name the alternative, "Baseline\_CoverCrop" and click, "Create Alternative."




Figure 4.24: Create alternative assessment with cover cropping.

Select the new alternative assessment created, and click on the "Define Field Practices >>>" button.

✓ [2] Assessment Definition
2. APEX Assessments
Create New Baseline Assessment
OR Select An Existing Assessment Below
Baseline X
Baseline_CovCrop
Crop_Alternative
Crop_Alternative_Tillage Mod 🔀
Cran Alternative Tillage Deselect V
and Create New Alternative Of Selected
For Baseline and Alternative Assessments
Define Field Practices >>>

Figure 4.25: Select new cover crop alternative.

### 4.3.2. Define the Field Practices

Double click the **"Field Name**" to begin the selection of the field practices. Set the land use to **"Crop,"** and **"Save."** From the list of practices in the **"Field Practices Editor,"** select **"Cover Crop (3403)"** and click **"Add to Field."** A message box opens to tell you that you will need to use the **"Crop Mix Tool"** in the planting operation editor to define the cover crop input information. Click **"OK,"** and then click the **"Close"** button to exit the **"Field Practices Editor."** Click the **"Define Field Operation Schedule >>>"** button to move on to the next step of defining the field operation schedule.



Field Practices Editor	×
[Field Name: Crop-1.0]	
<b>Review and Select Practices</b>	
Select one or more practices to add to the APEX Assessment for this field:	?
Display All Practices	•
Conservation Crop Rotation (328) Contour Farming (330) Cover Crop (340) Diversion (362) Adding this practice may require further action!	Add To > Field X
	ок
	Close

Figure 4.26: Add cover crop practice to field.

### 4.3.3. Select Field Operation Schedule

Double click the "Field Name" to open the "Operation Schedule Editor," then choose the "Select a previously defined operation schedule" option. From the drop-down list, choose the operation schedule associated with the original baseline crop schedule of permanent corn grain (T1).

Operations Schedule Editor	22
Auto Irrigation: No Auto Fertilization: No	
1. Select an Operation Schedule:	?
$\bigcirc$ Select a default operation schedule	
$\odot$ Select a previously defined operation schedule	
To filter the op. schedule list, enter a search term:	
X T1 Crop-1.0-Corn Grain\Corn,grain; SP, spring manure, Z60	•
Apply Prev. Defined to Field	Customize Op. Schedule

Figure 4.27: Select previously defined operation schedule.

Click the "Customize Op. Schedule" button to modify this operation schedule to include the cover crop. Name the op. schedule, "T4 Cover Crop-Crop-1.0-Corn Grain\Corn,grain; SP, spring manure, Z60," then click "Apply Name & Start Customizing."



Figure 4.28: Name and customize operation schedule.



First, double click on the "**Harvest without kill**" operation to edit the date to occur on 9/30 instead of 10/20. Click the "**Update**" button to update the operation in the schedule.

Ор	erations Sch	edule I	Editor						23
	Auto Irriga	tion: I	No	Сору	Ops to Other Years		Complete	Operation S	chedule
	to Fertiliza	tion: 1	NO						
U	pdate Har	vest/	Kill Op	eratio					?
				inclu cont If th	e: A NLL operation must be added to permanency s aded, the model assumes the crop continues to grow tinuing to grow in the field (i.e. corn). Therefore, I K the crop is a perennial, do not include a KILL until the	This is the case even for crops which are obviously not ILL MUST be including at the conclusion of the crop life. crop is destroyed.			
					Year Month (1-6): 1 (1-12)	Day (1-31): 30			
				I	Type: Harvest without kill.	•			
				(	Crop: Corn grain	Limit To Ops. Years to Harvest	0		
				Met		- Schedule Crops (Trees):			
	( <u> </u>								
	Cancel							Update	
	Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	PHU
x	Corn grain	1	5	11	Plow, cultivate, other	MOLDBOARD PLOW REG GE7B	0	NA	NA
x	Corn grain	1	5	15	Plow, cultivate, other	SOIL FINISHER	0	NA	NA
x	Corn grain	1	5	15	Fertilize\VTManure	Fertilizer App - Truck spreader	3569.608667	lbs/acre	NA
X	Corn grain	1	5	15	Fertilize\10-10-10	Fertilizer app In furrow or with seed or band 1	99.92406166	lbs/acre	NA
x	Corn grain	1	5	16	Plant in rows	Planter, 40 inch	0	plants/acre	2126.4
x	Corn grain	1	7	1	Fertilize\32-06-00	Fertilizer app Surface Broadcast no incorp 2	199.8481233	lbs/acre	NA
x	Corn grain	1	10	20	Harvest without kill.	COMBINE SELF-PROP 4WD	0	NA	NA
x	Corn grain	1	10	21	Kill crop	KILL	0	NA	NA
•									•

Figure 4.29: Update harvest operation to occur in September.

### 4.3.4. Add Cover Crop Planting Operation

Next, move to the "**Planting**" tab to add a cover crop planting on October 1<sup>st</sup>. Set the month and date of the operation first. Then, for the crop, choose "**Cover Crop Mix**" to open the "**Cover Crop Mix Wizard**." The "**Cover Crop Mix Wizard**" allows a cover crop to be created from multiple plant species. For this exercise, we will create a cover crop from only "**Rye**" as shown below.

Click the "Save Crop Mix" button to close the "Cover Crop Mix Wizard."



	-	
Operations Schedule Editor		
Auto Irrigation: No Auto Fertilization: No	Copy Ops to Other Ye	ars
Tillage Irrigation Fertilize	er Pesticide Planting	Harvest/Kill Grazing
Add a Planting Operat	ion	
Year Month (1-6): 1 (1-12): 10	Day (1-31): 1	Crop: -not set- Fillage Op: -not set-
Crop:Cover Crop	Mix • Limit to C	p. Sched. Crops
Planting Type: Plant in rows	•	(*Required*)
Cover Crop Mix Wizard	(over lyne	23
All Crops Available	Cover Crop/Dens	ity (plants/ac)
Red Clover	A Rye 0	(~ )
Reed Canarygrass	>	
Rice	>	
Rye		
sage		M
short grass		S
Silage & haylage	<	Fe
Smooth Brome Grass		Fe
Save Crop Mix		PI

Figure 4.30: Creating cover crop inputs.

To finish adding the cover crop planting operation, choose "**DRILL**, **LISTER Disk**" for the equipment and "**Straight Row**" for the cover or practice type. Then click "**Add Planting Op**.". The cover crop planting will be added to the table of operations.

Operations Schedule Editor	8
Auto Irrigation: No Copy Ops to Other Years	Complete Operation Schedule
Auto Fertilization: No	
Tillage Irrigation Fertilizer Pesticide Planting Harvest/Kill Grazing	
Add a Planting Operation	?
Year Month Day Crop: -not set-	
(1-6): 1 (1-12): 1 (1-31): 1 Tillage Op: -not set-	
Crop:Cover Crop Mix  Limit to Op. Sched. Crops	
Planting Type: Plant in rows	
Equipment: DRILL, LISTER Disl	
Density: (plants/acre) PHU: 0 (* )	
	(+) Add Planting Op.

Figure 4.31: Finish adding cover crop planting operation.

### 4.3.5. Add Cover Crop Kill Operation

Any time that a crop is planted, it must also be killed at some point in the operation schedule. For this rye cover crop, we will assume it is killed in the spring, right before the plowing for preparation of the corn begins. Navigate to the "**Harvest/Kill**" tab. Set the kill date for the rye crop to be May 10<sup>th</sup>. Click on the "Add Op." button to add this kill operation to the schedule.



Operations Schedule Editor	23
Auto Irrigation: No     Copy Ops to Other Years       Auto Fertilization: No     Copy Ops to Other Years	Complete Operation Schedule
Tillage Irrigation Fertilizer Pesticide Planting Harvest/Kill Grazing	
Add a Harvest/Kill Operation         NOTE: A KILL operation must be added to permanently stop the growth of a crop. If a KILL operation is not included, the model assumes the crop continues to grow. This is the case even for crops which are obviously is continuing to grow in the field (i.e. com). Therefore, I KILL MUST be including at the conclusion of the crop life If the crop is a perennial, do not include a KILL until the crop is destroyed.         Year       Month       5       Day (1-31):       10         Type:       Kill crop <ul> <li>Crop:</li> <li>Rye</li> <li>Limit To Ops.</li> <li>Schedule Crops</li> <li>Method:</li> <li>KILL</li> <li>KILL</li> <li>(+) Add Op.</li> </ul>	? e.

Figure 4.32: Add kill operation for rye cover crop.

Finally, click "Complete Operation Schedule" to finish this operation schedule.

### 4.3.6. Define Soils and Run APEX

Click the "Define Soils" button to re-characterize the soils for this alternative.

<ul> <li>[4] Operations</li> </ul>	
4. Field Operations Def	inition 김
Double-Click A Field's Name To View or Schedule For That Fie	<sup>r</sup> Edit The Operations eld
Field Name	Operations Status
Crop-1.0	Complete
Practices: Cover Crop ()	
Define Soils >>	

Figure 4.33: Define Soils.

Click on "**Run APEX >>>**" to run the current alternative assessment.

<ul> <li><sup>5] Soils</sup></li> <li>5. Field Soil Parameter</li> </ul>	r Editing 🔋
Double-Click A Field's Name To Vi Parameters For That	iew or Edit The Soil t Field
Field Name	Soil Name
Crop-1.0	Scantic
Run Apex >>>	

Figure 4.34: Run APEX.



#### 4.3.7. View Report

In the "**Reports**" section of the STAR navigation pane, select the "**Baseline**" assessment to report on. You will now see that there are 5 alternative assessments to report on. Choose all of the APEX parameters, and the "**Baseline\_CovCrop**" alternative. Then, click "**View Reports**."



Figure 4.35: Selection of outputs and alternatives for report.

The output portion of the report shows that the rye cover crop, and earlier harvest of the corn, resulted in a little over a 30% reduction in the sediment P loss and a 50% reduction in the soluble P loss from this continuous corn grain rotation.

Apex Parameter	Field Name	Baseline	Baseline_CovC rop
Total Outflow (inches)	Crop-1.0	9.15	5.56
Total Sediment Yield (t/ac)	Crop-1.0	9.51	5.97
Total Soluble P in Outflow (lb/ac)	Crop-1.0	0.40	0.20
Total Sediment P in Outflow (lb/ac)	Crop-1.0	10.66	6.93
Tile Drain Phosphorus Loss (lb/ac)	Crop-1.0	0.00	0.00
Total Soluble N in Outflow (lb/ac)	Crop-1.0	206.85	173.74
Total Sediment N in Outflow (lb/ac)	Crop-1.0	82.62	50.67
Tile Drain Nitrogen Loss (lb/ac)	Crop-1.0	0.00	0.00
Total Soluble Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00
Total Sediment Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00
Nitrogen Volatilization (Ibs/acre)	Crop-1.0	38.64	46.61
Forage Crop Yield (t/ac)	Crop-1.0	0.00	0.00
Grain Yield (t/ac)	Crop-1.0	2.43	2.40

Figure 4.36: STAR output report	from cover crop alternative.
---------------------------------	------------------------------

🗲 STONE ENVIRONMENTAL

### 5. Exercise 4, Using Local Soils Test Data

STAR allows users to override the soil survey (SSURGO) based soils information with data from local soil tests. Using local soil test data provides the ability to refine the APEX predictions. This exercise will modify the baseline assessment with site specific soils data from a soil sample test.

### 5.1. Create an Alternative Assessment

In the "Assessment Definition" item from the STAR navigation pane, select the "Baseline" assessment and click "Create New Alternative of Selected." Name the alternative, "Baseline\_SoilMod" and click, "Create Alternative."



Figure 5.1: Create alternative assessment with cover cropping.

Select the new alternative assessment created, and click on the "Define Field Practices >>>" button.



✓ [2] Assessment Definition				
2. APEX Assessments	?			
Create New Baseline Assessment				
OR Select An Existing Assessment Below	_			
Baseline	<b>^</b>			
Baseline_CovCrop				
Baseline_SoilMod				
Crop_Alternative				
Deselect	•			
and Create New Alternative Of Selected				
For Baseline and Alternative Assessments				
Define Field Practices	>>>			

Figure 5.2: Select new cover crop alternative.

### 5.1.1. Define the Field Practices

For this alternative assessment, we will not add any practices. Follow the steps from previous exercises to setup the field practices to have no special conservation practices. Once completed, click the "**Define Field Operation Schedule** >>>" button to move on to the next step of defining the field operation schedule.

### 5.1.2. Define Field Operations

This alternative will have the same continuous corn for grain operation schedule as the baseline assessment (we called this schedule "T1 Crop-1.0-Corn Grain\Corn,grain; SP, spring manure, Z60"). Use the "Apply Prev. Defined to Field" option to assign the same operation to the current "Baseline\_SoilMod" alternative.

### 5.1.3. Define Soils and Modify with Site Specific Soil Test Data

Begin by clicking the "**Define Soils** >>" button to characterize the field soils from SSURGO. Once complete, the "**Field Soil Parameter Editing**" section of the STAR navigation pane will be shown.

r Editing	?
ew or Edit The Soil Field	
Soil Name	^
Scantic	
	Ŧ
e	r Editing ew or Edit The Soil Field Soil Name Scantic

Figure 5.3: Soil parameter editing section of navigation pane.

Double click the "Field Name" to open the "Field Soils Editor". A soil test came back with the following results for your field:

Modified Morgan's available P: 4.6 ppm



- pH: 7.2
- Al: 17 ppm
- Organic matter: 4.1% (2.38% organic carbon)

Modify the data for surface soil layer to reflect these site specific measurements as shown in the figure below. When all of the inputs are completed, click the "**Update Soil**" button. After the update is complete, close the "**Field Soils Editor**" by clicking the "**x**" in the upper right hand corner.

Field Soils E	ditor							23
Edit Soil	Paramete	ers						?
Soil Name:		Scanti	с					
Apply to al	l layers:	WTMN:	0	WTMX:	0	HSG:	4	
	Select	Layer #:	1	•				
Initial Soi	l P from Fiel	d Tests:	Modified Mo	rgan 🔻				
	Soil I	Value:	4.6	PH:	7.2	AL:	17	
Z:	1.1811023	BD:	1.14	SAN:	19.7	SIL:	54.3	
WOC:	2.38	CNDS:	0	SSF:	0			
CEC:	0	SATC:	1.0999984	]				
							(+) Update So	il
Default So	il Values							
WTMN:	0	WTMX:	0	HSG:	4	PH:	5.5	
Z:	1.1811023	BD:	1.14	SAN:	19.7	SIL:	54.3	
WOC:	3.4802784	CNDS:	0	SSF:	0			
CEC:	0	SATC:	1.0999984	]				

Figure 5.4: Modification of soil characteristics with site specific data.

### 5.1.4. Run APEX and View Report

Click the "**Run APEX >>>**" button to run the APEX simulation of the modified soil alternative. In the "**Reports**" section of the STAR navigation pane, select the "**Baseline**" assessment to report on. You will now see that there are 6 alternative assessments to report on. Choose all of the APEX parameters, and the "**Baseline\_SoilMod**" alternative. Then, click "**View Reports**."

The results in the outputs section of the report show that the soluble and sediment P losses are smaller compared to the same baseline simulation using the SSURGO data (about 5% lower for soluble P and 20% lower for sediment P). This shows the value in being able to incorporate site specific soils data into a STAR assessment.





Figure 5.5: Selection of outputs and alternatives for report.

Apex Parameter	Field Name	Baseline	Baseline_SoilM od
Total Outflow (inches)	Crop-1.0	9.15	9.19
Total Sediment Yield (t/ac)	Crop-1.0	9.51	9.72
Total Soluble P in Outflow (lb/ac)	Crop-1.0	0.40	0.38
Total Sediment P in Outflow (lb/ac)	Crop-1.0	10.66	8.52
Tile Drain Phosphorus Loss (lb/ac)	Crop-1.0	0.00	0.00
Total Soluble N in Outflow (lb/ac)	Crop-1.0	206.85	160.44
Total Sediment N in Outflow (lb/ac)	Crop-1.0	82.62	65.64
Tile Drain Nitrogen Loss (lb/ac)	Crop-1.0	0.00	0.00
Total Soluble Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00
Total Sediment Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00
Nitrogen Volatilization (lbs/acre)	Crop-1.0	38.64	31.26
Forage Crop Yield (t/ac)	Crop-1.0	0.00	0.00
Grain Yield (t/ac)	Crop-1.0	2.43	2.40

Figure 5.6: STAR outputs from modified soil alternative.





VT STAR Training / September 15, 2015 /  $\ensuremath{\mathbb{C}}$  2015 Stone Environmental, Inc. All rights reserved

Appendix E: VT STAR Application Manual



VT STAR Final Report / October 13, 2015

# Systematic Tool for Analyzing

**STAR** 

### Resources

## User's Guide





United States Department of Agriculture Natural Resources Conservation Service



535 Stone Cutters Way / Montpelier / VT / 05602 / USA 802.229.4541 / info@stone-env.com / www.stone-env.com

### TABLE OF CONTENTS

А. В. С.	STA OVE STA	R LOGIN PROCESS RVIEW of STAR RT MENU	4 4 4
D. E. F.	SELI CRE CRE	ATE A BASELINE APEX ASSESSMENT	.3 16 22
G. H. a	DEF FIEL	INE FIELD PRACTICES	23 30 33
b	. IF	RIGATION	34
C.	F	ERTILIZER	36
e	. Р	LANTING	8
f.	н	ARVEST/KILL/BURN4	1
g	G	RAZING4	12
I. J. К.	FIEL RUN RFP	D SOIL PARAMETER EDITING	14 19 51
L.	SIM	ULATING CONSERVATION PRACTICES	56
a	. N	1ANAGEMENT RELATED CONSERVATION PRACTICES	6
	1.	Nutrient Management (590)5	6
	2.	* Brush Management (314)5	6
	3.	Conservation Crop Rotation (328)5	6
	4.	Residue Management, No-till, Strip Till (329)5	6
	5.	*Prescribed Burning (338)5	6
	6.	*Critical Area Planting (342)5	6
	7.	*Residue Management, Seasonal (344)5	57
	8.	*Irrigation Water Management (449)5	57
	9.	*Forage Harvest Management (511)5	57
	10.	Pasture and Hayland Planting (512)5	57
	11.	Prescribed Grazing (528)5	57
	12.	*Range Planting (550)5	57
	13.	Pest Management (595)5	57
	14.	*Tree and Shrub Establishment (612)5	57
	15.	*Upland Wildlife Habitat Management (645)5	58

	16	*Forest Stand Improvement (666)	EO
	10.		
	17.		
b.		UNSERVATION PRACTICES REQUIRING A DIVISION OF FIELD AREA	
	1.	Grassed Waterway (412)	
	2.	Riparian Forest Buffer (391)	58
	3.	Fence (382)	58
	4.	Filter Strip (393)	59
	5.	Grade Stabilization Structure (410)	59
	6.	Gully (for use with Baseline Assessment ONLY)	59
C.	C	ONSERVATION PRACTICES REQUIRING MODEL PARAMETER MODIFICATIONS	59
	1.	Contour Farming (330)	59
	2.	*Pond (378)	59
	3.	*Pipeline (516)	59
	4.	*Terrace (600)	59
	5.	*Watering Facility (614)	59
	6.	Waste Utilization (633)	59
	7.	*Irrigation System, Sprinkler (442)	59
	8.	*Irrigation Pipeline (430)	59
	9.	*Stripping Cropping (585)	59
	10.	*Contour Buffer Strips (332)	59
	11.	Diversion (362)	59
	12.	*Vegetative Barrier (601)	59
	13.	*Riparian Herbaceous Cover (390)	59
	14.	*Hedgerow Planting (422)	59
	15.	*Cross Wind Practices (589)	59
	16.	*Windbreak / Shelterbelt Establishment (380)	59
	17.	*Herbaceous Wind Barriers (603)	59
	18.	Field Border (386)	59
	19.	Subsurface Drain (606)	59
м.	APP	PENDIX A: EXPORTING CUSTOMER DATA FROM TOOLKIT	60

### A. STAR LOGIN PROCESS

To access the site, type in or click here for the STAR URL <u>http://nrcs-star.tamu.edu</u>. The login page will load and you will be prompted to enter your user name and password. Select the "Login >>" button to load STAR.

Welcor Systema	ne to STAR Ver	sion 1.0! Resources
	Please login to the syste	em.
	(User Name)	
	(Password)	
	Login >>	
	LICDA	

### **B. OVERVIEW of STAR**

The Systematic Tool for Analyzing Resources (STAR) is a web-based interface that enables the user to couple NRCS Toolkit Conservation Plans to the Agricultural Policy/Environmental eXtender (APEX) model. APEX is a whole farm/ small watershed management model. The model has the capability of evaluating various land management strategies considering sustainability, erosion (wind, sheet and channel), economics, water supply and quality, soil quality, plant competition and weather. Through the use of the routing component in APEX, conservation practices such as grassed filter strips, riparian buffers, and grassed waterways can be evaluated for use in capturing sediment and nutrients from runoff.

STAR enables the user to compare current conditions/conservation practices with potential alternative scenarios to allow for the selection of the conservation practice(s) that will address the resource concern(s) providing the greatest benefits/savings.

### C. START MENU

When the user first logs in, four options are available. The user can 1) begin making conservation plan assessments by using an existing conservation plan to define assessments, fields and schedules that can then be analyzed by APEX, 2) import or create new conservation plans, 3) manage their user preferences, and 4) administrators have the option to edit user information.



### **BEGIN CONSERVATION PLAN ASSESSMENTS**

If the first option, Begin Conservation Plan Assessments, is chosen, the user can proceed to Section D. If a new conservation plan needs to be added, click the *Create New Conservation Plans* button. The user will then have the choice to Import Toolkit Data As New Plan or Create New Plan Without Toolkit Data.



### **CREATING NEW CONSERVATION PLANS**

1. To import toolkit data to create a new plan, click the *Import Toolkit Data as New Plan* button.

In order to import conservation plan data, a properly formatted XML file needs to have been created through the NRCS Toolkit desktop application. Refer to Appendix A for instruction on

exporting an XML file from Toolkit. Before importing the XML, you should confirm that the planning land units have valid geometry. NOTE: Errors in the geometry, including overlapping polygons, can result in errors in STAR.

- a. Click the *Upload Toolkit XML File* button and browse to the location where the XML file is saved. Open the file. The data will then be imported into STAR.
- b. Once the files have been imported, a report will be generated which will indicate if any errors were encountered during the import.

	Data As New Plan
Select a Toolkit XML File To Uploa	ad:
	Upload Toolkit XML fil
ConservationPlans: inserted 1	increted D

- 2. If Toolkit data is not available, the user can still create a new plan.
  - a. Click the *Create New Plan Without Toolkit Data* button.
  - b. Then enter a name for the new plan and the land owner's name.
  - c. Click the *Create & Define PLUs* button.

Conversation Plan Ed	itor	22
New Conse	rvation Plan	?
Create	New Plan Without Toolkit Data	
New Plan Name:	Tract 234	_
Land Owner Name:	Smith	
Conservation Plan ID:		
c	reate & Define PLUs >>	
Cancel		

d. At this point the user has two options: a planning land unit (PLU) shapefile, containing boundaries of conservation area, can be uploaded and/or the user can draw the PLUs on the map.

Conversation Pl	an Editor		23
New Co	servation Pla	n	?
c	reate New Plan Without Tool	kit Data	
New Plan N	ame: Tract 234		
Land Owner N	ame: Smith		
Conservation Pla	n ID:		
There are tv	o options for creati	ng PLL	Js:
1. Upload a PL	U Shapefile		
want to upload. 1 key. Preview the "Save Uploaded S	o select multiple files, hold o uploaded PLUs on the map a HP to Plan" button or click o	down "Ct and eithe ancel to	rl" or "Shift" r hit the start over,
Upload	Save Uploaded SHP to Pl	an	Cancel
AND/OR			
2. Draw PLUs			
Hit New PLU and Double click to fin Edit to make cha multiple PLUs by	use the mouse to draw the F ish drawing. Select Save to iges, or Cancel to start over reselecting the New PLU but	PLU on th complet . You can ton.	ne screen. e the PLU, n create
New	PLU Save Edit	Canc	el
Cancel			
Caller			

i. PLU Shapefile

To add a shapefile of a PLU, click the **Upload** button under the first option – Upload a PLU Shapefile. The interface will prompt the user to browse to the location of where the shapefile is located.

NOTE: The shapefile MUST be projected in Web Mercator (Auxiliary Sphere). This can be accomplished by reprojecting the shapefile in a geographical information system software such as ArcGIS.

Select both the shapefile (.SHP) and database file (.DBF) and click open. The shapefile will then be added to the map.

ii. Draw PLU on the map

To draw the PLU directly on the map, click the **New PLU** (A) button under the Draw PLUs option. Draw the boundaries of the PLU by clicking on the map and clicking around the edge of the PLU. Double-click when the PLU boundary is complete. To edit the boundary before saving, click the **Edit** (B) button. This will allow the user to edit points on the delineated boundary. To clear the delineated boundary, click the **Cancel** (C) button. Click the **Save** (D) button when complete.





### MANAGE USER PREFERENCES

In the Manage User Preferences section, the user can manage application options and preferences such as crops, fertilizers, tillage, and pesticides. The interface provides an extensive list of crops, fertilizers, tillage equipment and pesticides. These lists will show in their entirety within the various sections of the interface unless trimmed down in this section. By selecting a subset of the lists, only the selected items will appear in menus later in the interface. The selected items in each list can be modified at any time. Depending on the user's level of user privileges, preferences can be set at a regional or national level. Only users with administrative privileges will be allowed to set preferences at the national level.

To begin selecting preferences, click the Manage User Preferences button. The User Preference screen will appear. To view the different lists (Crops, Fertilizers, Tillage and Pesticides), click on the Pref Type drop down menu and select one of the lists.

ser Preferences					-
You may adjust your preferences fr controlled by the "Type" dropdown your region), and the right-hand co	or the values shown in various -list. The left-hand column sho vlumn shows your currently sel	listings througho ws all possible va ected values. Ma	ut STAR. The listing of alues not yet selected ( ke sure to save your ch	values you are adjusting is either nationally, or only in nanges before changing type	s.
Regional Prefs. Only	🔘 National Prefs.	Pref Type	Crops +	Save Changes	1
		Alfalfa	Crops		
		Alfalfa HAY Alfalfa See Almonds Altal Wild Annual Ry Apple Tree Artichokes Ash TREE Asparagus Bahia gras Bahia gras Bahia gras Barley all Barley fee Barley ma Barley see Barley sea Barley sea Barley sea	Y Fertilizers Tillage Pesticides Rye e Grass a is hay is seed d d or malt lt edible er		
		Bermuda g Bermuda l Big Blue S Black Locu	grass seed hay tem grass ist Trees		

The list on the right is the complete default list, and the list on the left is the user selected list. To move an item from the right default list to the selected list, select the item in the default list and click the "<" button. To remove an item from the selected list, select the item, and then click the ">" button.

Make selections from each of the four lists. When all selections have been made, click the *Save Changes* button. Click the "X" at the top right of the screen to exit.

er Preferences						
You may adjust your preferences for the values s controlled by the "Type" dropdown-list. The left- your region), and the right-hand column shows y	shown in various listing: hand column shows all your currently selected	s throughou possible valu values. Make	t STAR, The l ues not yet s e sure to sav	listing of value elected (eithe e your change	es you are adjusting is r nationally, or only in es before changing types.	
🕑 Regional Prefs. Only 🔅 Natio	nal Prefs.	Pref Type:	Crops	+	Save Changes	
iom grain ioton Stripper iorghum grain		Sesbania short grass Sideoats SideoatsGra Silage & hay Silage & hay Silage & hay Sinap Beans Snap Beans Songhum Al Sorghum Al Sorghum Ma Sorghum Ma Sorghu	ImaGr Vlage eat Grass me Grass fresh processed vy olasses sh cesses s for seed for sugar for seed for sugar ino			

### **ADMINISTRATION & USER MANAGEMENT**

This section allows administrator to add and edit user information. The list shows the user names, their user privileges and the region they are assigned to. Click the *Toggle Edit Mode* button to add or edit a particular user.

Toggle Edit Mod	•	
Name	Role	Region
admin	admin	Texas
Evelyn	admin	Texas
Lori	basic	Texas
New User	basic	Texas
Susan	basic	Texas
test	basic	Texas
testbasic	admin	Texas
user1	basic	Texas
user2	basic	Texas
user3	basic	Texas
user4	basic	Texas

← →		1	-	-					<mark>- □ -&gt;</mark> ¢ ★ ¢
🥭 /Views/NavAccon	dian.xaml ×					-			the second s
<u>File Edit View</u>	Favorites <u>T</u> ools <u>I</u>	<u>H</u> elp							
× Google	👻 🔧 Search 🔹	Share	🥖 More ≫						👥 📃 Sign In 🔧
	👘 🕶 <u>P</u> age 🕶 <u>S</u> a	fety • T <u>o</u> ols	- @- ]- @ 📖	8					
USDA APE	X ONRCS - Fa	arm Scale	Water Quality Mo	deling To	ol			Choose Basemap Imager	y T Legend Find Addres
STREET, STREET, ST	Plan: -not set	t-	-	Assessm	nent: -not set-	-	Procession in the local distribution of the		
✓ [0] Start Menu			1.00	F	User Management		23	3	and and and
Welcome to Please proce	o STAR! eed by choosing a	an option be	? low		Select a user from edit a user. Admin options to add and	the list and and super u delete user	hit Toggle Edit Mode to sers will also have s.	and the second s	Galifi - E
Begin Conservation Plan Assessments	Use an existing cons- assessments, fields, then be analyzed by	ervation plan t and schedules	o define that can		Toggle Edit Mode	Role	Add User		
Create New Conservation Plans	Import or create new	v conservation	plans.	-	admin	admin	Texas		
Manage User Preferences	Manage your applica preferences.	Add/Ed	it The User		Lori	basic	Texas		1 100
Administration &	Manage your applica			_	New User	basic	Texas		
User Management	preferences.	User E-Mail:	user@stone*env.com		Susan	basic	Texas		
About STAR	History and vision of	User Region:	Texas	-	test	basic	Texas		
		Change to	Texas	•	testbasic	admin	Texas		
> [1] Choose Plan		User Role:	basic		user1	basic	Texas		
> [2] Assessment De	efinition	Change to	basic	*	user2	basic	Texas		A start to
> [3] Practices		Password:			user3	hasic	Texas		Notes 1 to
<ul> <li>[4] Operations</li> <li>[5] Soils</li> </ul>		_		_	usord	basic	Toxas		The set of the
> [6] Run Apex			Apply/Save Changes		T ISON	Dasic	16405		
> [7] Reports		-	Delete [New User]	_					*
		-							
					No				90%

With administrator privileges, the user can update the user's name, email address, user region, user role and change the user login password. When all changes to a user have been made, click the *Apply/Save Changes* button. The administrator can also delete the user by selecting the user and clicking the *Delete* button at the bottom of the Add/Edit The User screen. To add a new user, click the *Add User* button and simply fill in the information for the user and click the *Apply/Save* **Changes** button. To close the editor screen, click the **Toggle Edit Mode** button. To exit the Administration & User Management section, click the "X" at the top right of the screen.

nt: -not set-	User Management		23			
	Select a user fro	om the list and	hit Toggle Edit Mode to	User Management		
- Comments	edit a user. Adn options to add a	nin and super u and delete users	sers will also have s.	Select a user fro edit a user. Adn options to add a	om the list and nin and super u and delete users	hit Toggle Edit Mode to sers will also have 3.
	Toggle Edit Mod	e	Add User	Tagala Edit Mad		
	Name	Role	Region	Toggie Edit Mod		De star
	admin	admin	Texas	Name	Role	Region
Add (Edit The User	Evelyn	admin	Texas	aumin	aumin	Texas
Aud/Eult The User	Lori	basic	Texas	Erin	basic	Texas
Jser Name: Erin	New User	basic	Texas	Evelyn	admin	Texas
ser E-Mail: holland00@gmail.com	Sucan	basic	Toxas	Lori	basic	Texas
er Region: Texas	Susan	Dasic	техаз	Susan	basic	Texas
ange to Texas	• test	Dasic	Texas	test	basic	Texas
lan Balar Barra	testbasic	admin	Texas	testhasic	admin	Texas
ange to basic	user1	basic	Texas	user1	hasia	Tevre
	user2	basic	Texas	user1	Dasic	Texas
Password: 20000310	user3	basic	Texas	user2	basic	Texas
Analu/Caus Channes	user4	basic	Texas	user3	basic	Texas
Appry/ Dave Changes				user4	basic	Texas
	1					
Delete [New User]						

### D. SELECT A CONSERVATION PLAN

 Click the *Begin Conservation Plan Assessments* button on the Start Menu and select a conservation plan from the list to work with an existing conservation plan and click the *Load the Selected Conservation Plan!* button. This will load step 2, Assessment Definition.

> [0] Start Menu		
* [1] Choose Pla	n	-
1. Choose	Conservation Plan	
Choo	se an Existing Conservation Plan From The Lists Below	
× 0 ·	BarbTXPlan \ Barb	
	Text New TX \ Barb	
× 0 ·	Tract 234 \ Smith	
	TXTest1111 \ Barb	
Los	ad the Selected Conservation Plan)	
> [2] Assessmen	t Definition	
▶ [3] Practices		
> [4] Operations		
> [5] Soils		
* [6] Run Apex		
7 [7] Reports		

The user can not only select from conservation plans loaded by the user, but also from conservation plans shared with the user (Group Plans)by other conservation planners. The user can also select from plans that are shared with everyone in the region.

> [0] Start Menu	
+ [1] Choose Plan	
1. Choose Conservation Plan	?
Choose an Existing Conservation Pla From The Lists Below	n
O Your Plans	
X BarbTXPlan \ Barb	-
X Text New TX \ Barb	
Tract 234 \ Smith	
TXTest1111 \ Barb	
Plans Shared With You (Group Plans)	
Field4_HydGrpD_07222014 \ Stone	
and the second sec	
O Plans Shared With Evenyone	<u></u>
Plans Shared With Everyone	-
Load the Selected Conservation Plan	
121 Account Definition	
[2] Practices	
> [4] Operations	
Contraction of the second s	
> [5] Soils	
<ul> <li>[5] Soils</li> <li>[6] Run Apex</li> </ul>	

Within STAR, the user can view the planning land unit(s) overdrawn on top of several layer choices including: Imagery (aerial view), Streetmap, Topography, Crop Data Layer (CDL) and Soil. To switch between layers, simply click on the Choose Basemap drop down and select from one of the layer choices.





- A. Imagery (aerial view)
- **B.** Streetmap
- C. Topography
- D. Crop Data Layer (CDL)
- E. Soil

When displaying the CDL layer, a CDL Data legend can be displayed for ease of identifying the various cropland data uses. To display the legend, simply click the Legend button in the top right corner of the screen. Then select the CDL Data legend to display.



The user can also determine the land use of the planning unit by selecting the Land Units legend. The Land Units legend displays a more general land use compared to the Cropland Data legend.



A user can navigate to a field either by panning/zooming to an area of interest or by clicking on the *Find Address* button at the top right of the screen. Enter the address and click *Find*. A list of Address Candidates will appear. Select one and a red marker will be placed on the map at the address.



### E. CREATE A BASELINE APEX ASSESSMENT

The purpose of the BASELINE ASSESSMENT is to establish a beginning point to which alternative assessments can be compared to. The baseline assessment would normally include all of the conservation practices currently in place on the planning land unit.

 To create a baseline APEX assessment for the chosen conservation plan, click on the *Create New Baseline Assessment* button from the APEX Assessments panel, and then in the *Create a New Baseline Assessment* window, enter a name for the assessment and click the *Create Baseline and Select Planning Land Units* button.



2. Once the new assessment has been named, you will be immediately prompted to select planning land units (PLUs) from the conservation plan to include in the assessment. To select

PLUs one at a time, use the "single hand tool" b. To select multiple PLUs, use the

"overlapping hands" will tool and draw a box to select any PLUs that are inside the box. Keep in mind that if more than one PLU is chosen, water, sediment, and nutrients will be routed to the edge of each PLU and will not be routed through the adjacent PLU. Routing through an adjacent PLU is only carried out in the case of specific conservation practices which will be discussed in greater detail later in this document. Once you have selected the PLU(s), they will be labeled with the land use that was identified in the Toolkit data.



- Upon selecting a PLU, the user will be asked to select whether the PLU contains a gully. If the PLU does not contain a gully, select "None". If a gully is present in the PLU, select whether it is "Unstabilized" or "Stabilized".
  - a. Unstabilized indicates the gully is bare earth and is continuing to erode.
  - b. Stabilized indicates the gully has some cover and is no longer eroding.
- 4. If a gully is present, select whether the gully is on the edge of the field or extends into the middle of the field by clicking either the *Edge of Field Only* or *Mid-field* button.

23

- a. Edge of Field option
  - i. Enter the width of the gully. Click *Preview* to view a preliminary buffer equal to the width entered. This preliminary buffer will aid in delineating the proper width of the gully. To change the preliminary buffer width, simply change the entered width value and click *Preview*. Click *Continue* to proceed with delineating the gully.

Get Wid	ith	ä
Width prac	h of newly defined tice area, in feet:	d
	40 ft.	
	Preview	
	Continue	

ii. A Field Split Editor screen will become active. Click the *Start* button to begin delineating the gully. Start splitting the field by first clicking slightly outside of the field (A), then clicking across the field, till you cross the boundary on the other side (B). The delineation will be seen as a yellow line (A-B) and can be altered by clicking the *Alter* button and clicking on a point on the line. Alter the line as needed. Click the *Finish* button to complete the gully delineation process.





- iv. The user will then be asked to select the land use and drainage direction for the original field and the new gully area.
  - The field name of the delineated areas can be renamed by selecting and typing a new name into the Field Name cell. In the example below, the field name for the gully was renamed as "gully".
  - 2. Select the land use of the original field.
  - Select the drainage area to which the original field will drain to. This will likely be the gully area. Click the OK button adjacent to the original field row to submit the choices.
  - 4. Select the land use of the gully area. The appropriate land use for the gully will likely be the "gully" selection.
  - Select the drainage area to which the gully area will drain to. This will likely be the outlet. Click the *OK* button adjacent to the gully row to submit the choices.

Start Fire	o <b>r</b> Nish Alter C	ancel	2	X
Field Name	Required Settings	arrest 1	<u> </u>	
Crop - Corn	Land Use:		Drains To	
	Crop	Ŧ	gully	*
gully	Land Use:		Drains To	OK
	Gully		outlet	*

v. Close both the Field Split Editor and Field Selection Tools screens by clicking on the **"x"** in the upper right corner of the forms.

b. Mid-Field option

- i. Enter the width of the gully and click *Apply Width*. Enter the depth of the gully and click *Apply Depth*.
- ii. To delineate the gully, click the *Start* button and draw the gully on the field making certain to cross the field boundary. Once the gully has been drawn in, click the *Finish* button.



- iii. The user will then be asked to select the land use and drainage direction for the original field and the new gully area.
  - The field name of the delineated areas can be renamed by selecting and typing a new name into the Field Name cell. For example, the field name for the gully was named as "gully"
  - 2. Select the land use of the original field.
  - 3. Select the drainage area to which the original field will drain to. This will likely be the gully area. Click the **OK** button adjacent to the original field row to submit the choices.
  - 4. Select the land use of the gully area. The appropriate land use for the gully will likely be the "gully" selection.
  - Select the drainage area to which the gully area will drain to. This will likely be the outlet. Click the *OK* button adjacent to the gully row to submit the choices.

Field Split	Editor				23
Start	Finish	Alter	Cancel	?	
Field Nam	e Req	uired Setti	ngs		
Cotton		Land	Use:	Drains To:	OKI
	Cro	p		gully	• OK:
gully		Land	Use:	Drains To:	OVI
1	Gul	ly	•	outlet	* OK!

- iv. Close both the Field Split Editor and Field Selection Tools screens by clicking on the "x" in the upper right corner of the forms.
- 5. Select the assessment from the Existing Assessment list to work with the newly created assessment and then proceed to Define Field Practices (section G).



### F. CREATE AN ALTERNATIVE ASSESSMENT

The purpose of an ALTERNATIVE ASSESSMENT is to develop one or more alternative conservation practice strategies to compare with the baseline assessment as well as other alternative assessments in order to determine the best conservation practice strategy to address the resource concern(s)

 Select an existing baseline assessment (A) from the list of Existing Assessments and click the *Create New Alternative of Selected* (B) button. You will be prompted to enter a name for the alternative assessment in the *Create a New Alternative Assessment* window.



 The alternative assessment will use the same fields as the baseline assessment. Make sure to select the newly created alternative (A) beneath the baseline before clicking on the Define Field Practices button (B) to continue.

[2] Assessment Defini	tion	
APEX Asse	essments	?
Create No	ew Baseline Assessment	t
R Select An Existing	g Assessment Below	
Alternative	A A	
and Create	New Alternative Of Sele	ected
and Create	New Alternative Of Sele ernative Assessments Define Field P	ected
. and Create	New Alternative Of Sele ernative Assessments Define Field P	ected

### G. DEFINE FIELD PRACTICES

1. After an assessment has been selected from the Existing Assessment list, the user can proceed to defining the field conservation practices. Click the *Define Field Practices* button.



2. The **Field Practice Definition** panel will become visible. At this point the user can change the name of the field by double clicking the field name and typing in a new name. Any change to the name will be reflected in the field label in the map. For example, in the example below the name of the field was changed from Crop-1.0 to Corn. The field name can only be changed for a baseline assessment. The user can also change the Land Use by selecting a new land use from



the drop down menu.

- 3. To complete the practice definition step, the user must double click on the **Incomplete** label under definitions. This will prompt the *Field Land Use Determination* screen.
- 4. To define the land use, select a land use from the drop down box and click *Save*.


5. The Field Practices Editor screen will then appear. A list of conservation practices which were imported from Toolkit will be listed in the upper box. The user can select from those practices (Only Practices from Toolkit), or all practices can be displayed and chosen from. To add a practice to the Selected Practices on Field box (B), select it in the upper box and click Add To Field. > button (A). A message will be displayed informing the user how the practice will be implemented by STAR.



B



82

6. Once a practice has been added to the lower box, it can be deleted by selecting the practice in the lower box and clicking *Remove Practice From Field*. If a practice that requires a field to be split into more than one field is chosen, the user will be prompted to delineate that boundary. If no splitting practices have been selected for the field, click *Close*. If a splitting practice has been chosen for the field, click *Locate Practice Boundaries*.

Name: Pasture-1.0]	
ew and Select Practices	
ect one or more practices to add EX Assessment for this field:	I to the
Display All Practices	
nd (378)	-
nce (382)	Add
parian Forest Buffer (391)	To
ter Strip (393)	Field
cted Practices on Field	
parian Forest Buffer (391)	Remove Practice From
	Name: Pasture-1.0] ew and Select Practices ect one or more practices to add EX Assessment for this field: Display All Practices nd (378) nce (382) parian Forest Buffer (391) ter Strip (393) cted Practices on Field parian Forest Buffer (391)

Double click the practice in the *Field Split Manager* screen list to be delineated.

Fiel	d Split Manager		23
Fi	eld Splitting:		?
	The practices listed below re split the current field into se	equire that you eparate fields.	
	Double click a practice fi below to divide the field:	rom the list	
	Practice	Splitting Complete?	
	Riparian Forest Buffer (391)	False	
(F	Re)Open Practice Editor	Finish & Close	All

Some splitting practices will invoke a *Get Width* screen. Enter the width of the splitting practice. Click *Preview* to view a preliminary buffer equal to the width entered. This preliminary buffer will aid in delineating the proper width of the splitting practice. To change the preliminary buffer width, simply change the entered width value and click *Preview*.

	Get Width	
1	Width of newly defined practice area, in feet:	
	90 ft.	X
	Preview	1
1	Continue	

Click *Continue* to proceed to delineate the splitting practice.



Click the *Start* button. Click outside of the original field boundary at the point where the splitting practice boundary will intersect the original field boundary. Draw a line along the splitting practice boundary by single clicking. When finished delineating the splitting practice boundary, double click. Make certain that the splitting practice boundary has intersected the original field boundary in two locations. Then click *Finish* in the *Field Split Editor*.

Other splitting practices will invoke a Split Location screen. Select whether the splitting practice is on the edge of the field or extends into the middle of the field by clicking either the *Edge of Field Only* or *Mid-field* buttons.

plit Location	1	
	Edge Of Field Only	
	Mid-field	

- a. Edge of Field option
  - i. Enter the width of the splitting practice. Click *Preview* to view a preliminary buffer equal to the width entered. This preliminary buffer will aid in delineating the proper width of the splitting practice. To change the preliminary buffer width, simply change the entered width value and click *Preview*. Click *Continue* to proceed with delineating the splitting practice. Click the *Start* button. Click

Get Wi	dth 😞
Widt prac	h of newly defined tice area, in feet:
	90 ft.
	Preview
	Continue

outside of the original field boundary at the point where the splitting practice boundary will intersect the original field boundary. Draw a line along the splitting practice boundary by single clicking. When finished delineating the splitting practice boundary, double click. Make certain that the splitting practice boundary has intersected the original field boundary in two locations. Then click *Finish* in the *Field Split Editor*.

- b. Mid-Field option
  - i. Enter the width of the splitting practice and click *Apply Width*.
  - To delineate the splitting practice, click the *Start* button and draw the location of the splitting practice on the field making certain to cross the field boundary. Once the splitting practice has been drawn in, click the *Finish* button. The length of the channel will display after the splitting practice has been delineated.

	Split Location 23
-	Mid-field
	How Wide Will The Channel Be (In feet)? 50.0
	Apply Width
	Using The Tools Below Draw The Channel Onto The Selected Field On The Map. Start Finish Alter
	Channel Length: 1666 Feet
	Cancel

In all cases, the *Field Split Editor* will expand to include land use and drainage settings for each field. For each field select the land use and indicate where the field drains to. The name of the field can optionally be edited by highlighting the field name and typing a new name.

Field Split Editor					23
Start   Finish   Al	ter Cancel				
Field Name	Required Settings				
Pasture-1.0	Land Use: Drains To:			o:	OKI
	Pasture		Riparian Forest B	Buffer 🔹	JOK:
Riparian Forest Buffer	Land Use:		Drains To:	oki	
//2010/10/2012/2012/2012/2012/2012/2012	Forest	*	outlet 🔹		

Click the **OK** button adjacent to each field settings when the required settings have been selected. Exit out of any other field split editor screens.

7. The Definitions column for the field just edited should now be labeled as **Complete**. Continue editing each field until all fields are labeled as **Complete**.

# H. FIELD OPERATIONS DEFINITION

- 1. The next step is to define the field operation schedules for each field. To continue click the *Define Field Operation Schedule* button.
- 2. You will notice now that the conservation practices for each field are listed. To complete the field operation schedules click the **Incomplete** label under the Operations Status column.



- 3. The Operations Schedule Editor screen will appear. At this point the user has two options:
  - a. Select a default operation schedule
  - b. Select a previously defined operation schedule

and do	ions Scl	hedule Ed	itor					
1. Se	lect a	n Opera	tion	Schedule:				[
05	Select a	default o	peratio	on schedule				
0 5	Select a	previous	y defir	ned operation	schedule			
To f	ilter the	e op. sche	dule					
list,	enter a	search te	erm:					
								7
Ap	ply Prev to F	v. Defined ield				Cu	stomize Schedul	Op. e
Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	Edited

If the first option is chosen, the user will be able to select from default RUSLE2 operation schedules. To narrow down the list of operation schedules, type a search term in the filter box (for e.g. Corn). The list will then only include operation schedules that include the search term.

Operati	ons Sch	nedule Ed	litor				22
1. Se	lect a	n Opera	ation	Schedule:			?
• s	elect a	default o	peratio	n schedule			
Os	elect a	previous	ly defin	ed operation	schedule		
To fi list,	lter the enter a	op. sche search te	erm:	Corn			]
							1
Con	n\Corn,g	grain;CT,F	P,CMZ3	8.1			ľ
Con	n\Corn,g	grain;NT,C	MZ38.1				
Con	n\Corn,g	grain;ST,C	MZ38.1				
Cre			LICIN	THE PLACE VILL			

If the second option is chosen, the user can select from any previously edited and/or created operation schedules. Again, the operation schedule list can be narrowed by typing a search term in the filter box.

Once an operation schedule has been chosen from the list, the operations included in the schedule are displayed in the table below. The table includes a list of scheduled operations to be simulated by the APEX model, including information about the crop, year, month, day, operation type, equipment used, rate, and units. If satisfied with the selection, click the

Operations	Sched	ule Edito	ł					-
1. Select	t an C	peratio	on Sch	nedule:				[
• Selec	t a dei	fault oper	ation s	chedule				
O Selec	t a pre	eviously d	efined	operation schedule				
To filter list, ente	the op er a sea	. schedul arch term	Corr	1				
Apply F	Prev. D o Field	efined				Cus	tomize Schedul	Op. e
Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	Edited
Corn grain	1	2	15	Plow, cultivate, other	BEDDER DISK-HIPPER 4i	0	NA	No
Corn grain	1	2	25	Plant with drill	DRILL, DOUBLE DISK 7" 36FT	2004.64	PHU	No
Corn grain	1	3	25	Plow, cultivate, other	ROW CULTIVATOR 12, 20 FEET	0	NA	No
Corn grain	1	8	1	Harvest without kill.	COMBINE SELF-PROP 4WD	0	NA	No
Corn grain	1	8	2	Kill crop	KILL	0	NA	No
Corn grain	1	9	15	Plow, cultivate, other	OFFSET DIS/HEAVDUTY14-18F	0	NA	No
Corn grain	1	10	15	Plow, cultivate, other	SOIL FINISHER	0	NA	No
Com arain	1	11	15	Plow, cultivate, other	BEDDER DISK-HIPPER 6	0	NA	No

*Customize Op. Schedule* button. If not satisfied with the chosen schedule, choose another operation schedule from the list.

4. To begin customizing the operation schedule, enter a name for the operation schedule and click the *Apply Name & Start Customizing>>>* button.

perations	Sched	ule Editor						
Enter Na	ame F	or The	Custo	m Operation Schedule				
Test Cor	m,grain	;CT,FP,CM	IZ38.1					
					Apply Nam	ne & Start (	Customi:	zing >>
Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	Edited
Corn grain	1	2	15	Plow, cultivate, other	BEDDER DISK-HIPPER 4i	0	NA	No
Corn grain	1	2	25	Plant with drill	DRILL, DOUBLE DISK 7" 36FT	2004.64	PHU	No
Corn grain	1	3	25	Plow, cultivate, other	ROW CULTIVATOR 12, 20 FEET	0	NA	No
Corn grain	1	8	1	Harvest without kill.	COMBINE SELF-PROP 4WD	0	NA	No
Corn grain	1	8	2	Kill crop	KILL	0	NA	No
Corn grain	1	9	15	Plow, cultivate, other	OFFSET DIS/HEAVDUTY14-18F	0	NA	No
		10	15	Plow, cultivate, other	SOIL FINISHER	0	NA	No
Corn grain	1	10						110

 In order to define the appropriate cover treatment of practice, any planting operation must be edited. To begin editing a planting operation, double click on a planting operation in the table (A).

appro	priate o	over trea	itment (	or practice before Continui	ng.	Next >>>
Сгор	Year	Month	Day	Tillage Op.	Tillage Equip.	Edited
Corn grain	1	2	25	Plant in rows	Planter, 38 inch	No

Select the crop, planting type, equipment used for planting and the cover type or practice.

If no contour farming or terracing type conservation practices are present on the field, the cover type or practice drop down (A) will default to Straight Row. To edit and define the planting operation, edit the information by selecting the appropriate data from the drop down menus. Then click the **Update** button. Do this for all of the planting operations in the operation schedule.

Operations	Schedule Edito	r					Ę.
Auto Ir Auto Ferti	rigation: No ilization: No	_					
Update	Planting Ope	eration	1				?
Year (1-6):	1 Month (1-12):	2 D (1-3	ay C 31): 25 T	rop Name: [Corn illage Operation:	grain] [Plant with drill]		
Cre	op: Corn grain		• Limit to Op	p, Sched. Crops			
Planting Ty	pe: Plant in row	5	Cover Type	(*Required*)			
Equipme	nt: Planter, 38 i	inch	or Practice: s	Straight Row	• (A)		
Densi	ity: 23000 (p	lants/ac	rre) PHU: 3	3608.352 (° 1	=)	_	
Cance	Vice March	Devi	Tillers On		Tillage Paris	DINI	Update
Crop	Year Month	Day	plants at dall		DBTU DOUBLE DICK 7" SCET	2000 2520	Edited
com grain			Frank Weil Unit		DIALEDOODLE DISK 7 SOFT	500015520	

Once all planting operations have been updated, the user will be able to add/edit any tillage, irrigation, fertilization, pesticide, planting, harvesting/kill or grazing operations by clicking on the respective tabs.

		hedule	Editor							2
Au	Auto Irriga to Fertiliza	ation: ation:	No No	Cop	y Ops to Other Years	-		Compl	ete Operati	on Schedule
Ti	lage Irrig	gation	Fertilize	r Pes	ticide Planting Harvest/Kill	Grazing A				
A	ld a Tilla	ige Op	peration							?
	Year (1-6), 1	Mor	1th 1	Day (1-31)	. 1					
-	illage Type	(1-1	( (	(1-51)						
ĺ	Crop	Plow	, cultivate	, other						
	crop.	Alfal	fa		Limit To Op. Sch	ned, Crops				
	Equipment	•			*					
									(+) Add	Tillage Op
	Crop	Year	Month	Day	Tillage Op.	Tillage Equip,	Rate	Units	(+) Add PHU	Tillage Op Edited
x	Crop Corn grain	Year 1	Month 2	Day 15	Tillage Op. Plow, cultivate, other	Tillage Equip, BEDDER DISK-HIPPER 4i	Rate 0	Units NA	(+) Add PHU NA	Tillage Op Edited No
x	Crop Corn grain Corn grain	Year 1	Month 2 2	Day 15 20	Tillage Op. Plow, cultivate, other Plow, cultivate, other	Tillage Equip. BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1	Rate 0	Units NA NA	(+) Add PHU NA NA	Tillage Op Edited No Yes
x x x	Crop Corn grain Corn grain Corn grain	Year 1 1	Month 2 2 2	Day 15 20 25	Tillage Op. Plow, cultivate, other Plow, cultivate, other Plant in rows	Tillage Equip. BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE19FT 1 Planter, 38 inch	Rate 0 0 23000	Units NA NA plants/acre	(+) Add PHU NA NA 3608.35	Tillage Op Edited No Yes Yes
x x x x x	Crop Corn grain Corn grain Corn grain Corn grain	Year 1 1 1	Month 2 2 2 3	Day 15 20 25 25	Tillage Op. Plow, cultivate, other Plow, cultivate, other Plant in rows Plow, cultivate, other	Tillage Equip. BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE19FT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET	Rate 0 23000 0	Units NA NA plants/acre NA	(+) Add PHU NA NA 3608.35 NA	Tillage Op Edited No Yes Yes No
x x x x x x x	Crop Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1	Month 2 2 2 3 8	Day 15 20 25 25 1	Tillage Op. Plow, cultivate, other Plow, cultivate, other Plant in rows Plow, cultivate, other Harvest without kill.	Tillage Equip. BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET COMBINE SELF-PROP 4WD	Rate 0 23000 0 0	Units NA NA plants/acre NA NA	(+) Add PHU NA NA 3608.35 NA NA	Tillage Op Edited No Yes No No
x x x x x x x	Crop Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1 1	Month 2 2 2 3 8 8 8	Day 15 20 25 25 1 2	Tillage Op. Plow, cultivate, other Plow, cultivate, other Plant in rows Plow, cultivate, other Harvest without kill. Kill crop	Tillage Equip. BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE1SFT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET COMBINE SELF-PROP 4WD KILL	Rate 0 23000 0 0	Units NA NA plants/acre NA NA NA	(+) Add PHU NA NA 3608.35 NA NA NA	Tillage Op Edited No Yes No No No
x x x x x x x x x x x x x x x x x x x	Crop Corn grain Corn grain Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1 1 1 1	Month 2 2 2 3 8 8 8 9	Day 15 20 25 25 1 2 15	Tillage Op. Plow, cultivate, other Plow, cultivate, other Plant in rows Plow, cultivate, other Harvest without kill. Kill crop Plow, cultivate, other	Tillage Equip. BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE1SFT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET COMBINE SELF-PROP 4WD KILL OFFSET DIS/HEAVDUTY14-18F	Rate 0 23000 0 0 0 0	Units NA NA plants/acre NA NA NA	(+) Add PHU NA NA 3608.35 NA NA NA NA	Tillage Op Edited No Yes No No No No

- 6. Adding new operations
  - a. TILLAGE

Add a tillage operation by selecting year/month/day in the rotation, the type of tillage, crop and tillage equipment used. Then click the *Add Tillage Op* button. When the new tillage operation has been added successfully, a notification will appear and then the new operation will appear in the table below

Ope	rations Sc	nedule	Editor											23
A Aut	uto Irriga o Fertiliza	ation: ation:	No No	Copy	Ops to (	Other Ye	ears					Compl	ete Operati	on Schedule
Till	age Irri	gation	Fertilizer	Pest	icide   Pl	lanting	Harvest/Kill	Grazing		Netter			x	
Ad Ti	d a Tilla Year (1-6): 1 lage Type Crop	ge Or Mor (1-1 Plow Corn FIEL	peration 2): 2 , cultivate grain D CULTIV/	Day (1-31) , other	: 20 * * E1! *		Limit To Op. S	ched. Cro	95	Tillage (	Operati	on Added OK		?
	Crop	Vear	Maath	Dav	Tillaga (	00			Tillage Equip		Rate	Unite	(+) Add	Tillage Op
¥	Corp grain	1	2	15	Diow. cu	ultivata v	other		REDDER DISK-H	IDDER 4	0	NA	NA	No
x	Corn grain	1	2	25	Plant in	rows	-		Planter, 38 inch	arren ar	23000	plants/acre	3608.35	Yes
×	Corn grain	1	3	25	Plow, cu	ultivate. d	other		ROW CULTIVATO	OR 12, 20 FEFT	0	NA	NA	No
x	Corn grain	1	8	1	Harvest	without	kill.		COMBINE SELF-	PROP 4WD	0	NA	NA	No
x	Corn grain	1	8	2	Kill crop				KILL		0	NA	NA	No
x	Corn grain	1	9	15	Plow, cu	ultivate, o	other		OFFSET DIS/HE	AVDUTY14-18F	0	NA	NA	No
x	Corn grain	1	10	15	Plow, cu	ultivate, o	other		SOIL FINISHER		0	NA	NA	No
x	Corn grain	1	11	15	Plow, cu	ultivate, d	other		BEDDER DISK-H	IPPER 6i	0	NA	NA	No

b. IRRIGATION

Three options are available for applying irrigation

- 1. No Irrigation no irrigation is applied
- 2.Auto If automatic irrigation is chosen, the model will irrigate the crop when it determines the crop has met the specified conditions. The model has been set to irrigate when the crop reaches a water stress level of 15%. If necessary, the crop will be irrigated once a day until a total maximum of 24 inches of water has been applied to the crop during the current growing season. To select this option, select the *Auto* radio button and then click the *Add Irrigation* button. Auto irrigation will be indicated in the top left corner.



3. Manual – If manual irrigation is chosen, select the year/month/day of application, method of application and enter the volume applied. Then click the *Add Irrigation* button. A notification will be received when the operation has been added successfully, and the new irrigation operation will be added to the spreadsheet below.

peration	s Sche	dule l	Editor									24
Auto I Auto Fer	rrigati tilizati	ion: I ion: I	No No	Copy	Ops to Other Ye	ears				Compl	lete Oper	ation Schedule
Tillage	Irrigat	tion	Fertilizer	Pest	cide Planting	Harvest/Kill	Grazing					
Add Ir Year (1-6):	rigati O Ai	ion ( uto Mon (1-12	Coperation Math 2): 4	Day (1-31)	1			No Irrigation			x	?
Crop:	Corn	arain			• 20			A				
Irr. Volu	ume:	2.0		(in/acre	)	Limit To Op. S	ched. Crops	Irrigation Operatio	on Adde	d/Updated OK		Add Irrigation
Irr. Volu	ume:	2.0 Year	Month	(in/acre Day	) Tillage Op,	Limit To Op. S	ched. Crops Tillage	Irrigation Operatio	n Adde	d/Updated OK		Add Irrigation Edited
Irr. Volu Crop X Corn g	ume:	2.0 Year 1	Month 2	(in/acre Day 15	) Tillage Op, Plow, cultivate, o	Limit To Op. Si	Tillage BEDD	Irrigation Operatio	on Adde	d/Updated OK NA	NA	Add Irrigation Edited <mark>No</mark>
Irr. Volu Crop X Corn g X Corn g	ume:	2.0 Year 1	Month 2 2	(in/acre Day 15 20	Tillage Op, Plow, cultivate, o Plow, cultivate, o	Limit To Op, Si other other	Tillage BEDD FIELD	Irrigation Operation ER DISK-HIPPER 41 CULTIVATOR GE15FT 1	on Adde [ 0 0	d/Updated OK NA NA	NA	Add Irrigation Edited No Yes
Irr. Voli Crop X Corn g X Corn g X Corn g	ume:	2.0 Year 1 1	Month 2 2 2	(in/acre Day 15 20 25	Tillage Op, Plow, cultivate, o Plow, cultivate, o Plant in rows	other	Tillage BEDD FIELD Plante	Irrigation Operation ER DISK-HIPPER 41 CULTIVATOR GE15FT 1 ar. 38 inch	0 23000	d/Updated OK NA NA plants/acre	NA NA 3608.35	Add Irrigation Edited No Yes 5 Yes
Irr. Volu Crop X Corn g X Corn g X Corn g X Corn g X Corn g	ume: grain 1 grain 1 grain 1 grain 1	2.0 Year 1 1 1	Month 2 2 2 3	(in/acre Day 15 20 25 25	) Tillage Op. Plow, cultivate, o Plow, cultivate, o Plant in rows Plow, cultivate, o	other other	Tillage BEDD FIELD Plante ROW	Irrigation Operation ER DISK-HIPPER 41 CULTIVATOR GE15FT 1 ar. 38 inch CULTIVATOR 12, 20 FEET	0 23000 0	OK NA NA plants/acre NA	NA NA 3608.35	Add Irrigation Edited No Yes Yes No
Irr. Volt Crop X Corn g X Corn g X Corn g X Corn g X Corn g X Corn g X Corn g	ume: grain 1 grain 1 grain 1 grain 1 grain 1	2.0 Year 1 1 1 1	Month 2 2 2 3 8	(in/acre Day 15 20 25 25 1	) Tillage Op. Plow, cultivate, o Plow, cultivate, o Plant in rows Plow, cultivate, o Harvest without	other other other kill.	Tillag BEDD FIELD Planta ROW COME	Irrigation Operation ER DISK-HIPPER 4i CULTIVATOR GEISFT 1 Irr. 38 inch CULTIVATOR 12, 20 FEET INE SELF-PROP 4WD	0 0 23000 0	OK NA NA plants/acre NA NA	NA NA 3608.35 NA NA	Add Irrigation Edited No Yes 5 Yes No No
Irr. Volu Crop X Corn g X Corn g X Corn g X Corn g X Corn g X Corn g X Corn g	y grain 1 grain 1 grain 1 grain 1 grain 1 grain 1 grain 1	2.0 Year 1 1 1 1 1	Month 2 2 2 3 8 8	(in/acre Day 15 20 25 25 1 2 2 5	) Tillage Op. Plow, cultivate, o Plow, cultivate, o Plant in rows Plow, cultivate, o Harvest without Kill crop	other other other kill.	Tillag BEDD FIELD Planta ROW COME KILL	Irrigation Operation ER DISK-HIPPER 4i CULTIVATOR GE15FT 1 Irr. 38 inch CULTIVATOR 12, 20 FEET INE SELF-PROP 4WD	0 0 23000 0 0 0	OK NA NA plants/acre NA NA NA	NA NA 3608.35 NA NA NA	Add Irrigation Edited No Yes Yes No No
Irr. Volu Crop X Corn g X Corn g	grain 1 grain 1 grain 1 grain 1 grain 1 grain 1 grain 1 grain 1	2.0 Year 1 1 1 1 1 1	Month 2 2 2 3 8 8 9	(in/acre Day 15 20 25 25 1 2 2 15	) Tillage Op. Plow, cultivate, o Plow, cultivate, o Plant in rows Plow, cultivate, o Harvest without Kill crop Plow, cultivate, o	Limit To Op, Si other other kill.	Tillag BEDD FIELD Plantx ROW COME KILL OFFSI	Irrigation Operation ER DISK-HIPPER 4i CULTIVATOR GEISFT 1 ar. 38 inch CULTIVATOR 12, 20 FEET INE SELF-PROP 4WD ET DIS/HEAVDUTY14-18F	0 0 23000 0 0 0 0	OK NA NA plants/acre NA NA NA NA	NA NA 3608.35 NA NA NA NA	Add Irrigation Edited Yes Yes No No No

Op	erations \$	Schedule	Editor										-23
A	Auto Irr uto Fertil	igation: lization:	No No	Copy O	s to Other Ye	ears				Cor	nplete Oper	ation Scheo	lule
Т	illage II	rrigation	Fertilizer	Pesticid	e Planting	Harvest/Kill	Grazing	1					
•	Year (1-6):	Ilage Of <sup>Mor</sup> (1-1 PE: Ploy	peration hth 2): 1	Day (1-31):	1								?
	Cro Equipme	op: Com ent: FIEL	n grain D CULTIVA	TOR GE1		Limit To Op. S	ched. Crop	ps					
1	Crop	Year	Month								(+) A	dd Tillage (	Эp
x	Corn ora			Day Ti	lage Op.			Tillage Equip.	Rate	Units	(+) A	dd Tillage ( Edited	Op
		ain 1	1	Day Ti 1 Pl	lage Op. w, cultivate,	other		Tillage Equip. TRUCK PICKUP 3/4 TON	Rate 0	Units NA	(+) A PHU NA	dd Tillage ( Edited <mark>No</mark>	op •
x	Corn gra	ain 1 ain 1	1 2	Day Ti 1 Pl 15 Pl	lage Op. w, cultivate, w, cultivate,	other other		Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i	Rate 0 0	Units NA NA	(+) A PHU NA NA	dd Tillage ( Edited No No	op.
x x	Corn gra	ain 1 ain 1 ain 1	1 2 2	Day Ti 1 Pl 15 Pl 20 Pl	lage Op. w, cultivate, w, cultivate, w, cultivate,	other other other		Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1	Rate 0 0 0	Units NA NA NA	(+) A PHU NA NA	dd Tillage ( Edited No No Yes	ACC A
x x x	Corn gra Corn gra Corn gra	ain 1 ain 1 ain 1 ain 1	1 2 2 2	Day         Ti           1         Pl           15         Pl           20         Pl           25         Pl	lage Op. w, cultivate, w, cultivate, w, cultivate, int in rows	other other other		Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 inch	Rate 0 0 0 23000	Units NA NA NA plants/acre	(+) A PHU NA NA NA 3608.35	dd Tillage ( Edited No No Yes Yes	acceleration of the second sec
x x x x	Corn gra Corn gra Corn gra Corn gra	ain 1 ain 1 ain 1 ain 1 ain 1	1 2 2 2 3	Day         Ti           1         Pl           15         Pl           20         Pl           25         Pl	lage Op. ow, cultivate, ow, cultivate, ow, cultivate, ont in rows ow, cultivate,	other other other		Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET	Rate 0 0 23000 0	Units NA NA NA plants/acre NA	(+) A PHU NA NA 3608.35 NA	dd Tillage ( Edited No No Yes Yes No	acceleration of the second sec
x x x x x x	Corn gra Corn gra Corn gra Corn gra Corn gra	ain 1 ain 1 ain 1 ain 1 ain 1 ain 1	1 2 2 2 3 4	Day         Ti           1         Pl           15         Pl           20         Pl           25         Pl           25         Pl           1         Ir	lage Op. ow, cultivate, ow, cultivate, ow, cultivate, ow, cultivate, w, cultivate, igate	other other other		Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET Center Pivot Sprinkler Irrigation	Rate 0 0 23000 0 2	Units NA NA NA plants/acre NA inches	(+) A PHU NA NA 3608.35 NA NA	dd Tillage ( Edited No Yes Yes No Yes	•
x x x x x x x x	Corn gra Corn gra Corn gra Corn gra Corn gra	ain 1 ain 1 ain 1 ain 1 ain 1 ain 1 ain 1	1 2 2 3 4 8	Day         Ti           1         PI           15         PI           20         PI           25         PI           25         PI           1         Ir           1         Hatter	lage Op. ow, cultivate, ow, cultivate, w, cultivate, ant in rows w, cultivate, igate rvest without	other other other other		Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 Inch ROW CULTIVATOR 12, 20 FEET Center Pivot Sprinkler Irrigation COMBINE SELF-PROP 4WD	Rate 0 0 23000 0 2 2 0	Units NA NA NA plants/acre NA inches NA	(+) A PHU NA NA NA 3608.35 NA NA NA	dd Tillage ( Edited No Yes Yes No Yes No	A C

c. FERTILIZER

Three options are available for applying fertilizer

1. No Fertilizer – no fertilization is applied

2.Auto – If automatic fertilization is chosen, the model will fertilize the crop when it determines the crop has met the specified conditions. The model has been set to fertilize when the crop reaches a stress level of 15%. If necessary, the crop will be fertilized once every three (3) weeks at a rate of 67 lbs of elemental Nitrogen per acre until a total maximum of 714 lbs N/acre has been applied to the crop during the current growing season. In the case that multiple crops are grown within one year (double cropping, intercropping, etc.), nitrogen will only be applied up to 714 lbs N/acre for all crops combined. To select this option, select the *Auto* radio button and then click the *Add Fertilizer* button. Auto fertilization will be indicated in the top left corner.

Operations Schedule Editor					23
Auto Irrigation: No Auto Fertilization: No	Copy Ops	to Other Y	ears		Complete Operation Schedule
Tillage Irrigation Fertilizer	Pesticide	Planting	Harvest/Kill	Grazing	
Add Fertilizer Operatio	No Fertilize selected, the cro scre up to a ma:	p will be autor kimum of 714	natically fertilized w Ibs/acre per year. 1	when it reaches a In the case that	ant nibrogen stress level of 15%. Depending on the amount of stress, the crop will be allowed to be fertilized once every 3 lipite crops are grown within one year, nibrogen will only be applied up to 714 libs/asre for all crops combined. Add Fertilizer

3. Manual – If manual fertilization is chosen, select the year/month/day of application, method of application, type of fertilizer applied and enter the rate applied. Then click the *Add Fertilizer* button. A notification will be received when the operation has been added successfully, and the new irrigation operation will be added to the spreadsheet below.

pera	ations Sch	nedule	Editor								3
Auto	uto Irriga Fertiliza	ation:	No No	Copy	Ops to Other Ye	ears					Complete Operation Schedul
illa	age Irrig	ation	Fertilizer	Pest	icide Planting	Harvest/Kill	Grazing	1			
d.	Auto Auto	izer O	peratio	No Fe selected, acre up to	rtilizer the crop will be autom o a maximum of 714 lb	hatically fertilized w bs/acre per year. I Ye	when it reach In the case t Bar	es a plant nitrogen stress level of 15%. D hat multiple crops are grown within one y Month Day 19	Deper rear,	nding on the emount of stress, the crop will b nitregen will only be applied up to 714 lbs/er	e allowed to be fertilized once every 3 cre for all crops combined.
			1	Metho Fertilize	d: Fertilizer app r: 18-46-00	p Surface Broa	adcas +	Crop: Corn grain Rate (lbs/acre) 200.00		Limit To Ops     Schedule Cro	;. op:
								(+) Add Fertilizer			
C	Crop	Year	Month	Day	Tillage Op.	_	_	(+) Add Fertilizer Tillage Equip.	R	Notification	X
c	Crop Corn grain	Year 1	Month 1	Day 1	Tillage Op. Plow, cultivate, c	other		(+) Add Fertilizer Tillage Equip. TRUCK PICKUP 3/4 TON	R	Notification	×
0	Crop Corn grain Corn grain	Year 1 1	Month 1 2	Day 1 15	Tillage Op. Plow, cultivate, c Plow, cultivate, c	other		(+) Add Fertilizer Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i	R O O	Notification	
	Crop Corn grain Corn grain Corn grain	Year 1 1	Month 1 2 2	Day 1 15 20	Tillage Op. Plow, cultivate, c Plow, cultivate, c Plow, cultivate, c	other other		(+) Add Fertilizer Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1	R 0 0	Notification Fertilizer Operation Adde	ed/Updated
	Crop Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1	Month 1 2 2 2	Day 1 15 20 25	Tillage Op. Plow, cultivate, c Plow, cultivate, c Plow, cultivate, c Plant in rows	other other		(+) Add Fertilizer Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 inch	R 0 0 2	Notification Fertilizer Operation Adde	ed/Updated
	Crop Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1	Month 1 2 2 2 3	Day 1 15 20 25 25	Tillage Op. Plow, cultivate, c Plow, cultivate, c Plow, cultivate, c Plant in rows Plow, cultivate, c	other other other		(+) Add Fertilizer Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET	R 0 0 2 0	Notification Fertilizer Operation Adde	ed/Updated
	Crop Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1 1 1	Month 1 2 2 2 3 4	Day 1 15 20 25 25 1	Tillage Op. Plow, cultivate, c Plow, cultivate, c Plow, cultivate, c Plant in rows Plow, cultivate, c Irrigate	other other other		(+) Add Fertilizer Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET Center Pivot Sprinkler Irrigation	R 0 0 2 0 2	Notification Fertilizer Operation Adde	ed/Updated
	Crop Corn grain Corn grain Corn grain Corn grain Corn grain Corn grain Corn grain	Year 1 1 1 1 1 1 1	Month 1 2 2 3 4 8	Day 1 15 20 25 25 1 1	Tillage Op. Plow, cultivate, c Plow, cultivate, c Plow, cultivate, c Plow, cultivate, c Plant in rows Plow, cultivate, c Irrigate Harvest without	other other other kill.		(+) Add Fertilizer Tillage Equip. TRUCK PICKUP 3/4 TON BEDDER DISK-HIPPER 4i FIELD CULTIVATOR GE15FT 1 Planter, 38 inch ROW CULTIVATOR 12, 20 FEET Center Pivot Sprinkler Irrigation COMBINE SELF-PROP 4WD	R 0 0 2 0 2 0	Notification Fertilizer Operation Adde	ed/Updated

Oper	ations Sch	hedule	Editor									3	22
A Auto	uto Irriga o Fertiliza	ation: ation:	No No	Cop	y Ops to Other Ye	ears				Cor	mplete Oper	ation Schedul	e
Tilla	age Irrig	gation	Fertilize	r Pes	ticide Planting	Harvest/Kill	Grazing	16					
Ade ( Till	d a Tilla Year 1-6): 1 age Type: Crop:	Mor (1-1 Plow	oeration 2): 1	Day (1-31) e, other	): 1	Limit To Op. S	ched. Crop	15				?	)
E	quipment:				•						(+).A	Add Tillage Op	1
0	Crop	Year	Month	Day	Tillage Op.		1	Tillage Equip.	Rate	Units	PHU	Edited	j
x	Corn grain	1	1	1	Plow, cultivate, o	other		TRUCK PICKUP 3/4 TON	0	NA	NA	No	
x	Corn grain	1	2	15	Plow, cultivate, o	other		BEDDER DISK-HIPPER 4i	0	NA	NA	No	
x	Corn grain	1	2	19	Fertilize\18-46-0	00	1	Fertilizer app Surface Broadcast incorp 1	200	Ibs/acre	NA	Yes	
x	Corn grain	1	2	20	Plow, cultivate, o	other		FIELD CULTIVATOR GE15FT 1	0	NA	NA	Yes	
x	Corn grain	1	2	25	Plant in rows		-	Planter, 38 inch	23000	plants/acre	3608.35	Yes	
x	Corn grain	1	3	25	Plow, cultivate, o	other	13	ROW CULTIVATOR 12, 20 FEET	0	NA	NA	No	
x	Corn grain	1	4	1	Irrigate			Center Pivot Sprinkler Irrigation	2	inches	NA	Yes	
x	Corn grain	1	8	1	Harvest without	kill.		COMBINE SELF-PROP 4WD	0	NA	NA	No	

#### d. PESTICIDE

The Pesticide tab works much like the Tillage tab. The user selects the year, month and day of the operation. Then the user selects the application method, crop to which the pesticide is being applied, the pesticide being applied, the application rate of the pesticide and the units of the rate. To add the operation to the crop schedule, click the *Add Pesticide* button.

#### e. PLANTING

#### Intercropping

Multiple planting operations can be added if multiple crops are intercropped. Simply add a planting operation for each of the crops in the cropping system by selecting the year/month/day of planting, planting type, crop, equipment used for planting and the cover type or practice. Then click the **Add Planting Op.** button. The following screen shows an intercropping schedule which includes corn and clover.

Operations Scl	nedule Ed	itor										23
Auto Irriga Auto Fertiliza	ation: No ation: No		Copy Ops	to Other Y	ears				Cor	nplete Oper	ation Sched	lule
Tillage Irrig	gation F	ertilizer	Pesticide	Planting	Harvest/Kill	Grazing						
Add a Plan Year (1-6): 1	Month (1-12):	eratio	Day (1-31): 1	Limit to (	Crop: -not se Tillage Op: -r Do. Sched. Cro	nt- not set-					[	?
Planting Type Equipment: Density:	Plant in	rows (plants	* ( * d	Cover Type or Practice: PHU:	(*Require	- - -				(+) Add	Planting O	p.
Crop	Year M	Ionth	Day Tilla	ge Op.		1	Tillage Equip,	Rate	Units	PHU	Edited	T
X Corn grain	1 1		1 Ploy	v, cultivate,	other		TRUCK PICKUP 3/4 TON	0	NA	NA	No	-
X Clover	1 3	2	1 Plan	nt with drill			Broadcast Seeder	50000	plants/acre	0.00000	Yes	
X Corn grain	1 2	2	15 Ploy	v, cultivate,	other		BEDDER DISK-HIPPER 4i	0	NA	NA	No	
X Corn grain	1 2	2	19 Fert	ilize\18-46-6	00		Fertilizer app Surface Broadcast incorp 1	200	lbs/acre	NA	Yes	
X Corn grain	1 3	2	20 Ploy	v, cultivate,	other		FIELD CULTIVATOR GE15FT 1	0	NA	NA	Yes	
X Corn grain	1 2	2	25 Plan	nt in rows			Planter, 38 inch	23000	plants/acre	3608.35	Yes	
X Corn grain	1 3	3	25 Ploy	v, cultivate,	other		ROW CULTIVATOR 12, 20 FEET	0	NA	NA	No	-
X Corn grain	1 4	ŧ.	1 Irrig	jate			Center Pivot Sprinkler Irrigation	2	inches	NA	Yes	
X Corn grain	1 8	3	1 Har	vest without	kill.		COMBINE SELF-PROP 4WD	0	NA	NA	No	-

#### Crop Rotations

Crop rotations can also be created by added additional planting operations in consecutive years. The following screen shows a rotation of corn and cotton. Other operations such as tillage, irrigation, fertilization, harvesting and killing should be included for each crop in the respective year.

Opera	ations Schedu	le Edit	or	_							_		-83
Au Auto	ito Irrigation Fertilization	n: No n: No	4	Сору Орз	to Other Y	ears				Cor	mplete Oper	ation Sche	dule
Tilla	ge Irrigatio	n Fer	tilizer	Pesticide	Planting	Harvest/Kill	Grazing						
Add	l a Tillage	Opera	tion										?
Y	(ear 1 M	onth	1 (1	Day 1	8								
Tilla	age Type: pl	w. cul	tivate, of	ther	2								
	Crop:				ā n	Limit To Op. S	ched. Crops						
Ec	uipment:			-									
10	rop	Vear	Month	Day	Tillage On.			Tillane Fouin.	Rate	Units	(+) A	dd Tillage Edited	Op
xc	Corn grain	1	2	25	Plant in rov	vs		Planter, 38 inch	23000	plants/acre	3608.35	Yes	
x c	Corn grain	1	4	1	Irrigate			Center Pivot Sprinkler Irrigation	2	inches	NA	Yes	
x c	Corn grain	1	8	1	Harvest wit	hout kill.		COMBINE SELF-PROP 4WD	0	NA	NA	No	
x c	Corn grain	1	8	2	Kill crop			KILL	0	NA	NA	No	
x c	otton Stripper	2	2	25	Fertilize\18	-18-00		Fertilizer app Knifed or injected 1	380	lbs/acre	NA	Yes	
x c	otton Stripper	2	3	1	Plant in rov	vs		Planter, 38 inch	75000	plants/acre	3600.00	Yes	
x	otton Stripper	2	3	25	Plow, cultiv	ate, other		ROW CULTIVATOR 12, 20 FEET	0	NA	NA	Yes	
× c	Cotton Stripper	2	9	27	Harvest wit	hout kill,		COTTON PICKER SELF-PROP	0	NA	NA	Yes	
x c	otton Stripper	2	10	1	Kill crop			KILL	Ó	NA	NA	Yes	

#### Cover Crops

When adding a mix of crops to be used as a cover crop, the crops can be added in one planting operation using the cover crop mix wizard. Select the planting date for the cover crop. Select "—Cover Crop Mix —" as the crop. This will invoke the Cover Crop Mix Wizard. Select a crop from the list of available crops and click the arrows to the right to add the crop to the list. Enter a plant density in the box to the right of the crop in the cover crop list. Continue to add additional crops as needed. When all crops have been added to the cover crop mix, click *Save Crop Mix*. Select the planting type, equipment used for the cover crop and cover type or practice and click the *Add Planting Op* button.

perations Schedu	le Edito	or										23
Auto Irrigation Auto Fertilization	n: No n: No	C	ору Оря	s to Other Ye	ars				Cor	mplete Oper	ation Sche	dule
Tillage Irrigatio	n Fer	tilizer I	Pesticide	Planting	Harvest/Kill	Grazing						
Add a Plantin	ng Ope	eration									(	?
Year 1	Aonth		ay .		Crop: -not s	t-	-					
(1-6):	1-12):	Cover C	rop Mix	Wizard	_	23						
Crop:	Cover C		All Crops	Available	Cove	Crop/Density (plants/ac)						
Planting Type: Pl	ant in n	Onions	green		Ann	al Rye Grass 50000						
Equipment:		Orchar	d grass	and	> Clov	r White 75000						
	_	Peanut	u grass s	seeu	in the second	100000						
Density:		PEAS				100000						
		Peas A	ustrian w	vinter	< Pear	Austrian winter 100000				(+) Add	Planting C	p.
Crop	Year	Peas c	owpeas		*			Rate	Units	PHU	Edited	
Corn grain	1		-1				K-HIPPER 4i	0	NA	NA	No	
Corn grain	1	Save C	rop Mix				Surface Broadcast incorp 1	200	lbs/acre	NA	No	T
Corn grain	1	2	20	Plow, cultiv	ate, other	FIELD CUL	TIVATOR GE15FT 1	0	NA	NA	No	
Corn grain	1	2	25	Plant in row	s	Planter, 38	inch	23000	plants/acre	3608.35	Yes	
Corn grain	1	4	1	Irrigate		Center Pive	ot Sprinkler Irrigation	2	inches	NA	No	
Corn grain	1	8	1	Harvest wit	hout kill.	COMBINE	SELF-PROP 4WD	0	NA	NA	No	
	1	8	2	Kill crop		KILL		0	NA	NA	No	
Corn grain	1	-										
Corn grain Cotton Stripper	2	2	25	Fertilize\18	-18-00	Fertilizer a	pp Knifed or injected 1	380	lbs/acre	NA	No	
Corn grain Cotton Stripper Cotton Stripper	2	2	25 1	Fertilize\18	-18-00 's	Fertilizer a Planter, 38	pp Knifed or injected 1 inch	380 75000	lbs/acre plants/acre	NA 3600.00	No Yes	

A planting operation will be added to the spreadsheet for each crop in the cover crop mix. Each planting operation can be edited.

Operati	ons Schedule E	ditor		_								53
Auto Auto F	o Irrigation: N ertilization: N	0	Copy (	Ops to	Other Ye	ars				Cor	nplete Oper	ation Schedule
Tillage	Irrigation	Fertilizer	r Pestic	ide	Planting	Harvest/Kill	Grazing					
Add a Yea (1-6 Tillag	a Tillage Ope ar Monti (1-12) e Type: Plow, Crop: Alfalfa	h ): 1	Day (1-31): ., other	1		Limit To Op. S	ched. Crops					?
Cro	P.	Year	Month	Day	Tillage	Op.		Tillage Equip.	Rate	Units	(+) / PHU	dd Tillage Op Edited
× Cor	n grain	1	4	1	Irrigate	e		Center Pivot Sprinkler Irrigation	2	inches	NA	No
× Cor	m grain	1	8	1	Harves	st without kill.		COMBINE SELF-PROP 4WD	o	NA	NA	No
× Cor	n grain	1	8	2	Kill cro	p		KILL	0	NA	NA	No
× Ann	ual Rye Grass	1	9	1	Plant v	vith drill		Broadcast Seeder	50000	plants/acre	0.00000	Yes
X Clo	ver White	1	9	1	Plant v	vith drill		Broadcast Seeder	75000	plants/acre	0.00000	Yes
X Kale	e	1	9	1	Plant v	vith drill		Broadcast Seeder	100000	plants/acre	0.00000	Yes
X Pea	s Austrian winter	1	9	1	Plant v	vith drill		Broadcast Seeder	100000	plants/acre	0.00000	Yes
X Cot	ton Stripper	2	2	25	Fertiliz	e\18-18-00		Fertilizer app Knifed or injected 1	380	lbs/acre	NA	No
X Cot	ton Stripper	2	3	1	Plant in	n rows		Planter, 38 inch	75000	plants/acre	3600.00	Yes *

If fertilizer or irrigation is added manually to the cover crop, the fertilizer or water needs to be added to only one of the crops in the cover crop mix in order for all of the crops to take advantage.

#### f. HARVEST/KILL/BURN

Harvest operations are used to harvest the crop. In the case of forage crops, numerous harvest operations can be included to simulate multiple cuttings. If a harvest operation is not included in the management schedule, no yield will be reported.

The burning operation is used to remove the above-ground plant material. Currently, the model is set to remove 90% of the above-ground biomass. All plants are affected equally. For example, trees are burned to the same extent as grasses.

The Kill operation must be added to permanently stop the growth of a crop. If a Kill operation is not included, the model assumes the crop continues to grow. This is the case even for crops which obviously do not continue to grow in the field after harvest (e.g. corn and wheat). The model will allow the plant to continue growing and using resources (nutrients, water, etc.). Therefore, a Kill operation MUST be included at the conclusion of the crop life. If the crop is a perennial, do not include a Kill operation until the crop is destroyed.

If a cover crop mix is included in the operation schedule, a Kill operation must be included for each crop in the mix. This can, however, be accomplished in one step. Select the date of kill, select KILL COVER CROPS for the Type, and then select Kill for the Method. This will add a kill operation for each crop in the cover crop mix.



#### g. GRAZING

Grazing can also be simulated by adding Start and Stop Grazing operations. The animals can begin grazing a crop on the date as set on the Start Grazing operation. Grazing is also limited by the grazing limit which is set to 0.9 tons/acre. The animals will be allowed to graze provided the amount of forage as set by the grazing limit is available. Animals will be allowed to graze until they have grazed the forage to the grazing limit. This prevents the herds from overgrazing or grazing more than the producer would allow them to graze a particular pasture. When the herd has grazed down to the grazing limit, animals are removed from the field and held in an offsite holding area. When the amount of forage present on the field surpasses the limit, the animals are allowed to return to the field and continue grazing. The limit is not a daily consumption limit but rather a forage availability limit. The Stop Grazing operation removes the animals from the field. A stocking density (acres/animal unit) can also be set on the Start Grazing operation. If stocking density changes throughout the season, additional Start Grazing operations can be added and the stocking rate modified.

peration	ns Schedule E	ditor										13
Auto I Auto Fei	Irrigation: N rtilization: N	lo lo	Сору С	ps to O	ther Years				Cor	nplete Oper	ation Sched	ule
Tillage	Irrigation	Fertilizer	Pestici	de Pla	anting Harvest/Kil	Grazing						
Add G	razing Ope	eration	Graze	Type	Year (1-6)	Mc 1 (1-	Day 12): 9 (1-31): 16					2
			Graze M	lethod:	StartGraze *							
		Lucia	Turner				Taining 1	1	Terrer	(+) Add	Graze Op.	
Crop		Year	Month	Day	Tillage Op.		Tillage Equip.	Rate	Units	(+) Add PHU	Graze Op.	
Crop X Corn	grain	Year 1	Month	Day 20	Tillage Op. Plow, cultivate, othe	ur.	Tillage Equip. FIELD CULTIVATOR GE15FT 1	Rate	Units	(+) Add PHU NA	Graze Op. Edited	
Crop X Corn X Corn	grain grain	Year 1 1	Month 2 2	Day 20 25	Tillage Op. Plow, cultivate, othe Plant in rows	r	Tillage Equip. FIELD CULTIVATOR GE15FT 1 Planter, 38 inch	Rate 0 23000	Units NA plants/acre	(+) Add PHU NA 3608.35	Graze Op. Edited No Yes	
Crop X Corn X Corn X Corn	grain grain grain	Year 1 1	Month 2 2 4	Day 20 25 1	Tillage Op. Plow, cultivate, othe Plant in rows Irrigate	r	Tillage Equip. FIELD CULTIVATOR GE15FT 1 Planter, 38 inch Center Pivot Sprinkler Irrigation	Rate 0 23000 2	Units NA plants/acre inches	(+) Add PHU NA 3608.35 NA	Graze Op. Edited No Yes No	
Crop X Corn X Corn X Corn X Corn X Corn	grain grain grain grain grain	Year 1 1 1 1	Month 2 2 4 8	Day 20 25 1	Tillage Op. Plow, cultivate, othe Plant in rows Irrigate Harvest without kill.	r	Tillage Equip. FIELD CULTIVATOR GE15FT 1 Planter, 38 inch Center Pivot Sprinkler Irrigation COMBINE SELF-PROP 4WD	Rate 0 23000 2 0	Units NA plants/acre inches NA	(+) Add PHU NA 3608.35 NA NA	Graze Op. Edited No Yes No No	
Crop X Corn X Corn X Corn X Corn X Corn X Corn	grain grain grain grain grain	Year 1 1 1 1 1	Month 2 2 4 8 8	Day 20 25 1 1 2	Tillage Op. Plow, cultivate, othe Plant in rows Irrigate Harvest without kill. Kill crop	r	Tillage Equip. FIELD CULTIVATOR GE15FT 1 Planter, 38 inch Center Pivot Sprinkler Irrigation COMBINE SELF-PROP 4WD KILL	Rate 0 23000 2 0 0	Units NA plants/acre inches NA NA	(+) Add PHU NA 3608.35 NA NA NA	Graze Op. Edited No Yes No No	
Crop X Corn X Corn X Corn X Corn X Corn X Annu	grain grain grain grain grain grain al Rye Grass	Year 1 1 1 1 1 1 1	Month 2 2 4 8 8 9	Day 20 25 1 1 2 1	Tillage Op. Plow, cultivate, othe Plant in rows Irrigate Harvest without kill. Kill crop Plant with drill	r	Tillage Equip. FIELD CULTIVATOR GE15FT 1 Planter, 38 inch Center Pivot Sprinkler Irrigation COMBINE SELF-PROP 4WD KILL Broadcast Seeder	Rate 0 23000 2 0 0 0 50000	Units NA plants/acre inches NA NA plants/acre	(+) Add PHU NA 3608.35 NA NA NA 0.00000	Edited No Yes No No Yes	
Crop X Corn X Corn X Corn X Corn X Corn X Annu X Clove	grain grain grain grain grain grain al Rye Grass ar White	Year 1 1 1 1 1 1 1 1 1	Month 2 2 4 8 9 9	Day 20 25 1 1 2 1 1 1	Tillage Op. Plow, cultivate, othe Plant in rows Irrigate Harvest without kill. Kill crop Plant with drill Plant with drill	r	Tillage Equip. FIELD CULTIVATOR GE15FT 1 Planter, 38 inch Center Pivot Sprinkler Irrigation COMBINE SELF-PROP 4WD KILL Broadcast Seeder Broadcast Seeder	Rate 0 23000 2 0 0 50000 75000	Units NA plants/acre inches NA NA plants/acre plants/acre	(+) Add PHU NA 3608.35 NA NA NA 0.00000 0.00000	Graze Op. Edited No Yes No No Yes Yes	
Crop X Corn X Corn X Corn X Corn X Corn X Corn X Annu X Clove X Kale	grain grain grain grain grain grain al Rye Grass ar White	Year 1 1 1 1 1 1 1 1 1 1 1	Month 2 2 4 8 9 9 9	Day 20 25 1 1 2 1 1 1 1	Tillage Op. Plow, cultivate, othe Plant in rows Irrigate Harvest without kill. Kill crop Plant with drill Plant with drill Plant with drill	r	Tillage Equip.         FIELD CULTIVATOR GE15FT 1         Planter, 38 inch         Center Pivot Sprinkler Irrigation         COMBINE SELF-PROP 4wD         KILL         Broadcast Seeder         Broadcast Seeder         Broadcast Seeder         Broadcast Seeder	Rate 0 23000 2 0 0 50000 75000 100000	Units NA plants/acre inches NA NA plants/acre plants/acre plants/acre	(+) Add PHU NA 3608.35 NA NA 0.00000 0.00000 0.00000	Graze Op. Edited No Yes No No Yes Yes Yes	

#### 7. Editing operations

Existing operations can be edited by simply double-clicking on the operation line in the spreadsheet. The appropriate screen will appear. Edit the operation as needed and click the **Update** button.

#### 8. Deleting operations

Operations can be deleted by simply clicking the  $\bowtie$  button beside the operation. A message will appear to verify that you want to delete the operation schedule record.

#### 9. Completing the Operation Schedule

Once all operations have been added, edited or deleted as desired, the operation schedule can be submitted. Click the *Complete Operation Schedule* button in the top right corner of the screen.

10. The Operations Status should now be **Complete**. At this point the user can define the soils by clicking the **Define Soils** button on the **Field Operations Definition** panel.

> [1] Choose Plan	
[2] Assessment Definiti	on
3 [3] Practices	
[4] Operations	
4. Field Opera	ations Definition
Double-Click A Field's Sche	Name To View or Edit The Operat adule For That Field
Field Name	Operations Status
	the second se
Corn	Complete
Corn Filter <b>Practices:</b> Filter Strip (p:	Complete Complete arameters adjusted by STAR)
Corn Filter Practices: Filter Strip (pi gully	Complete Complete arameters adjusted by STAR) Complete
Corn Filter Practices: Filter Strip (pi gully	Complete Complete arameters adjusted by STAR) Complete Define Soils >>
Corn Filter Practices: Filter Strip (pi gully	Complete Complete arameters adjusted by STAR) Etemplete Define Soils >>
Corn Filter Practices: Filter Strip (pi gully	Complete Complete arameters adjusted by STAR) Complete Define Soils >>
Corn Filter Practices: Filter Strip (pi gully ]	Complete Complete arameters adjusted by STAR) Complete Define Soils >>
Corn Filter Practices: Filter Strip (pi gully 5 [5] Soils 5 [5] Soils 6 Run Apex	Complete Complete arameters adjusted by STAR) Complete Define Soils >>

# I. FIELD SOIL PARAMETER EDITING

The user can define the soils for the scenario. To accomplish this, click the **Define Soils** button on the **Field Operations Definition** panel. A window with additional information related to soils processing will appear. Click the OK button to continue with soil definition. The program will determine the predominant soil for each field in the scenario. Once processing has been completed, the user will receive a message confirming this.

Field Name	Operations Status
Crop-1.0	Complète
Practices: Grassed	Waterways (parameters adjusted by STAR)
	the second s



The predominant soil for each field will then be displayed in the Field Soil Parameter Editing panel.

> [0] Start Menu	
> [1] Choose Plan	
[2] Assessment Definition	n
> [3] Practices	
> [4] Operations	
* [5] Soils	
5. Field Soil P	arameter Editing 🛛 😢
Double-Click A Field Param	's Name To View or Edit The Soil eters For That Field
Field Name	Soil Name
Corn	Branyon
gully	Branyon
Filter	Branyon
- D	Run Apex >>>
> [6] Run Apex	
2 [7] Reports	

To edit the soil parameters for a particular field, double click on the soil name of the field in interest. A Field Soil Parameters screen will appear.

<b>Edit Soil</b>	Paramete	ers						
Soil Name:	V	ergenne	5					
Apply to al	l layers:	WTMN:	0	WTMX:	0	HSG:	4	
	Select	Layer #:	1	•				
Initial Soi	I P from Fiel	d Tests:		-				
			Soil	P Value:	0	PH:	5.9	
z:	0.4921259	BD:	1.3	SAN:	15.9	SIL:	25.6	
WOC:	2.3201856	CNDS:	0	SSF:	0			
CEC:	0	SATC:	0.3299952			-		
						E	(+) Update	e Soil
Default So	il Values							
WTMN:	0	WTMX:	0	HSG:	4	PH:	5.9	
Z:	0.4921259	BD:	1.3	SAN:	15.9	SIL:	25.6	
WOC:	2.3201856	CNDS:	0	SSF:	0			_
CEC:	0	SATC:	0.3299952	1	-			

The following soil parameters are defined only once for all soil layers:

**WTMN**: Minimum depth to the water table. This is the depth (ft) from the soil surface to the water table when the water table is at its highest level.

**WTMX**: Maximum depth to the water table. This is the depth (ft) from the soil surface to the water table when the water table is at its lowest level.

HSG: Soil hydrologic group

1 = A: Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of sands or gravel that are deep and well to excessively drained. These soils have a high rate of water transmission (low runoff potential). Hydrologic Group A (1) soils generally have a sand content of 80% or greater.

2 = B: Soils having moderate infiltration rates when thoroughly wetted, chiefly moderately deep to deep, moderately well to well drained, with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission. Hydrologic Group B (2) soils generally have a sand content between 60% and 80%.

3 = C: Soils having slow infiltration rates when thoroughly wetted, chiefly with a layer that impedes the downward movement of water or of moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission (high runoff potential). Hydrologic group C (3) soils generally have a sand content less than 50% and a clay content less than 40%.

4 = D: Soils having very slow infiltration rates when thoroughly wetted, chiefly clay soils with a high swelling potential; soils with a high permanent water table; soils with a clay pan or clay layer at or near the surface; and shallow soils over nearly impervious

materials. These soils have a very slow rate of water transmission. Hydrologic group D soils generally have a clay content greater than 40%.

The remaining soil parameters are editable by layer (i.e. soil horizon). Layers can be selected by clicking on the Select Layer drop down box and choosing a desired layer. Soil parameters can be edited as needed. Default soil values are provided in the lower portion of the form for the user's knowledge.

User's can choose to enter initial soil phosphorus from soil field test results for each soil layer. Choose from the Mehlich test or the Modified Morgan test. For both tests, soil P and pH are required. For the Modified Morgan the user is also prompted to enter Aluminum, which is required for conversion of the value to model compatible units.

**Z**: Depth from the soil surface to the bottom of the layer (ft).

PH: Soil pH.

**BD**: Moist bulk density. The soil bulk density expresses the ratio of the mass of solid particles to the total volume of the soil. In moist bulk density determinations, the mass of the soil is the oven dry weight and the total volume of the soil is determined when the soil is at or near field capacity. Bulk density values should range between 1.1 and 1.9 Mg/m<sup>3</sup>.

**SAN**: The percentage of sand in the soil. The percentage of soil particles which have a diameter between 2.0 and 0.05 mm.

**SIL**: Percentage of silt in the soil. The percentage of soil particles which have an equivalent diameter between 0.05 and 0.002 mm.

**WOC**: Percent of organic carbon in the soil layer. % organic carbon = % organic matter/1.72.

**CNDS**: Initial soluble nitrogen concentration. The user may define the concentration of nitrate (dry weight basis) for all soil layers at the beginning of the scenario. (ppm)

**SSF**: Initial soluble phosphorus concentration. This value will be calculated either by values entered by the user for the initial soil P test or automatically calculated by APEX. (ppm)

**CEC**: Cation exchange capacity. The cation exchange capacity of a soil is the quantity of positive ions necessary to neutralize charge of a unit quantity of soil, under a given set of conditions. (cmol/kg)

**SATC**: Saturated conductivity is the rate at which water passes through the soil layer, when saturated. The saturated hydraulic conductivity relates soil water flow rate (flux

density) to the hydraulic gradient and is a measure of the ease of water movement through the soil. The saturated conductivity is the reciprocal of the resistance of the soil matrix to water flow. (in/h).

Once the user has completed the soil parameter edits for the soil, click the *Update Soil* button. At this point the scenario can be submitted to APEX. To continue click the *Run APEX* button.

# J. RUN APEX

- 1. To begin the simulation, click the *Run APEX* button.
- 2. Confirm that you want to submit the scenario to APEX.

> [3] Practices	
<ul> <li>[4] Operations</li> <li>[5] Sells</li> </ul>	
5. Field Soil F Double-Click A Fie Parar	Parameter Editing
Field Name	Soil Name
Corn	Branyon
gully	Branyon
Filter	Branyon
	Run Apex >>>

re you sure?	
Are you sure you want to submit this the Scenario through the APEX mode definition.	: Scenario to APEX? Hit OK to start running el. Otherwise, hit Cancel to continue Scenario

Once submitted, the assessment may take several minutes to process.

3. The status of the assessment can be viewed in the run table. As the model progresses through the various steps in the simulation, the Status column will reflect this progress.



Once the assessment is finished, a message will be displayed to inform you that the simulation has successfully finished processing and the status will display as complete.



If the run was not successful and a message such as the one pictured below is received, the simulation files should be sent to the support staff for further diagnosis.

APEX Run Completion	Results	×
Execution Process H "// APEX execution f	as Finished. The Message ailure: Run Incomplete. E	Was: xit Code: 408"
Would you like to do	ownload the APEX source	files?
Click OK to downloa or click Cancel to pr	id the files, oceed without downloadi	ng the files.
	OK	Cancel

The simulation files can be downloaded as a .ZIP file by clicking OK on the message pictured above or by clicking on the O button adjacent to the run under the D/L column.

	a second s	1.1.1.1	1.1
Name	Run Time	Status	D/L
Test EMS	11/26/2014 1:04:33 PM	complete	Ø
Alternative 1	11/25/2014 1:52:08 PM	complete	Ð
11-25-14	11/25/2014 1:41:08 PM	5: FAILED	Ø
Test Baseline	1/1/0001 1:01:01 AM		
Alternative 1	1/1/0001 1:01:01 AM		

4. If the simulation was successful, output can be viewed through the Reports section.

### K. REPORTS

- 1. Click on the **Reports** tab.
- 2. Select one or more of the APEX output parameters from the list.

[7] Reports	
7. Reports	?
Select one or more APEX parameters:	
Nitrogen Stress (days)	
Phosphorus Stress (days)	-
Total Surface Nitrogen loss (lbs/ac)	
Total Subsurface Nitrogen loss (lbs/ac)	

- 3. Then select the Baseline assessment from the drop down menu to display output for.
- 4. If any Alternative assessments have been made on the chosen baseline assessment, they will be listed in the Alternative box below. If desired, one or more Alternative assessments can be chosen to compare against the baseline assessment.
- 5. To clear all selections, click the *Refresh List* and reselect parameters and assessments.

* [/] Reports	0
7. Reports	?
Select one or more APEX parameters:	
Nitrogen Stress (days)	<u>*</u>
Phosphorus Stress (days)	
Total Surface Nitrogen loss (lbs/ac)	
Total Subsurface Nitrogen loss (lbs/ac)	
Total Surface Dheenborus loss (lbs/as)	
Select the Baseline assessment to report of	n:
Test EMS Optionally, select one or more Alternatives	* to compare to the
Test EMS Optionally, select one or more Alternatives Baseline: Alternative 1	• to compare to the
Test EMS Optionally, select one or more Alternatives Baseline: Alternative 1 Refresh List	• to compare to the View Reports
Test EMS Optionally, select one or more Alternatives Baseline: Alternative 1 Refresh List	• to compare to the View Reports
Test EMS Optionally, select one or more Alternatives Baseline: Alternative 1 Refresh List	to compare to the View Reports
Test EMS Optionally, select one or more Alternatives Baseline: Alternative 1 Refresh List	to compare to the View Reports
Test EMS Optionally, select one or more Alternatives Baseline: Alternative 1 Refresh List	• to compare to the View Reports

- 6. Once all selections are made, click the *View Reports* button to display the report. If the report does not open, hold down the CTRL key and click the *View Reports* button again.
- 7. The report not only contains data for the parameters chosen in the previous step, but it also includes information regarding the location and cropping practices.
- 8. The following data is provided for each assessment and field in the Summary of Field Inputs section of the report:
  - a. Practices: conservation practices applied to the field
  - b. Op Schedule: operation/management schedule used for the field
  - c. Dominant Soil: the dominant soil present in the field
  - d. Field acres: calculated acres of the field
  - e. Hydrologic Soil Group: The soil group of the dominant soil.
  - f. Slope (%): The average slope of the field calculated from elevation data.
  - g. Slope Length (ft): The calculated slope length based on field dimensions.
  - h. Weather Station: Historical weather site used for simulation
  - i. Avg. Annual Precip (in): Average annual precipitation received at this location based on the historical weather data
  - j. Total N Applied (lbs/ac): Total amount of elemental nitrogen applied through automatic or manual fertilization as set in the operation schedule
  - k. Total P Applied (lbs/ac): Total amount of elemental phosphorus applied through automatic or manual fertilization as set in the operation schedule
  - I. Total Irr Applied (in/ac): Total amount of irrigation applied through automatic or manual irrigation as set in the operation schedule
  - m. STIR Tillage Value: Soil Tillage Intensity Rating based on tillage equipment used in the operation schedule.

# STAR\* Systematic Tool for Analyzing Resources **APEX Outputs Report**



Conservation Plan: MikePlan

SAMPLE Date Created: 9/9/2015 3:18:36 PM

#### Summary of Field Inputs:

		Assessments				
Field Name		MikeBase	AltTile	AltFilter		
Crop-1.0	Practices		Subsurface Drain	Filter Strip		
	Op Schedule	Crop-1.0-MW_031215- Crop-1.0-Corn Silage \Corn,silage; No till, Z60	Crop-1.0-MW_031215- Crop-1.0-Corn Silage \Corn,silage; No till, Z60	Crop-1.0-MW_031215- Crop-1.0-Corn Silage \Corn,silage; No till, Z60		
	Dominant Soil	Vergennes	Vergennes	Vergennes		
	Field Acres	19.42	19.42	19.17		
	Hydrologic Soil Group	D	D	D		
	Slope	4.62%	4.62%	4.61%		
	Slope Length (ft)	45.72	45.72	45.72		
	Weather Station	BURLINGTON WSO A	BURLINGTON WSO A	BURLINGTON WSO A		
	Avg Annual Precip (in)	36.43	36.43	36.43		
	Total N Applied (lbs/ac)	109.89	109.89	109.89		
	Total P Applied (lbs/ac)	39.26	39.26	39.26		
	Total Irr Applied (in/ac)	0.00	0.00	0.00		
	STIR Tillage Value	48.09	48.09	48.09		
Filter	Practices			Filter Strip		
	Op Schedule			Custom - Grass Filter Strip		
	Dominant Soil			Vergennes		
	Field Acres			0.25		
	Hydrologic Soil Group			D		
	Slope			0.03%		
	Slope Length (ft)			10.00		
	Weather Station			BURLINGTON WSO A		
	Avg Annual Precip (in)			36.43		
	Total N Applied (lbs/ac)			8.91		
	Total P Applied (lbs/ac)			3.92		
	Total Irr Applied (in/ac)			0.00		
	STIR Tillage Value			1.08		

9. The Summary of APEX Output section contains the data for the selected APEX parameters for each assessment and field.

APEX OUTPUTS Report Agricu Conservation Plan: MikePlan						
Date Created: 9/9/2015	3:18:37 PM					
Summary of APEX Outp	out					
Apex Parameter	Field Name	MikeBase	AltTile	AltFilter		
Total Outflow (inches)	Crop-1.0	6.96	3.82	6.68		
Total Sediment Yield (t/ac)	Crop-1.0	10.81	6.88	3.19		
Total Soluble P in Outflow (lb/ac)	Crop-1.0	0.14	0.06	0.13		
Total Sediment P in Outflow (lb/ac)	Crop-1.0	5.24	3.24	2.14		
Tile Drain Phosphorus Loss (lb/ac)	Crop-1.0	0.00	0.95	0.00		
Total Soluble N in Outflow (lb/ac)	Crop-1.0	16.15	22.92	16.44		
Total Sediment N in Outflow (lb/ac)	Crop-1.0	50.13	32.40	20.89		
Tile Drain Nitrogen Loss (Ib/ac)	Crop-1.0	0.00	15.23	0.00		
Total Soluble Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00	0.00		
Total Sediment Pesticide in Outflow (lb/ac)	Crop-1.0	0.00	0.00	0.00		
Nitrogen Volatilization (Ibs/acre)	Crop-1.0	14.24	14.62	14.31		
Forage Crop Yield (t/ac)	Crop-1.0	4.92	4.94	4.94		
Grain Yield (t/ac)	Crop-1.0	0.00	0.00	0.00		
Drought Stress (days)	Crop-1.0	10.22	10.00	9.85		
Phosphorus Stress (days)	Crop-1.0	0.00	0.00	0.00		
Nitrogen Stress (days)	Crop-1.0	0.00	0.00	0.00		

Total soluble N in outflow includes N in tile drainage. Total soluble P in outflow does NOT include P in tile drainage.

# L. SIMULATING CONSERVATION PRACTICES

Conservation practices selected during Step 3 Field Practices Definition are summarized below. The Vermont implementation of STAR does not include practices marked with an asterisk (\*). All other practices are available for both Texas and Vermont.

#### a. MANAGEMENT RELATED CONSERVATION PRACTICES

Conservation practices in this category are accomplished through the use of management practices that simulate the practices. Management practices are constructed in the Field Operations Definition section (Section H)

#### 1. Nutrient Management (590)

Nutrient management is simulated by modifying nutrient inputs using the Fertilizer operation schedule editor. Fertilizers can be added, removed, or modified using the editor.

### 2. \* Brush Management (314)

Brush Management is simulated by removing targeted woody species, yucca, and/or prickly pear from the operation schedule. The baseline assessment will be simulated using a management schedule which includes the unwanted species. The alternative assessment management schedule should not include these species or should include the species at a reduced density to simulate partial removal.

### 3. Conservation Crop Rotation (328)

Conservation Crop Rotation is simulated by creating a management schedule which includes two or more crops grown in succession over several years. See Section G: Planting for an example of how to set up a crop rotation.

# 4. Residue Management, No-till, Strip Till (329)

Residue Management is simulated by incorporating fewer tillage operations or operations that do not disturb the soil to a great extent. The tillage operations used should not exceed a STIR value greater than 30.

#### 5. \*Prescribed Burning (338)

Prescribed burning of crops can be applied using the Harvest/Kill tab in the operation schedule editor.

## 6. \*Critical Area Planting (342)

Critical Area Planting is simulated by including plants in the management schedule that are suited for the site conditions and intended uses.

- \*Residue Management, Seasonal (344) Seasonal Residue Management is simulated by including tillage operations at the proper time and intensity to be consistent with the NRCS Conservation Practice Standards for leaving the required amount of residue on the surface for erosion control.
- \*Irrigation Water Management (449)
   Irrigation Water Management is simulated by including irrigation operations at the appropriate time and in the appropriate amounts to manage soil moisture for proper plant growth, minimize soil erosion, and reduce runoff and deep percolation.
- \*Forage Harvest Management (511)
   Forage Harvest Management is simulated by harvesting numerous times during the growing season to promote plant re-growth.
- 10. Pasture and Hayland Planting (512)

Pasture and Hayland Planting is simulated by planting species that are well suited for the climatic and soil conditions of the site. Species which will meet the level of nutrition for the livestock should also be considered.

#### 11. Prescribed Grazing (528)

Prescribed Grazing is simulated by scheduling grazing practices to control the harvest of vegetation. Stocking rate should be considered for the amount of predicted available forage.

12. \*Range Planting (550)

Range Planting is simulated by planting species that are well suited for the climatic and soil conditions of the site. Species which will meet the level of nutrition for the livestock should also be considered. Planting density should be adequate to prevent excessive soil and water loss and improve water quality.

13. Pest Management (595)

Pest Management is simulated by including pesticide operations in the operation schedule. Pesticide fate in runoff, leached, and degraded can then be looked at for each pesticide applied.

14. \*Tree and Shrub Establishment (612)

Tree and Shrub Establishment is simulated by planting tree and shrub species. Depending on the purpose of the establishment (timber, pulpwood, energy biomass), the density of the establishment and the years to harvest can be modified.

#### 15. \*Upland Wildlife Habitat Management (645)

Upland Wildlife Habitat Management is simulated by planting species that will provide adequate forage for wildlife. Other conservation practices which could be included but not limited to Upland Wildlife Habitat Management include prescribed grazing (528), range planting (550), brush management (314), prescribed burning (338), nutrient management (590), filter strip (393), contour buffer strips (332), riparian forest buffers (391), riparian herbaceous cover (390), and windbreak establishment (612).

#### 16. \*Forest Stand Improvement (666)

Forest Stand Improvement can be simulated by first simulating in the baseline assessment the species that are currently present on the site. An alternative assessment should only simulate the desired species composition and density. Both tree and grass species can be simulated in conjunction with each other. Grazing can also be simulated.

#### 17. Cover Crop (340)

Cover Crop is simulated by planting a species or suite of species suitable for the climatic and soil conditions of the site. Planting density should be considered for each species in the mix. Cover crops are usually killed by means of tillage or chemical operations. To accomplish this, a KILL operation should be included to simulate the destruction of the cover crop.

### b. CONSERVATION PRACTICES REQUIRING A DIVISION OF FIELD AREA

Conservation practices in this category are accomplished by splitting out the conservation area from the original field of interest. The division of field area will result in two or more subareas. The hydrological routing between fields is also defined by the user. (Section G)

### 1. Grassed Waterway (412)

Using the Field Split Editor delineate where the grassed waterway is located in the original field. Define the hydrological routing by selecting the area which the original field and grassed waterway drains to. Enter the width of the grassed waterway in feet.

### 2. Riparian Forest Buffer (391)

Using the Field Split Editor delineate where the riparian forest buffer is located in the original field. Define the hydrological routing by selecting the area which the original field and riparian forest buffer drains to. Enter the width of the riparian forest buffer in feet.

3. Fence (382)

Using the Field Split Editor delineate where the fence(s) are located in the original field.

4. Filter Strip (393)

Using the Field Split Editor delineate where the filter strip is located in the original field. Define the hydrological routing by selecting the area which the original field and filter strip drains to. Enter the width of the filter strip in feet.

5. Grade Stabilization Structure (410)

Using the Field Split Editor delineate where the grade stabilization structure (GSS) is located in the original field. Define the hydrological routing by selecting the area which the original field and GSS drain to. Enter the width of the GSS in feet.

Gully (for use with Baseline Assessment ONLY)
 Using the Field Split Editor delineate where the gully is located in the original field.
 Define the hydrological routing by selecting the area which the original field and gully drain to. Enter the width of the gully in feet.

#### c. CONSERVATION PRACTICES REQUIRING MODEL PARAMETER MODIFICATIONS

Conservation practices in this category are accomplished simply by selecting them for each field in the field practices editor screen. Once any of these practices are selected for a field, the model is automatically parameterized to simulate the practice. No additional action is required from the user. (Section G)

- 1. Contour Farming (330)
- 2. \*Pond (378)
- 3. \*Pipeline (516)
- 4. \*Terrace (600)
- 5. \*Watering Facility (614)
- 6. Waste Utilization (633)
- \*Irrigation System, Sprinkler (442)
- 8. \*Irrigation Pipeline (430)
- 9. \*Stripping Cropping (585)
- 10. \*Contour Buffer Strips (332)
- 11. Diversion (362)

- 12. \*Vegetative Barrier (601)
- \*Riparian Herbaceous Cover (390)
- 14. \*Hedgerow Planting (422)
- 15. \*Cross Wind Practices (589)
- 16. \*Windbreak / Shelterbelt Establishment (380)
- 17. \*Herbaceous Wind Barriers (603)
- 18. Field Border (386)
- 19. Subsurface Drain (606)

# M. APPENDIX A: EXPORTING CUSTOMER DATA FROM TOOLKIT

1

The user can export customer data from Customer Service Toolkit such as the planned land units and practice schedule.

1. To export data from Toolkit, the user should check out the desired customer folder. Then click on the Folder tab and double-click the Customer to open the Customer File.

File Too	ols Re	ports Hel	p				
0							
Check In	/Out	Folders					
	Fo	Iders o	checked	outby	CHANCE WA	LKER	
-							_
		Status	Owner	Last Check I	In County	Customer Name	Busi
		N/ 1		12/17/2012	PARKER, TX	THOMAS P BUTT	butt
		on lead					
	-	for read		1/4/2013	PARKER, TX	CHANCE H WALKER	wal12
1	-	oro read හිර read හිර read		1/4/2013 1/4/2013	PARKER, TX PARKER, TX	CHANCE H WALKER CHANCE H WALKER	wal12 test1
1	-	ero read හිත් read හිත් read write	CHANCE WA	1/4/2013 1/4/2013 5/9/2012	PARKER, TX PARKER, TX PARKER, TX	CHANCE H WALKER CHANCE H WALKER CHANCE H WALKER	wal12 test1 tk1
2	+	ero read හිත් read හිත් read write	CHANCE WA	1/4/2013 1/4/2013 5/9/2012	PARKER, TX PARKER, TX PARKER, TX	CHANCE H WALKER CHANCE H WALKER CHANCE H WALKER	wal 12 test1 tk1
2	+	ero read හිත් read හිත් read write	CHANCE WA	1/4/2013 1/4/2013 5/9/2012	PARKER, TX PARKER, TX PARKER, TX	CHANCE H WALKER CHANCE H WALKER CHANCE H WALKER	wal12 test1 tk1

2. Select Tools from the Toolkit toolbar menu and select Export **Customer Data** 

ustome	r Service Toolkit TRAINING			WIRR			
Tools F	Reports Holp In Customer Data						
e GSAT	Land Unit: Practice Sc	chedule Customer File Reporting	_				
1	a Church at a Read but	Upon-W(BB	n-witte				
	Wander texanologianative wire     Conhoc, Reports     Conhoc, Reports     Conhoc, Reports     Conhoc, Reports     Conhoc, Reports     Pan, Map1     Pan, Map1     Pan, Map1     Pan, Map1     Pan, Map1     Reports     Recource_Map1	Name 2] BragenRanch mad 2] TookifiiS_Tenplate mad	30e 416KB 2045KB	Date Modeu 1/15/2006 9/15/2005	Addada		
ojecto	<b>¢ )</b>	20.5 KB					
-					Charles H Stanley AUTHENTICATE		

3. An Export Customer Data window will appear showing progress. Click the Close button when finished. The file will be save to the <u>C:\ Users \</u> <user.name> \ AppData \ Roaming \ USDA \ Toolkit5 \ SessionExportData directory. This file can then be importing into STAR to create assessments.

	Customer Data Export: Technical Tools are available to start from the Toolkit Tools menu. Refer to the Toolkit Help Topic on Technical Tools for information about using the Export Customer Data capability.
	Export finished.
-	Close