PWC Prep Tool Documentation

Revision: 20231010-1

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Introduction

The USEPA's Pesticide in Water Calculator (PWC) simulates pesticide applications to land surfaces and the subsequent transport to and fate in surface water bodies and simple ground aquifers.[1] The PWC model was designed for regulatory applications as applied by the Office of Pesticide Programs (OPP) and uses the Pesticide Root Zone Model (PRZM) and the Variable Volume Water Model (VVWM). PWC requires the user to parameterize the modeling scenario(s) by specifying pesticide physical-chemical properties, environmental factors, and application parameters.

Need and Objective

Most pesticides are labeled for a variety of uses, with application instructions and restrictions often differing for each use site *(e.g.*, crop and region). Comprehensive simulation of potential environmental exposure for all use sites and market regions for an active ingredient (AI) can potentially result in thousands of PWC runs (simulations) that require parameterization. Fortunately, to accommodate many runs the PWC model accepts a batch file for input; however, manually parameterizing these runs is time-prohibitive and error prone. Specifically, defining application information (*i.e.*, application dates, application rates, etc.) is cumbersome due to the multitude of permutations that can result from crop management timing (*i.e.*, emergence and harvest dates) and use restrictions that are unique to each use site and region.

There exists a substantial need for a tool that can, for any AI, correctly and efficiently automate the assignment of application information for each PWC run across all use sites and regions. The PWC Prep Tool is designed to fulfill this need.

Complexity of Modeling Pesticide Uses

Pesticide labels provide detailed instructions for use of a product, and agronomic practices that vary by region such as typical emergence and harvest dates must also be considered when attempting to model pesticide uses. To draw factual conclusions from the modeling results, it is critical that the pesticide exposure modeling accurately reflects these factors. Satisfying these restrictions can be challenging due to the complex interaction of label instructions and regional variables.

Pesticide labels include several types of restrictions, including:

- The number of applications in a year must not exceed the maximum annual number of applications.
- The total amount applied in a year must not exceed the maximum annual application amount.
- Interval specific (*e.g.*, pre-emergence or post-emergence) number of applications and amounts applied must not be exceeded.
- Some uses allow for various application rates but limit the number of applications for a given rate.
- The pre-harvest interval (PHI) and minimum reapplication interval (MRI) must also be respected.

Furthermore, it is possible that specific application rates can only be made during certain times of the year. For example, application restrictions may permit the use of a higher application rate during the month prior to harvest, or in the two weeks following emergence. Satisfying all these conditions and ensuring that the model is conservative (see following section) can require complex logic, and the PWC Prep Tool attempts to account for all these restrictions when assigning application dates and rates.

PWC Prep Tool Conservatism

EPA has implemented the following conventions when parameterizing the PWC model for Endangered Species Act (ESA) assessments for pesticides:

[1] USEPA 2022. *PWC (Pesticide in Water Calculator)*. https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#PWC

- Application simulations should maximize application rates and number of applications to the maximum extent possible without violating label instructions; and,
- Applications should be made in the wettest month(s) allowed by the label. For example, if the pesticide can be applied to a crop only during post-emergence, then the wettest month in the post-emergence interval should be used (which may not be the wettest month overall in the year).

The PWC Tool implements these conventions when assigning applications.

Geographical Scope of PWC Prep Tool

Currently, the PWC Prep Tool is designed to prepare PWC runs for any region and use site within the continental United States, assuming the supporting information is specified correctly. The tool relies on the ESA or FIFRA scenario files to extract the emergence and harvest dates. For each use site to be simulated in PWC, the user must specify an ESA or FIFRA scenario.

PWC Prep Tool Use and Guidelines

What is the PWC PREP Tool?

The PWC Prep Tool (PWC-PT) is a program that facilitates the parameterization and generation of a PWC batch input file (.csv) for use in aquatic pesticide exposure modeling. The PWC-PT uses a user-friendly graphical interface (GUI) that enables efficient parameterization of PWC model runs and generation of a batch input file by implementing an algorithm that assigns application dates and rates based on use site and region-specific agronomic practices (label restrictions). This ensures PWC simulations are compliant with the product label while maximizing conservatism.

The PWC-PT is highly configurable and can be used to generate PWC batch input files for a wide range of pesticides with unique agronomic practices. Furthermore, the user has flexibility in setting up model runs using parameters like application distance from the water body, application method (*e.g.*, foliar, bare ground, incorporated), transport mechanisms (*e.g.*, runoff/erosion + drift or drift only), drift reduction factors, and water body scenarios (*i.e.*, standard aquatic "bins" used by EPA).

The PWC-PT can prepare PWC model runs to support regulatory aquatic exposure modeling for both the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Endangered Species Act (ESA). The user can specify use scenarios and waterbody parameters related to each of these assessment types.

The PWC-PT is not intended to set up a small number of PWC model runs. This would be quicker to do manually, without the functionality of the PWC-PT. The PWC-PT is best utilized when setting up a large number of runs, for an active ingredient with diverse uses and/or complex agronomic restrictions.

PWC Prep Tool Functions (Use Cases)

The PWC Prep Tool has two primary functions (use cases):

Use case #1: Generate a new PWC batch input file

Use case #1 allows the user to create a new PWC batch input file for a specific AI "from scratch". The structure of the resulting batch file matches the format of Appendix A in the PWC Documentation and can be input directly into the PWC program. To generate a new PWC batch input file using the PWC-PT, the user must parameterize the required input tables (see Step 3. Parameterize the Input Tables) and then use the GUI to execute the tool. For this use case, two output files are generated: The first file is the PWC batch file (.csv), and the second a log file (.log) that details the resulting applications and the parameters used to generate them. For more information regarding the output file for use case #1, refer to the **Output Files** section.

Use case #2: Quality-check an existing batch file

An auxiliary function of the PWC-PT is to quality check (QC) an existing PWC input batch file to verify that it does not violate the labeled use. The user parameterizes the appropriate input tables and then uses the GUI to QC a batch file. Use case #2 generates a QC report (.csv) and a log file (.log) detailing any label compliance findings. For more information regarding the output file for use case #2, refer to the **Output Files** section.

Use case #2 performs the following checks:

- Annual maximum number of apps is not exceeded
- Annual maximum amount applied is not exceeded
- Pre-Emergence maximum number of apps is not exceeded
- Pre-Emergence maximum amount applies is not exceeded
- Post-Emergence maximum number of apps is not exceeded
- Post-Emergence maximum amount applied is not exceeded
- MRI is adhered to
- PHI is not encroached
- No duplicate application dates are used (*i.e.*, more than one application on the same date)

- "Number of Apps" field is correct (*i.e.*, the number of applications specified in a scenario matches the "Number of Apps" field

Note that use case #2 does not ensure the following factors:

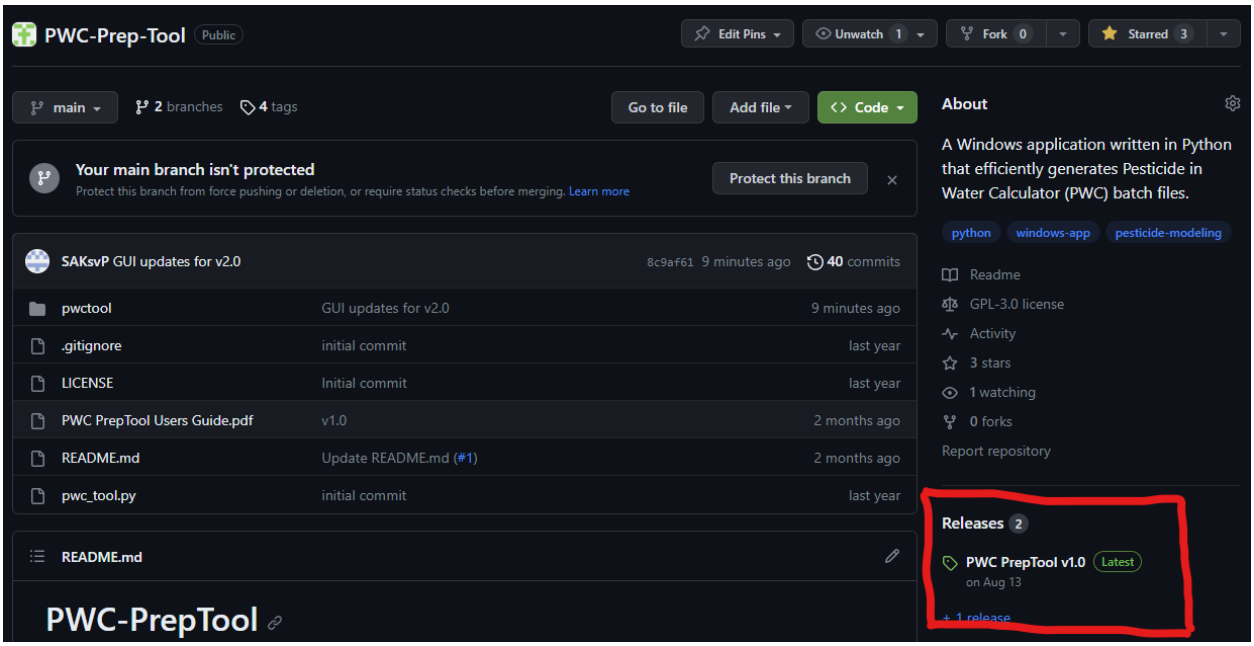
- That applications are made during the wettest months of the year
- The highest application rates are prioritized
- The maximum annual number of applications are made
- The maximum annual application amount is reached

In other words, the quality checks are intended to ensure that the applications to be simulated are label compliant. Lastly, the drift and efficiency factors are not checked, as these may change based on distance from the waterbody which cannot be determined from an existing batch file.

NOTE: The field names in an existing batch file can be anything; however, the columns must be in the same order specified in the official PWC documentation.

Downloading and Installing PWC-PT

The current release version of the PWC-PT is available to download from the GESTF GitHub repository at [GESTF-ESA/PWC-Prep-Tool: A Windows application written in Python that efficiently generates Pesticide in Water Calculator (PWC) batch files. (github.com)]



To install PWC-PT, download the latest release and run the installer. The installer sets up the tool and creates a PWC PrepTool link in the Start menu.

Running PWC-PT via the Graphical User Interface

Step 1. Starting the PWC-PT GUI

After the application is downloaded via GitHub, navigate to the application executable in file explorer and start the application. Note that some parameters have default settings, which will be reflected in the GUI when it is first opened (Figure 1):

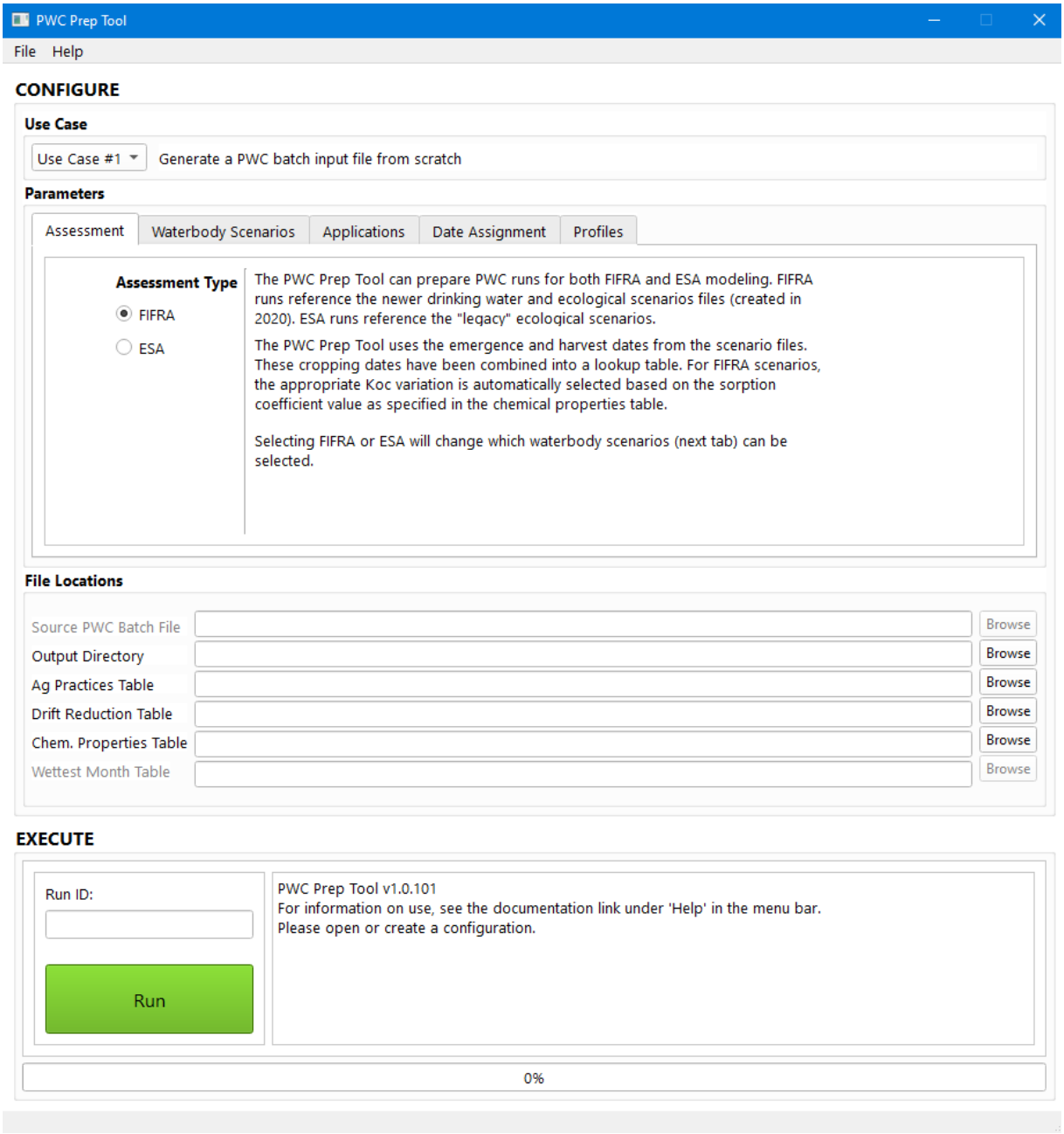


Figure 1: PWC Prep Tool GUI

Step 2. Specify Parameters and Options

Assessment Type

Users can generate PWC runs for both FIFRA and ESA regulatory modeling. This selection affects several other components of the model runs, including the scenario files, waterbody parameters, among others. The widgets in the GUI are automatically disabled or enabled based on the assessment type selected by the user. For example, when FIFRA is selected, the widgets related to wettest month prioritization are disabled.

Waterbody Scenarios

The user must specify the waterbody scenario(s) to model. A unique PWC model run will be parameterized for each waterbody type selected (for each use entered in the Agronomic Practices Table). The waterbody parameters are dependent on the assessment type, although there is some overlap between ESA and FIFRA standard waterbodies. Table 1 below shows the waterbody parameter values that correspond to each waterbody scenario available to the user. ESA bin 4 has the same parameter values as FIFRA Index Reservoir except that 'FlowAvgTime' equals 1 (for ESA)

instead of 0 (for FIFRA). ESA bin 7 has the same values as FIFRA Farm Pond. ESA bin 10 has the same values as FIFRA wetland.

Table 1: Waterbody parameters used by the PWC-PT

		Values Used in Batch File								
Assessment Type	Waterbody Type	Aquatic Bin	Flow Avg Time	Field Size (m2)	Waterbody Area (m2)	Init Depth (m)	Max Depth (m)	HL (m)	PUA	Baseflow
ESA	Bin 4	4	1	1.73E+06	5.26E+04	2.74	2.74	6.00E+02	1	0
	Bin 7	7	0	1.00E+05	1.00E+04	2	2	3.57E+02	1	0
	Bin 10	10	1	1.00E+05	1.00E+04	0.15	0.15	3.57E+02	1	0
FIFRA	Index Reservoir	4	0	1.73E+06	5.26E+04	2.74	2.74	6.00E+02	1	0
	Farm Pond	7	0	1.00E+05	1.00E+04	2	2	3.57E+02	1	0
	Wetland	10	1	1.00E+05	1.00E+04	0.15	0.15	3.57E+02	1	0

Applications

The user must specify which application methods should be modeled, with available application methods described in Table 2. The user must specify the application method for each use to be modeled in the Agronomic Practices Table (see **Agronomic Practices Table** section). The application methods (and corresponding setback distances or depth options) are enabled and disabled based on the presence of corresponding application methods in the Agronomic Practices Table. For example, if only application methods 1 and 2 appear in the Agronomic Practices Table, then only those application methods are enabled in the GUI.

Table 2: PWC application methods available in the PWC-PT

Application Method	Method ID in Batch Input File	Description (from PWC Documentation)
Bare Ground (Below Crop)	1	Distributes pesticide under the canopy into the soil with distribution inversely proportional with depth to 4cm.
Foliar (Above Crop)	2	Pesticide is intercepted by foliage in proportion to the foliage aerial coverage at the time of application. Pesticide that is not intercepted is treated as a ground application and is distributed in the ground to a depth of 4cm.
Incorporated Uniform	3	Pesticide is uniformly distributed from the surface to a user-specified depth.
Incorporated Entirely at Depth	4	Pesticide is placed entirely at a specific depth. Note that placement of pesticide below the runoff extraction depth (R-depth on *Runoff Tab*) will result in no pesticide being transported in runoff.
T-Band Split	5	Pesticide is distributed to a depth specified by the incorporation depth, with a specified fraction (see T-Band Split below) placed into the top 2cm.
Incorporated Linearly Increased with Depth	6	Pesticide mass is distributed in the soil linearly increasing with depth down to the depth specified by the user.
Incorporated Linearly Decreased with Depth	7	Pesticide is distributed in the soil linearly decreasing with depth down to the depth specified by the user.

Setback Distances and Drift Only Runs

Within the applications tab in the GUI, for uses with bare ground and foliar methods, the user can select different distances from the waterbody to simulate, with PWC model runs parameterized for each distance selected. If running standard "edge of waterbody" scenarios, specify the "000m" distance only. Alternatively, you can select any combination of other setback distances up to 150 meters. These distances correspond to drift reduction fractions listed in the **AgDRIFT Reduction Table** input table and are used to simulate application sites that are not directly adjacent to a water body by reducing the amount of spray drift based on the distance. See more information in the the section: AgDRIFT Reduction Table.

For uses with above ground application methods, the user can generate a "drift only" PWC run in addition to the standard runoff/erosion plus drift run. This will create a new run in the PWC batch file that excludes runoff and erosion by the application to incorporated entirely at depth with a depth of 4 cm.

Date Assignment

There are four parameters in the date assignment tab:

- Wettest Month Prioritization allows the user to turn on or off the wettest month prioritization functionality when assigning application dates. This is only available when ESA assessment type is selected (see the **Date Assignment Parameters** section for more information).
- App Date Prioritization allows the user to specify how to prioritize the application dates (see the **Date Assignment Parameters** section for more information).
- Random Start Dates allows the user to turn on or off random date assignments, and the Random Seed permits reproducibility (see the **Random Start Dates and Random Seed** section for more information).

Profiles

There are several parameters in the profiles tab:

- The Ag Practices Scenario is a drop-down list in which the user selects the name of the worksheet to use in the **Agronomic Practices Table** (APT). This is helpful because the user can build out several versions of the APT for different use scenarios to simulate possible changes to a label as needed.
- The AgDRIFT Reduction Scenario uses the same concept but for the **AgDRIFT Reduction Table** (DRT), allowing the user to simulate different drift reduction scenarios or even use different drift models.
- The Residential Adjustment Factor is the EEC adjustment factor for Residential use site run, and accounts for the fact that not all residential land cover is a potential application site. The US-EPA has typically used a value of 0.587 and is the default value used by PWC-PT.

Step 3. Specify the Use Case

In the configure panel, within the "Use Case" section, use the drop-down menu to select the appropriate use case based on your objective. Note the textual description of the use case to the right of the drop-down menu. Also note that certain components of the GUI will be greyed-out or disabled based on the use case.

Step 4. Parameterize the Input Tables

If executing use case #1 (generating a new PWC batch input file), several input tables must first be completed. These include the **Agronomic Practices Table (APT)**, the **AgDRIFT Reduction Table**, and the **Ingredient Fate Parameters** table. These are described in more detail in the **File Locations Pane** section.

Step 5. Specify File Locations

In the "File Locations" section of the Configure panel, select file or directory names by clicking the appropriate browse button to open the file dialog and navigate to the appropriate file or directory and specify the corresponding file path. Alternatively, enter the file or directory path directly into the text box. Each of these files/directories are discussed in more detail in the **File Locations Pane** section below.

Step 6. Executing the PWC Prep Tool

Below the Configure pane, the Execute pane is where the user executes the PWC-PT. The user should first specify a unique run identifier. This is used for naming the output files, so it is recommended to use conventional characters allowed in file names, and to use a standardized naming convention. For example, if the run identifier was "Test_Run_v1", the output files would be "Test_Run_v1_new_batch_file.csv" and "Test_Run_v1.log".

The diagnostic window presents processing status and feedback as the tool runs, and the progress bar indicates the amount of processing completed and remaining.

Step 7. Reviewing the Output

The PWC-PT writes output files to the output directory, as specified in the File Locations pane. Learn more about in the **Output Files** section.

Saving, Opening, and Editing Configurations

The current state of the GUI (*i.e.*, the parameters that are set or selected) is termed a "configuration", and the configuration can be saved and used again as needed. To save, open, or create a new configuration, use the "File" menu. Configurations are stored as human-readable YAML files (.yml) and the user can edit these YAML files directly, but they rely on specific formatting, so it is strongly recommended to only edit a configuration file by using the PWC-PT GUI to make the changes desired and then using the Save option to save the changes and update the YAML configuration file.

File Locations Pane

Source PWC Batch file

The source PWC Batch file is used in use case #2, where the PWC runs are checked for label compliance.

Output Directory

The output directory is the location where the output files will be written. Either use the browse button to specify the output directory or copy and paste the folder path into the text box. You must specify the output directory for both use cases.

Agronomic Practices Table

The agronomic practices table (APT) contains the agronomic practices restrictions for each labeled use of the active ingredient. The user must fill out the APT for each active ingredient to execute the PWC-PT. Each row in the APT is an individual labeled use. For the user, this is the most labor-intensive part of the whole process of using the PWC-PT and the part where error potential is highest. The APT is an Excel (.xlsx) file and the user can create different versions (unique Excel sheets in the same workbook) of the APT if desired.

IMPORTANT: There is an APT template for both ESA and FIFRA that comes downloaded with the PWC-PT. Please be sure to use the correct one for your assessment. The APT template is installed in the %USERPROFILE%\PWC-PT\data folder and is named "Default_APT.xlsx".

Table 3 shows the fields in the APT. A full example of an APT is displayed in **Appendix 1: Input File Examples**. If you create or modify an APT, please ensure that the field names match Table 2 (or the default APT that comes downloaded with the PWC Prep Tool).

Table 3: Agronomic Practices Table (APT) field definitions

Field Name	Type	Description
RunDescriptor	String	PWC run descriptor that matches the source PWC batch file. Must be unique in the APT.
LabeledUse	String	The labeled use for the pesticide. This is the use site. It is recommended to use the appropriate use site as displayed in the "AgCensus Crop List" sheet in the default APT. This will ensure that runs are only generated for HUCs that overlap states where the crop is actually grown and not all of the states allowed by the label. Learn more in the **Census of Agriculture Crop to State Lookup Table** section.
ApplicationMethod	String	The method of application to simulate. Must be one of: 1, 2, 3, 4, 5, 6, 7. See **Applications** section for more details.
DriftProfile	String	Drift profile identifier. Corresponds to "Profile" column in the **AgDRIFT Reduction Table**
Scenario	String	EPA scenario for a given class of use sites
States	Variable	The states where the label restrictions are valid. See **States Field Convention** in **Appendix 1: Input File Examples** for more information.
MaxAnnAmt	Float	The maximum annual amount of AI that can be applied (lbs/acre)
MaxAnnNumApps	Integer	The maximum annual number of applications that can be made
PHI	Integer	Pre-Harvest Interval. The number of days preceding harvest in which applications are not permitted
PreEmergence_MaxAmt	Float	The maximum amount of AI that can be applied within the pre-emergence interval. That is, the period after the harvest date and before the emergence date.
PreEmergence_MaxNumApps	Integer	The maximum number of applications that can be made within the pre-emergence interval.
PostEmergence_MaxAmt	Float	The maximum amount of AI that can be applied within the post-emergence interval. That is, the period after the emergence date and before the harvest date
PostEmergence_MaxNumApps	Integer	The maximum number of applications that can be made within the post-emergence interval
Rate1_MaxAppRate	Float	The maximum application rate for rate 1. This field is required to have a value for all rows in the APT. Ensure that the application rates are listed highest to lowest (Rate1 should be equal to or higher all other rates)
Rate1_MaxAppNumApps	Integer	The maximum number of applications that can be made at Rate1_MaxAppRate. May be left blank
Rate1_PreEmergenceMRI	Integer	The minimum recurrence interval (MRI) for rate1, pre-emergence interval. This value indicates that applications are valid in this interval at this rate. May be left blank
Rate1_PostEmergenceMRI	Integer	The MRI for rate1, post-emergence interval. This value indicates that applications are valid in this interval at this rate. May be left blank. However, either *Rate1_PreEmergenceMRI* or *Rate1_PostEmergenceMRI* must be specified
Rate1_Instructions	String	Special instructions for rate 1. More information about rate-specific instructions can be found in **Appendix 2: Rate Specific Instructions Convention**.
RateX_ …	…	Remaining fields for rates two through four

The APT is based upon and consistent with EPA's "Master Use Summary Table" used in biological evaluations. In other words, the user can take the information from the master use summary table and use it to fill out the APT.

The APT is designed to be flexible and account for a wide range of pesticide use restrictions. For example, the user can specify if applications can only be made in pre-emergence or post-emergence periods. The user can specify multiple potential application rates. The user can specify the application method (e.g., above crop, below crop, incorporated) for each labeled use.

IMPORTANT: To specify pre-emergence or post-emergence as a valid interval (i.e., applications can be made during this period), set the Pre/PostEmergenceMRI parameter to the appropriate value. This tells the date assignment algorithm that applications can be made for this period.

The PWC-PT supports up to four unique application regimens for each modeled use (row in APT), with corresponding restrictions. The ability to parameterize multiple rates accounts for more complex label instructions such as "make up to two applications at a rate of 0.25 - 1 lb. per acre pre-emergence, and/or three applications at a rate of 0.25 - 0.5 lbs. per acre post-emergence, not to exceed a total of 1.5 lbs. per acre per year".

IMPORTANT: The PWC-PT date assignment algorithm currently relies on application rates being provided from highest to lowest to ensure conservatism. When specifying the rate-specific parameters, enter rates from highest to lowest application rates. For example, *Rate1_MaxAppRate* should always be greater than or equal to *Rate2_MaxAppRate*, etc.

Table 4 shows how to set up the APT parameters based on label language for different restrictions.

Table 4: How to set up the APT based on label language

Example Label Language	How to translate into APT
Do not exceed more than 2 applications in a year	*MaxAnnNumApps* = 2
Applications can only be made during post-emergence	*Ratex_PostEmergenceMRI* = MRI value Leave *Ratex_PreEmergenceMRI* blank
No more than 5 applications can be made during pre-emergence	*PreEmergence_MaxNumApps* = 5
This set of restrictions corresponds to states west of the Rocky Mountains	*States* column entry = West of Rockies See **States Field Convention** for more info
Restrictions for a single use vary based on state	Make a new row in the APT for each state or set of states with the same restrictions
e.g., Corn: No more than 2 applications prior to tassel push. Earliest 1st application can be at 1-2 leaf stage, then second application can be 5-7 days later	Use multiple rates with a rate-specific-instruction for each specifying the time window. See **Appendix 2: Rate-Specific Instructions** for more info.

The scenario specified in the agronomic practices table is selected via drop down menu and the available options differ for FIFRA and ESA modeling. The PWC-PT utilizes the scenario files to determine the emergence date and harvest dates, or rather, a lookup table that has been derived from the scenario files. This lookup table, called "Scenario_EmergHarv_Dates.csv" is downloaded to and must remain in %USERPROFILE%\PWC-PT\data\. For FIFRA runs, there are three Koc variations, which can result in different emergence and harvest dates. The PWC-PT automatically decides the appropriate Koc variation based on the "SorptionCoefficient(mL/g)" and "kocflag" field in the Chemical Properties input table. If the "kocflag" is TRUE, the "SorptionCoefficient(mL/g)" field value is equal to the koc, and is categorized into one of the three koc variations (under 100; A, 100-3000: B, over 3000; C). If the "kocflag" is FALSE, the koc value is calculated as the "SorptionCoefficient(mL/g)" field multiplied by 100 and divided by 5 (assuming 5% soil organic carbon). Therefore, it is recommended to enter the "SorptionCoefficient(mL/g)" field as the koc value and specify "kocflag" to TRUE in the chemical properties table.

AgDRIFT Reduction Table

The AgDRIFT Reduction table is a lookup table that maps a drift profile to a corresponding drift reduction factor and efficiency value. The drift profile (e.g., A-F-M; Aerial (fine to medium)) is entered for each use in the APT (via drop down menu). The drift reduction value depends on the waterbody scenario (bin), application method, and setback distance. Table 5 below shows the default drift reduction table that comes with installation of the PWC-PT. AgDRIFT® (version 2.1.1) was used to generate the reduction values for each setback distance, as per EPA's current convention[2].

Table 5: Default Drift Reduction Table

Profile	Description	Efficiency	000m	030m	060m	090m	120m	150m
4-A-VF-F	Bin 4 - Aerial (Very Fine to Fine)	0.95	0.25828	0.15828	0.11262	0.08860	0.07420	0.06454
4-A-F-M	**Bin 4 - Aerial (Fine to Medium), EPA Default**	0.95	0.13490	0.05608	0.03444	0.02558	0.02070	0.01782
4-A-M-C	Bin 4 - Aerial (Medium to Coarse)	0.95	0.09654	0.03025	0.01704	0.01196	0.00961	0.00828
4-A-C-VC	Bin 4 - Aerial (Coarse to Very Coarse)	0.95	0.07574	0.01888	0.01025	0.00729	0.00585	0.00501
4-AB-N	Bin 4 - Airblast (Normal; Stone, Pome, Vinyard)	0.99	0.00122	0.00037	0.00023	0.00012	0.00010	0.00009
4-AB-D	Bin 4 - Airblast (Dense; Citrus, Tall Trees)	0.99	0.01653	0.00340	0.00190	0.00138	0.00104	0.00090
4-AB-SP	**Bin 4 - Airblast (Sparse: young, dormant), EPA Default**	0.99	0.04807	0.00366	0.00115	0.00060	0.00036	0.00023
4-AB-VI	Bin 4 - Airblast (Vineyard)	0.99	0.00264	0.00038	0.00023	0.00012	0.00009	0.00007
4-AB-ORC	Bin 4 - Airblast (Orchard)	0.99	0.02495	0.00349	0.00179	0.00117	0.00093	0.00069
4-AB-AP	Bin 4 - Airblast (Apples)	0.99	0.00091	0.00037	0.00023	0.00022	0.00012	0.00011
4-AB-APd	Bin 4 - Airblast (Apples Dormant)	0.99	0.07281	0.00295	0.00067	0.00026	0.00012	0.00009
4-AB-OR	Bin 4 - Airbast (Oranges)	0.99	0.01222	0.00157	0.00084	0.00048	0.00036	0.00033
4-AB-AL	Bin 4 - Airblast (Almond)	0.99	0.00697	0.00067	0.00025	0.00012	0.00008	0.00006
4-AB-GR-W	Bin 4 - Airblast (Grape, wrap around sprayer)	0.99	0.00040	0.00012	0.00008	0.00006	0.00005	0.00004
4-AB-GR	Bin 4 - Airblast (Grape)	0.99	0.00264	0.00038	0.00023	0.00012	0.00009	0.00007
4-AB-P	Bin 4 - Airblast (Pecans)	0.99	0.02443	0.00539	0.00318	0.00231	0.00194	0.00159
4-G-HB-VF-F	**Bin 4 - Ground (high boom, VF to Fine), EPA Default**	0.99	0.06610	0.01441	0.00855	0.00586	0.00431	0.00335
4-G-LB-VF-F	Bin 4 - Ground (Low boom, VF to Fine)	0.99	0.02723	0.00604	0.00387	0.00290	0.00230	0.00194
4-G-HB-F-MC	Bin 4 - Ground (High boom, Fine to M/C))	0.99	0.01662	0.00457	0.00315	0.00232	0.00184	0.00149
4-G-LB-F-MC	Bin 4 - Ground (Low boom, Fine to M/C)	0.99	0.01082	0.00299	0.00210	0.00162	0.00137	0.00114
4-NODRIFT	Bin 4 - No Drift	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7-A-VF-F	Bin 7 - Aerial (Very Fine to Fine)	0.95	0.2421	0.1455	0.1033	0.0812	0.0677	0.0588
7-A-F-M	**Bin 7 - Aerial (Fine to Medium), EPA Default**	0.95	0.1254	0.0508	0.0318	0.0234	0.0189	0.0162
7-A-M-C	Bin 7 - Aerial (Medium to Coarse)	0.95	0.0885	0.0274	0.0156	0.0109	0.0087	0.0075
7-A-C-VC	Bin 7 - Aerial (Coarse to Very Coarse)	0.95	0.0681	0.0169	0.0094	0.0067	0.0054	0.0045
7-AB-N	Bin 7 - Airblast (Normal; Stone, Pome, Vinyard)	0.99	0.0011	0.0003	0.0002	0.0001	0.00010	0.00008
7-AB-D	Bin 7 - Airblast (Dense; Citrus, Tall Trees)	0.99	0.0145	0.0030	0.0017	0.0012	0.0010	0.0008
7-AB-SP	**Bin 7 - Airblast (Sparse: young , dormant), EPA Default**	0.99	0.0416	0.0032	0.0011	0.0005	0.00030	0.00020
7-AB-VI	Bin 7 - Airblast (Vineyard)	0.99	0.0024	0.0004	0.0002	0.0001	0.00009	0.00007
7-AB-ORC	Bin 7 - Airblast (Orchard)	0.99	0.0218	0.0031	0.0016	0.0011	0.0008	0.0007
7-AB-AP	Bin 7 - Airblast (Apples)	0.99	0.0008	0.0004	0.0002	0.0002	0.0001	0.0001
7-AB-APd	Bin 7 - Airblast (Apples Dormant)	0.99	0.0631	0.0024	0.0006	0.0003	0.0001	0.00008
7-AB-OR	Bin 7 - Airbast (Oranges)	0.99	0.0107	0.0014	0.0007	0.0005	0.0004	0.0003
7-AB-AL	Bin 7 - Airblast (Almond)	0.99	0.0061	0.0006	0.0002	0.0001	0.00008	0.00005
7-AB-GR-W	Bin 7 - Airblast (Grape, wrap around sprayer)	0.99	0.0004	0.0001	0.00008	0.00006	0.00005	0.00004
7-AB-GR	Bin 7 - Airblast (Grape)	0.99	0.0024	0.0004	0.0002	0.0001	0.00009	0.00007
7-AB-P	Bin 7 - Airblast (Pecans	0.99	0.0216	0.0049	0.0029	0.0021	0.00170	0.00150

[2] *USEPA, 2013. Guidance on Modeling Offsite Deposition of Pesticides Via Spray Drift for Ecological and Drinking Water Assessment*. Environmental Fate and Effects Division, Office of Pesticide Programs of the U.S. Environmental Protection Agency. November 2013. EPA-HQ-OPP-2013-0676

7-G-HB-VF-F	**Bin 7 - Ground (high boom, VF to Fine), EPA Default**	0.99	0.0616	0.0131	0.00790	0.00540	0.00400	0.00310
7-G-LB-VF-F	Bin 7 - Ground (Low boom, VF to Fine)	0.99	0.0268	0.0055	0.00360	0.00270	0.00210	0.00180
7-G-HB-F-MC	Bin 7 - Ground (High boom, Fine to M/C))	0.99	0.0165	0.0042	0.0029	0.0022	0.0017	0.0014
7-G-LB-F-MC	Bin 7 - Ground (Low boom, Fine to M/C)	0.99	0.0109	0.0028	0.0019	0.0015	0.0012	0.0010
7-NODRIFT	Bin 7 - No Drift	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10-A-VF-F	Bin 10 - Aerial (Very Fine to Fine)	0.95	0.2421	0.1455	0.1033	0.0812	0.0677	0.0588
10-A-F-M	**Bin 10 - Aerial (Fine to Medium), EPA Default**	0.95	0.1254	0.0508	0.0318	0.0234	0.0189	0.0162
10-A-M-C	Bin 10 - Aerial (Medium to Coarse)	0.95	0.0885	0.0274	0.0156	0.0109	0.0087	0.0075
10-A-C-VC	Bin 10 - Aerial (Coarse to Very Coarse)	0.95	0.0681	0.0169	0.0094	0.0067	0.0054	0.0045
10-AB-N	Bin 10 - Airblast (Normal; Stone, Pome, Vinyard)	0.99	0.0011	0.0003	0.0002	0.0001	0.00010	0.00008
10-AB-D	Bin 10 - Airblast (Dense; Citrus, Tall Trees)	0.99	0.0145	0.0030	0.0017	0.0012	0.0010	0.0008
10-AB-SP	**Bin 10 - Airblast (Sparse: young , dormant), EPA Default**	0.99	0.0416	0.0032	0.0011	0.0005	0.00030	0.00020
10-AB-VI	Bin 10 - Airblast (Vineyard)	0.99	0.0024	0.0004	0.0002	0.0001	0.00009	0.00007
10-AB-ORC	Bin 10 - Airblast (Orchard)	0.99	0.0218	0.0031	0.0016	0.0011	0.0008	0.0007
10-AB-AP	Bin 10 - Airblast (Apples)	0.99	0.0008	0.0004	0.0002	0.0002	0.0001	0.0001
10-AB-APd	Bin 10 - Airblast (Apples Dormant)	0.99	0.0631	0.0024	0.0006	0.0003	0.0001	0.00008
10-AB-OR	Bin 10 - Airbast (Oranges)	0.99	0.0107	0.0014	0.0007	0.0005	0.0004	0.0003
10-AB-AL	Bin 10 - Airblast (Almond)	0.99	0.0061	0.0006	0.0002	0.0001	0.00008	0.00005
10-AB-GR-W	Bin 10 - Airblast (Grape, wrap around sprayer)	0.99	0.0004	0.0001	0.00008	0.00006	0.00005	0.00004
10-AB-GR	Bin 10 - Airblast (Grape)	0.99	0.0024	0.0004	0.0002	0.0001	0.00009	0.00007
10-AB-P	Bin 10 - Airblast (Pecans	0.99	0.0216	0.0049	0.0029	0.0021	0.00170	0.00150
10-G-HB-VF-F	**Bin 10 - Ground (high boom, VF to Fine), EPA Default**	0.99	0.0616	0.0131	0.00790	0.00540	0.00400	0.00310
10-G-LB-VF-F	Bin 10 - Ground (Low boom, VF to Fine)	0.99	0.0268	0.0055	0.00360	0.00270	0.00210	0.00180
10-G-HB-F-MC	Bin 10 - Ground (High boom, Fine to M/C))	0.99	0.0165	0.0042	0.0029	0.0022	0.0017	0.0014
10-G-LB-F-MC	Bin 10 - Ground (Low boom, Fine to M/C)	0.99	0.0109	0.0028	0.0019	0.0015	0.0012	0.0010
10-NODRIFT	Bin 10 - No Drift	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Chemical Properties

The chemical properties table (*Default_ChemicalProperties.csv*) is a lookup table that specifies fate and transport parameters for the active ingredient. The user must alter the version of this table that comes with the PWC-PT installation or duplicate it and create a new version. See a full example of the Ingredient Fate Parameters Table in Table 6**.**

Table 6: Example chemical properties table

Parameter	Value
SorptionCoefficient (mL/g)	46
kocflag	TRUE
WaterColumnMetabolismHalflife (day)	6.2
WaterReferenceTemperature (C)	20
BenthicMetabolismHalflife (day)	39
BenthicReferenceTemperature (C)	20
AqueousPhotolysisHalflife (day)	50
PhotolysisReferenceLatitude (?)	40
HydrolysisHalflife (days)	266
SoilHalflife (days)	30.42
SoilReferencerTemperature (C)	25
FoliarHalflife (day)	3
MolecularWeight (g/mol)	162.2
VaporPressure (torr)	5.20E-06
Solubility (mg/L)	5.50E+04
Henry's Constant (unitless)	0

Parameter	Value
Air Diffusion (cm3/d)	0.01
Heat of Henry (J/mol)	0.001

Note that you must enter the kocflag value as TRUE or FALSE.

Wettest Month Table

The wettest month table lists the months (January through December) in order from wettest to driest for each hydrologic unit code level 2 (HUC2). The wettest month table is shown below as Table 7. The rows represent the HUC2 regions. The columns are the wettest month rankings from wettest to driest. The values correspond to the month number (e.g., January = 1, February = 2, etc.). For example, the 5th wettest month in HUC 10a is August. This table was developed using the .dvf weather files that represent each HUC. The wettest month table is utilized by the PWC-PT in .csv format.

Table 7: Wettest Month Table

HUC2	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
1	11	5	4	9	12	6	8	3	10	2	1	7
2	7	5	10	8	6	3	2	9	11	12	4	1
3	3	2	7	1	4	12	5	11	6	8	9	10
4	4	8	9	7	6	5	3	11	10	12	2	1
5	5	3	7	6	4	11	8	12	2	9	10	1
6	3	7	12	2	1	5	6	11	4	9	8	10
7	6	8	7	5	9	4	10	3	11	12	2	1
8	7	2	8	4	12	9	1	5	3	6	11	10
9	6	7	5	8	9	4	10	3	11	1	12	2
10a	6	5	9	7	8	4	3	10	11	2	12	1
10b	5	6	4	9	10	3	7	11	8	1	12	2
11a	5	11	4	3	10	6	9	12	7	8	2	1
11b	6	8	7	5	9	10	4	3	11	2	1	12
12a	5	4	10	9	6	3	2	11	7	8	12	1
12b	9	5	6	8	10	7	4	11	3	2	12	1
13	9	8	7	10	6	12	2	11	1	3	5	4
14	5	4	9	6	7	3	8	10	2	11	12	1
15a	7	8	3	12	2	9	1	11	10	4	5	6
15b	12	8	9	3	7	2	11	1	10	4	6	5
16a	4	3	5	10	12	2	11	9	1	6	8	7
16b	11	6	12	4	5	3	1	2	10	8	9	7
17a	12	11	1	2	3	10	4	5	9	6	8	7
17b	5	3	4	11	12	6	1	2	10	9	8	7
18a	1	2	11	3	12	4	10	9	5	6	8	7
18b	1	3	2	12	11	4	10	9	5	8	6	7
19a	7	6	8	9	5	10	11	12	1	2	4	3
19b	8	9	7	10	6	12	11	4	5	2	3	1
20a	4	11	3	12	2	5	1	7	10	8	9	6
20b	12	1	11	2	10	3	4	5	9	7	6	8
21	11	5	10	9	8	12	7	6	4	1	2	3

The user will never need to alter the wettest month table, but rather only enter it as an input file. For this reason, the wettest month table will likely be hardcoded into the PWC-PT in the future.

Application Date Assignment Algorithm

Overview

A large part of the PWC Prep Tool is the application assignment algorithm. For a given PWC model run, the application dates and corresponding application rates must be specified in the batch input file. Determining the application dates and rates can be difficult in some cases due to complex label restrictions. For example, the maximum annual number of apps must not be exceeded, and the applications must be made during the appropriate interval (e.g., post-emergence). Conservatism is also necessary to account for realistic worst-case scenarios.

The date assignment algorithm is effectively a set of sequential logical decisions. This section describes user-controlled parameters that influence the algorithm's behavior as well as details the algorithm's logic. Then, examples of the application assignment algorithm are presented.

Conservatism

It is important to ensure conservatism during regulatory PWC modeling. For example, the maximum annual amount and highest application rates should be simulated so that the "realistic worst-case" modeled aquatic concentration is represented. If the ESA assessment type is selected, the wettest month prioritization can be turned on or off by the user. When turned on, the algorithm will prioritize applications during wetter months of the year. The PWC-PT application date assignment algorithm is designed to ensure conservatism is maximized, ensuring as many applications at the highest application rates are simulated.

Date Assignment Parameters

The user has some ability to configure the date assignment process. This flexibility takes the form of three parameters.

Wettest Month Prioritization

For ESA modeling, the user can turn on or off wettest month prioritization. This option is not available for FIFRA modeling. When wettest month prioritization is turned on, the algorithm will read the wettest months table to get a list of months from wettest to driest corresponding to the HUC2. Applications will be prioritized in the wettest months possible based on other agronomic restrictions.

Application Date Prioritization

For ESA modeling, with wettest month prioritization turned on: in some very uncommon cases, the maximum application rate and the wettest months cannot both be prioritized to the fullest degree of conservatism. This can only happen when there are multiple rates parameterized in the Agronomic Practices Table for a given use and those rates are valid in different pre/post emergence categories.

For example, say rate 1 has a higher application rate than rate 2, but rate 1 is only valid for post-emergence and post-emergence is in drier months than pre-emergence months. In this case, the user must prioritize either the maximum application rate or application during the wettest months. This decision is made by setting the App. Date Prioritization parameter to "Max. App. Rate" or "Wettest Month". In this example, setting the option to "Max. App. Rate" will make applications using rate 1 first before making applications using rate 2 (even though applications with rate 1 will be made during post-emergence, which are not the wettest months). Setting the option to "Wettest Month" will make applications using rate 2 (the lower rate) first in the wetter months of the year.

Another example of the significance of the "App. Date Prioritization" parameter is presented in Example 4 – Rate Limits and Rate Special Instructions**.**

Random Start Dates and Random Seed

By default, the first valid date of the month is utilized as the start date in a series of applications. For example, if applications can only be made during post-emergence and the emergence date is June 15th, then the first valid date of the month is June 15th (assuming no other restrictions). If the random start

dates box is checked, a random date within the month will be used as the start date (followed by subsequent applications in a series according to the MRI). For example, this would result in a random date being selected between June 15th and June 30th. Note that label restrictions specified in the Agronomic Practices Table are still followed regardless of whether this parameter is turned on or off. If the "Random Start Dates" is turned on, the user can specify a random seed (this can be an integer or a string) to reproduce the same results in a proceeding execution of the PWC-PT.

Algorithm Logic

High Level Overview

Iterate through each day (date) in the year (if wettest month prioritization is on, changes sorting)

- Prepare the first application in a series
  - Get the starting application date
  - Get the starting application rate
- Make subsequent applications in the series if the following conditions are true, otherwise return to outer loop
  - *Date is valid*
  - *Rate is valid*
  - *Annual limits are not exceeded*
  - *Interval limits (pre/post emergence) are not exceeded*
- After first valid start date, prepare the next application in a series
  - Get the next application date
  - Get the next application rate

Iterate through each date in a year

The outer loop of the algorithm is a list of potential application dates. This list contains all dates within the year that is sorted either sequentially or based on the wettest months (if ESA and wettest months prioritization is turned on). The algorithm will return to this outer loop anytime that another application date in a series is not valid, but applications can still be made.

Prepare the first application in a series

Get the starting application date

Application dates are assigned by first defining a start date, then defining the remaining applications of a series. There may be one or more series of applications that comprise all applications modeled within a given year (PWC run). The first application in a series is the start date, which is the first valid date during the outer loop iteration.

Get the starting application rate

For each application, there must be an application rate. The PWC-PT allows the user to specify up to four unique rates for each run descriptor (*RunDescriptor* field in the APT). The application rate for the starting application will be the highest rate that is suitable (valid) for that date.

Make subsequent applications if the following conditions are true

If the following conditions are met, then another application can be made following the start date (first application in a series). Otherwise, the algorithm returns to the outer loop.

Application Date is Valid

An application date is valid if several conditions are met. These include:

1. The interval (i.e., pre-emergence or post-emergence) corresponding to the application date is in a valid interval for the unique application rate
2. The rate-specific instructions are satisfied
3. The application date is not within the MRI of another application date

4. The pre-harvest interval (PHI) is not encroached

Application Rate is Valid

An application rate is valid if the rate-specific number of applications is not exhausted. If all rates are exhausted, then no more applications can be made.

Annual Limits are not Exceeded

Applications can be made if the annual limits are not exceeded. That is, the maximum number of applications are not exceeded, and the maximum annual amount is not exceeded.

Interval Limits are not Exceeded

Applications can be made if the interval limits (i.e., pre-emergence or post-emergence) are not exceeded.

Prepare the next application in a series

Following a valid start date, a series is initiated. Then, a subsequent application in a series is tested for validity. Subsequent applications are made until no more applications can be made.

Prepare the next application date in a series

The algorithm will first try to forward assign the next application date in a series based on the MRI. That is, if the start date is on June 15th, the next date in a series will be June 15th plus the number of days equal to the MRI. For example, if the MRI is 10 days, the next application date would be Jun 25th. This date is checked for validity just like the start date, to ensure that it complies with the label. If it is a valid date, and all other restrictions are met, it is assigned.

If it is not valid (e.g., the next forward date is outside of the post-emergence interval), then the algorithm will try to reverse assign. In this case, the next application date will be equal to the start date minus the MRI. If the resulting date is also not valid, but the annual limits are not exceeded, the algorithm will continue with the outer iteration and determine a new start date for a unique series.

Prepare the next application rate in a series

The application rate corresponding to the next application date in a series is determined the same way as the rate corresponding to the starting application rate.

Algorithm Examples

The following examples demonstrate how the algorithm manages different situations. Each example highlights a unique part of the application assignment logic.

Example 1 – FIFRA, Sorghum, Annual Limits

This example assigns applications for sorghum using the FIFRA scenario files and HUC2 convention while also highlighting the annual limits as a limiting factor. The agronomic restrictions for sorghum (which is a row in Agronomic Practices Table) are shown below in Table 8. The maximum annual amount is 0.9 lb./acre, and the maximum annual number of apps is 2. There are no interval (pre- and post-emergence) restrictions (note they are blank). There is only one application rate specified, which is rate 1 at a maximum of 0.45 lb./acre. This rate is only valid in the post-emergence interval (applications can only be made during post-emergence) as denoted by the "Rate1_PostEmergenceMRI" field specified as 5. Applications cannot be made during pre-emergence as the "Rate1_PreEmergenceMRI" field is blank. There are no restrictions on the number of applications for rate 1 and no rate-specific restrictions.

Table 8: Agronomic practices information, algorithm example 1

RunDescriptor	Sorghum_aerial
LabeledUse	SORGHUM, GRAIN
ApplicationMethod	2
Scenario	Other grains or corn

States	All
DriftProfile	A-F-M
MaxAnnAmt	0.9 lb./acre (1.01 kg/ha)
MaxAnnNumApps	2
PHI	14
PreEmergence_MaxAmt	
PreEmergence_MaxNumApps	
PostEmergence_MaxAmt	
PostEmergence_MaxNumApps	
Rate1_MaxAppRate	0.45 lb./acre (0.5 kg/ha)
Rate1_MaxNumApps	
Rate1_PreEmergenceMRI	
Rate1_PostEmergenceMRI	5
Rate1_Instructions	
Rate2_MaxAppRate	
Rate2_MaxNumApps	
Rate2_PreEmergenceMRI	
Rate2_PostEmergenceMRI	
Rate2_Instructions	
Rate3_MaxAppRate	
Rate3_MaxNumApps	
Rate3_PreEmergenceMRI	
Rate3_PostEmergenceMRI	
Rate3_Instructions	
Rate4_MaxAppRate	
Rate4_MaxNumApps	
Rate4_PreEmergenceMRI	
Rate4_PostEmergenceMRI	
Rate4_Instructions	

Information derived from the agronomic restrictions (Table 9) includes the HUC2 that corresponds to the states specified, the emergence and harvest date for the scenario, and the rate specific information. Note the HUC2 for this example is 02. All relevant information utilized for each run is written in the output log file.

Table 9: Information derived from the agronomic practices table, algorithm example 1

HUC2	02
Emergence	5/17
Harvest	10/7
Rate1_ValidIntervals	Post-Emergence
Rate1_instr_startdate	
Rate1_instr_enddate	
Rate1_instr_timeframe	
Rate2_ValidIntervals	
Rate2_instr_startdate	
Rate2_instr_enddate	
Rate2_instr_timeframe	
Rate3_ValidIntervals	
Rate3_instr_startdate	
Rate3_instr_enddate	

Rate3_instr_timeframe	
Rate4_ValidIntervals	
Rate4_instr_startdate	
Rate4_instr_enddate	
Rate4_instr_timeframe	

The algorithm starts by listing all potential application dates in the year. In this example, 5/17 (the emergence date) is the first valid application date (applications for rate 1 can only be made in post-emergence), and as a result, is the start date in a series of applications. The next applications in the series are forwards assigned (Table 10) based on the MRI, which is 5, until the maximum annual restrictions are reached. The maximum annual amount of 2 applications is reached and no more applications can be made.

Table 10: Application dates and rates for algorithm example 1

Application Date	Amount Applied
05-17	0.45 lb./acre (0.5 kg/ha)
05-22	0.45 lb./acre (0.5 kg/ha)

Table 11 shows the total number of applications and amount applied for the year, each interval, and each rate. There were 2 applications made in total, and both were within the post-emergence interval and with rate 1.

Table 11: Application results for algorithm example 1

Category	Number of Apps	Amount Applied
Annual	2	0.9 lb./acre (1.01 kg/ha)
Pre-Emergence	0	0
Post-Emergence	2	0.9 lb./acre (1.01 kg/ha)
Rate1	2	0.9 lb./acre (1.01 kg/ha)
Rate2	0	0
Rate3	0	0
Rate4	0	0

Example 2 – ESA, Sorghum, Wettest Month Prioritizations

This example is similar to example 1 but focuses on sorghum for ESA PWC modeling. This example demonstrates the wettest month prioritization that can be optionally turned on within the PWC-PT for ESA model runs. For the purposes of demonstration, this example has the same restrictions as example 1 (see Table 12). However, note the difference in the scenario value from example 1 due to using the OtherGrainESA scenario files.

Table 12: Agronomic practices information, algorithm example 2

RunDescriptor	Sorghum_aerial
LabeledUse	SORGHUM, GRAIN
ApplicationMethod	2
Scenario	OtherGrainESA
States	All
DriftProfile	A-F-M
MaxAnnAmt	0.9 lb./acre (1.01 kg/ha)
MaxAnnNumApps	2
PHI	14

PreEmergence_MaxAmt	
PreEmergence_MaxNumApps	
PostEmergence_MaxAmt	
PostEmergence_MaxNumApps	
Rate1_MaxAppRate	0.45 lb./acre (0.5 kg/ha)
Rate1_MaxNumApps	
Rate1_PreEmergenceMRI	
Rate1_PostEmergenceMRI	5
Rate1_Instructions	
Rate2_MaxAppRate	
Rate2_MaxNumApps	
Rate2_PreEmergenceMRI	
Rate2_PostEmergenceMRI	
Rate2_Instructions	
Rate3_MaxAppRate	
Rate3_MaxNumApps	
Rate3_PreEmergenceMRI	
Rate3_PostEmergenceMRI	
Rate3_Instructions	
Rate4_MaxAppRate	
Rate4_MaxNumApps	
Rate4_PreEmergenceMRI	
Rate4_PostEmergenceMRI	
Rate4_Instructions	

Table 13 shows information derived from the agronomic restrictions, including the HUC, emergence date, harvest date, and rate-specific information. Note that the emergence and harvest dates are different from example 1 because of the difference in scenario files.

Table 13: Information derived from the agronomic practices table, algorithm example 2

HUC2	2
Emergence	4/16
Harvest	11/1
Rate1_ValidIntervals	Post-Emergence
Rate1_instr_startdate	
Rate1_instr_enddate	
Rate1_instr_timeframe	
Rate2_ValidIntervals	
Rate2_instr_startdate	
Rate2_instr_enddate	
Rate2_instr_timeframe	
Rate3_ValidIntervals	
Rate3_instr_startdate	
Rate3_instr_enddate	
Rate3_instr_timeframe	
Rate4_ValidIntervals	
Rate4_instr_startdate	
Rate4_instr_enddate	
Rate4_instr_timeframe	

In this example, the wettest months prioritization is turned on. The wettest month table for HUC17a is shown in Table 14.

Table 14: Wettest month table for HUC 2, algorithm example 2

Wettest Month Rank	Month
1st	7
2nd	5
3rd	10
4th	8
5th	6
6th	3
7th	2
8th	9
9th	11
10th	12
11th	4
12th	1

Unlike in example 1, the algorithm starts the outer loop iteration from July 1st and progresses through July, May, October, etc., until it reaches the first valid application date. In this case, 7/1 is the first valid application date, because it is in the post emergence interval. Had the wettest month parameter been turned off, the first application would have been made on 4/16 (the emergence date) and the second five days later.

Table 15: Application dates and rates for algorithm example 2

Application Date	Amount Applied
07-01	0.45 lb./acre (0.5 kg/ha)
07-06	0.45 lb./acre (0.5 kg/ha)

The resulting applications totals displayed in Table 16 are the same as example 1. However, the application dates are different.

Table 16: Application results for algorithm example 2

Category	Number of Apps	Amount Applied
Annual	2	0.9 lb./acre (1.01 kg/ha)
Pre-Emergence	0	0
Post-Emergence	2	0.9 lb./acre (1.01 kg/ha)
Rate1	2	0.9 lb./acre (1.01 kg/ha)
Rate2	0	0
Rate3	0	0
Rate4	0	0

Example 3 – Interval Limits

This example highlights the relevance of interval limits, or pre- and post-emergence maximum amount and maximum number of applications. The agronomic restrictions for this example are shown in Table 17. Note the value of 3 for "PreEmergence_MaxNumApps" which restrictions the number of applications that can be made in the pre-emergence interval to 3. Also note that both pre- and post-

emergence are valid for Rate 1 because a value of 5 is entered for both “Rate1_PreEmergenceMRI” and “Rate1_PostEmergenceMRI”.

Table 17: Agronomic practices information, algorithm example 3

RunDescriptor	Example 3
LabeledUse	Example 3
ApplicationMethod	Example 3
Scenario	Vegetable fresh or processing market
States	All
DriftProfile	A-F-M
MaxAnnAmt	10 lb./acre (11.2 kg/ha)
MaxAnnNumApps	5
PHI	6
PreEmergence_MaxAmt	
PreEmergence_MaxNumApps	**3**
PostEmergence_MaxAmt	
PostEmergence_MaxNumApps	
Rate1_MaxAppRate	2 lb./acre (2.2 kg/ha)
Rate1_MaxNumApps	
Rate1_PreEmergenceMRI	**5**
Rate1_PostEmergenceMRI	5
Rate1_Instructions	
Rate2_MaxAppRate	
Rate2_MaxNumApps	
Rate2_PreEmergenceMRI	
Rate2_PostEmergenceMRI	
Rate2_Instructions	
Rate3_MaxAppRate	
Rate3_MaxNumApps	
Rate3_PreEmergenceMRI	
Rate3_PostEmergenceMRI	
Rate3_Instructions	
Rate4_MaxAppRate	
Rate4_MaxNumApps	
Rate4_PreEmergenceMRI	
Rate4_PostEmergenceMRI	
Rate4_Instructions	

The derived information (Table 18) indicates the HUC2 is 01 and the scenario corresponds to an emergence date of 6/9 and a harvest date of 9/30.

Table 18: Information derived from the agronomic practices table, algorithm example 3

HUC2	01
Emergence	6/9
Harvest	9/30
Rate1_ValidIntervals	Pre-Emergence, Post-Emergence
Rate1_instr_startdate	
Rate1_instr_enddate	
Rate1_instr_timeframe	

Rate2_ValidIntervals	
Rate2_instr_startdate	
Rate2_instr_enddate	
Rate2_instr_timeframe	
Rate3_ValidIntervals	
Rate3_instr_startdate	
Rate3_instr_enddate	
Rate3_instr_timeframe	
Rate4_ValidIntervals	
Rate4_instr_startdate	
Rate4_instr_enddate	
Rate4_instr_timeframe	

The resulting applications are shown in Table 19. Note that the first three applications are made in the pre-emergence interval. However, once the pre-emergence limit of three applications are reached, the remaining applications are made in the post-emergence interval.

Table 19: Application dates and rates for algorithm example 3

Date	Amount Applied
01/01	2 lb./acre (2.2 kg /ha)
01/06	2 lb./acre (2.2 kg /ha)
01/11	2 lb./acre (2.2 kg /ha)
06/09	2 lb./acre (2.2 kg /ha)
06/14	2 lb./acre (2.2 kg /ha)

The resulting totals are displayed in Table 20.

Table 20: Application results for algorithm example 3

Category	Number of Apps	Amount Applied
Annual	5	10 lb./acre (11.2 kg/ha)
Pre-Emergence	3	6 lb./acre (6.7 kg/ha)
Post-Emergence	2	4 lb./acre (4.5 kg/ha)
Rate1	5	10 lb./acre (11.2 kg/ha)
Rate2	0	0
Rate3	0	0
Rate4	0	0

Example 4 – Rate Limits and Rate Special Instructions

This example highlights rate-specific limits and special instructions. Sometimes, a label will specify more than one potential application rate, each with their own application rate and maximum number of applications. Rate-specific special instructions can also be specified, allowing the user to restrict or prohibit applications within certain time windows.

In this example there are three unique potential application rates of 5, 4, and 3 lb./acre (Table 21). However, rates one (5 lb./acre) and two (4 lb./acre) also have a specified maximum number of applications and unique special instructions. The special instructions for rate one are denoted as "Y_E-30", which means applications at this rate can only be made in the 30 days leading up to the emergence date. Similarly, rate two special instructions are Y_E+30, meaning applications at this rate can only be made in the 30 days following the emergence date. See **Appendix 2: Rate-Specific Instructions** for more information about the rate-specific special instructions convention.

Table 21: Agronomic practices information, algorithm example 4

RunDescriptor	Example 4
LabeledUse	Example 4
ApplicationMethod	Example 4
Scenario	Example 4
States	Example 4
DriftProfile	Example 4
MaxAnnAmt	20 lb./acre (22.4 kg/ha)
MaxAnnNumApps	5
PHI	3
PreEmergence_MaxAmt	
PreEmergence_MaxNumApps	
PostEmergence_MaxAmt	
PostEmergence_MaxNumApps	
Rate1_MaxAppRate	5 lb./acre (5.6 kg/ha)
Rate1_MaxNumApps	1
Rate1_PreEmergenceMRI	5
Rate1_PostEmergenceMRI	
Rate1_Instructions	Y_E-30
Rate2_MaxAppRate	4 lb./acre (4.5 kg/ha)
Rate2_MaxNumApps	2
Rate2_PreEmergenceMRI	
Rate2_PostEmergenceMRI	10
Rate2_Instructions	Y_E+30
Rate3_MaxAppRate	3 lb./acre (3.4 kg/ha)
Rate3_MaxNumApps	
Rate3_PreEmergenceMRI	5
Rate3_PostEmergenceMRI	5
Rate3_Instructions	
Rate4_MaxAppRate	
Rate4_MaxNumApps	
Rate4_PreEmergenceMRI	
Rate4_PostEmergenceMRI	
Rate4_Instructions	

Table 22 shows the derived information. Note that this example uses an emergence and harvest date that reflect an overwinter crop, as the emergence date is later in the year than the harvest date. The start date and end date for the rate-specific restriction intervals are included. For example, applications made with rate 1 must be made between 9/15 and 10/15 (the 30 days leading up to emergence.

Table 22: Information derived from the agronomic practices table, algorithm example 4

HUC2	17a
Emergence	10/15
Harvest	7/15
Rate1_ValidIntervals	Pre-Emergence
Rate1_instr_startdate	9/15
Rate1_instr_enddate	10/15
Rate1_instr_timeframe	Y
Rate2_ValidIntervals	Post-Emergence
Rate2_instr_startdate	10/15
Rate2_instr_enddate	11/14

Rate2_instr_timeframe	Y
Rate3_ValidIntervals	Pre-Emergence, Post-Emergence
Rate3_instr_startdate	
Rate3_instr_enddate	
Rate3_instr_timeframe	
Rate4_ValidIntervals	
Rate4_instr_startdate	
Rate4_instr_enddate	
Rate4_instr_timeframe	

This example is for ESA and has the wettest month prioritization turned on. The wettest months for HUC 17a are showed in *Table 23*.

Table 23: Wettest month table for HUC 17a, algorithm example 4

Wettest Month Rank	Month
1st	12
2nd	11
3rd	1
4th	2
5th	3
6th	10
7th	4
8th	5
9th	9
10th	6
11th	8
12th	7

In this example, there is a different outcome depending on whether wettest months or maximum application rate is prioritized (Table 24 and Table 25). This is the "Application Date Prioritization" parameter in the GUI and you can learn more about it in the section: Application Date Prioritization.

When wettest months are prioritized, only rate 3 is used as it is valid for the first potential application date (Dec 1st). Rate two (4 lbs./acre) is also valid for the post-emergence interval, but the rate-specific restrictions limit the use of this rate to between 10/15 and 11/14 (Table 22), so it is not valid on December 1st. Rate three is used for the remaining applications until the maximum annual number of applications is reached.

Table 24: Application results for algorithm example 4, wettest month prioritization

Date	Amount Applied
12-01	3 lb./ac (3.4 kg/ha)
12-06	3 lb./ac (3.4 kg/ha)
12-11	3 lb./ac (3.4 kg/ha)
12-16	3 lb./ac (3.4 kg/ha)
12-21	3 lb./ac (3.4 kg/ha)

When the maximum application rate is prioritized, the highest rate (rate one) is utilized first, then rate two, then finally rate three (Table 25). Rate one is limited to one application only, and rate two is limited to two applications.

Table 25: Application results for algorithm example 4, maximum rate prioritization

Date	Amount Applied

10-01	5 lb./ac (5.6 kg/ha)
10-15	4 lb./ac (4.5 kg/ha)
10-25	4 lb./ac (4.5 kg/ha)
11-04	3 lb./ac (3.4 kg/ha)
11-09	3 lb./ac (3.4 kg/ha)

In this example, the resulting totals are impacted by the Application Date Prioritization parameter (Table 26, Table 27). In both cases, the maximum annual number of applications is reached.

Table 26: Application results for algorithm example 4, wettest month prioritization

Category	Number of Apps	Amount Applied
Annual	5	15 (16.8 kg/ha)
PreEmergence	0	0
PostEmergence	5	15 (16.8 kg/ha)
Rate1	0	0
Rate2	0	0
Rate3	5	15 (16.8 kg/ha)
Rate4	0	0

Table 27: Application results for algorithm example 4, maximum rate prioritization

Category	Number of Apps	Amount Applied
Annual	5	19 lb./acre (21.3 kg/ha)
PreEmergence	1	5 lb./acre (5.6 kg/ha)
PostEmergence	4	14 lb./acre (15.7 kg/ha)
Rate1	1	5 lb./acre (5.6 kg/ha)
Rate2	2	8 lb./acre (9.0 kg/ha)
Rate3	2	6 lb./acre(6.7 kg/ha)
Rate4	0	0

Output Files

For both use case #1 and use case #2, two output files are generated. For use case #1, a new batch file (.csv) is created along with a log file (.log). For use case #2, a QC report (.csv) is generated along with a log file (.log).

New PWC Batch File

A new PWC Batch file is created for use case #1. This batch file can be entered directly into PWC as a batch input file. The field order is identical to the order described in the PWC documentation (Table 28).

Table 28: PWC batch input file columns

Column	Field Name	Type	Description
1	Run Descriptor	String	Run Descriptor (unused by PWC)
2	Run Name	String	Unique run name (arbitrary to PWC)
3	SorptionCoefficient (mL/g)	Float/In	Sorption Coefficient (mL/g)
4	Kocflag	Bool	Koc flag (TRUE if Koc, FALSE if Kd)
5	WaterColumnMetabolismHalflife	Float/In	Water Column Metabolism half-life (day)
6	WaterReferenceTemperature (C)	Float/In	Water Reference Temperature (ºC)
7	BenthicMetabolismHalflife (day)	Float/In	Benthic Metabolism half-life (day)
8	BenthicReferenceTemperature (C)	Float/In	Benthic Reference Temperature (ºC)

Column	Field Name	Type	Description
9	AqueousPhotolysisHalflife (day)	Float/In	Aqueous Photolysis Half-life (ºC)
10	PhotolysisReferenceLatitude (?)	Float/In	Photolysis reference latitude
11	HydrolysisHalflife (days)	Float/In	Hydrolysis half-life (day)
12	SoilHalflife (days)	Float/In	Soil half-life (day)
13	SoilReferencerTemperature (C)	Float/In	Soil reference temperature (ºC)
14	FoliarHalflife (day)	Float/In	Foliar half-life (day)
15	MolecularWeight (g/mol)	Float/In	Molecular weight (g/mol)
16	VaporPressure (torr)	Float/In	Vapor Pressure (torr)
17	Solubility (mg/L)	Float/In	Solubility (mg/L)
18	Henry's Constant	Float/In	Henry's Constant
19	Air Diffusion	Float/In	Air Diffusion Coefficient (cm^3/d)
20	Heat of Henry	Float/In	Heat of Henry (J/mol)
21	HUC2	String	Hydraulic Unit Code level 2 (*e.g.*, 17a)
22	Scenario	String	Scenario File
23	Weather overide	String	alternative weather file (if blank, use default from scenario)
24	blank 1		LEAVE BLANK
25	blank 2		LEAVE BLANK
26	blank 3		LEAVE BLANK
27	blank 4		LEAVE BLANK
28	blank 5		LEAVE BLANK
29	blank 6		LEAVE BLANK
30	blank 7		LEAVE BLANK
31	blank 8		LEAVE BLANK
32	blank 9		LEAVE BLANK
33	blank 10		LEAVE BLANK
34	blank 11		LEAVE BLANK
35	AquaticBin	Int	Aquatic Bin Number
36	FlowAvgTime	Float/In	Flow averaging time
37	Field Size	Float/In	Field size (m^2)
38	Waterbody Area	Float/In	Water body Area (m^2)
39	Init Depth	Float/In	Initial Depth (m)
40	Max Depth	Float/In	Max Depth (m)
41	HL	Float/In	Hydraulic Length (m)
42	PUA		PUA
43	Baseflow	Float/In	Baseflow (m^3/s)
44	Num_Daysheds		Number of Daysheds
45	IRF1		Dayshed fraction 1
46	IRF2		
47	IRF3		
48	IRF4		
49	IRF5		
50	IRF6		
51	IRF7		
52	IRF8		
53	IRF9		
54	IRF10		
55	IRF11		

Column	Field Name	Type	Description
56	IRF12		
57	IRF13		
58	IRF14		
59	IRF15		
60	IRF16		
61	IRF17		
62	IRF18		
63	IRF19		
64	IRF20		
65	IRF21		
66	IRF22		
67	IRF23		
68	IRF24		
69	IRF25		
70	IRF26		
71	IRF27		
72	IRF28		
73	IRF29		
74	IRF30		
75	IRF31		
76	NumberofApplications	Int	Number of Applications
77	Absolute Dates?	Bool	True = Absolute Dates, False = Relative Dates
78	Relative Dates?		
79	Day1	Int	First application day
80	Month1	Int	First application Month
81	AppRate1	Float	First application rate (kg/ha)
82	ApplicationMethod1	Int	First application method
83	Depth1	Float/In	First application depth, if applicable (cm)
84	T-BandSplit1		First application T-split, if applicable
85	Eff.1	Float	First application efficiency
86	Drift1	Float	First application drift

Run Name Convention

Convention for the "Run Name" field is "rundescriptor_huc2_scenario_bin_appmethod_driftprofile_distance_transportmechanism_depth_tband".

QC Report

For use case #2, a QC report (.csv) is produced (Table 29). This report contains information about the validity of each run within the PWC Batch File entered by the user. See more about use case #2 in the **PWC Prep Tool Functions (Use** Cases) section.

Table 29: QC report field information

Field Name	Type	Description
RunisValid	Bool	Overall indicator if run is label compliant
RunDescriptor	String	Run descriptor
HUC	String	HUC2 region
Bin	Int	Aquatic bin
Scenario	String	Scenario
EmergenceDate	Date	Scenario emergence date
HarvestDate	Date	Scenario harvest date

Field Name	Type	Description
AppRates(kg/ha)	List [Date]	List of application rates
AppDates (sorted)	List [Date]	List of application dates (sorted)
Check_Ann_NumApps_NotExceeded	Bool	True if annual number of apps. not exceeded
Modeled_Ann_NumApps	Int	Total number of apps. in batch file
Label_Ann_NumApps	Int	Total number of apps. on label (APT)
Check_Ann_Amt_NotExceeded	Bool	True if annual maximum amt. not exceeded
Modeled_Ann_Amt	Float	Total amount in batch file
Label_Ann_Amt	Float	Total amount in label (APT)
Difference_Ann_Amt	Float	Difference between modeled and label total amount
Check_PreE_NumApps_NotExceeded	Bool	True if pre-emergence number of applications not exceeded
Modeled_PreE_NumApps	Int	Pre-emergence number of apps. in batch file
Label_PreE_NumApps	Int	Pre-emergence max. number of apps. on label
Check_PreE_Amt_NotExceeded	Bool	True if pre-emergence amount not exceeded
Modeled_PreE_Amt	Float	Pre-emergence max. amount in batch file
Label_PreE_Amt	Float	Pre-emergence max. amount on label
Difference_PreE_Amt	Float	Difference between modeled and label pre-emergence amt.
Check_PostE_NumApps_NotExceeded	Bool	True if post-emergence number of applications not exceeded
Modeled_PostE_NumApps	Int	Post-emergence number of apps. in batch file
Label_PostE_NumApps	Int	Post-emergence max. number of apps. on label
Check_PostE_Amt_NotExceeded	Bool	True if post-emergence amount not exceeded
Modeled_PostE_Amt	Float	Post-emergence max. amount in batch file
Label_PostE_Amt	Float	Post-emergence max. amount on label
Difference_PostE_Amt	Float	Difference between modeled and label post-emergence amt.
Check_MRI_NotWithin	Bool	True if the MRI is adhered to for all apps.
Modeled_MRIs	List [Int]	List of MRIs in batch file
Label_MRI	Int	Label specific MRI
Check_NoDuplicate_AppDates	Bool	True if there are no duplicate application dates
Check_PreHarvInt_NotWithin	Bool	True if no apps. within the pre-harvest interval
Label_PreHarvInt	Int	Pre-harvest interval on label
Check_NumAppsField_IsCorrect	Bool	True if the “number of applications” field is correct
NumAppsField	Int	Value in the number of apps. field in batch file
Modeled_NumApps	Int	Actual number of applications in the batch file

Log File

For both use cases, a log file is produced. The log file contains information about the execution of the PWC-PT, including any warnings, errors, or information relevant to the user.

Limitations

Although the PWC-PT is powerful, there are limitations. The PWC-PT date assignment algorithm does not account for rain events. For example, a label may say “do not apply x hours before or during a rain event”. The PWC-PT does not consider rain events when making applications. This challenge would be difficult to overcome, given that the PWC batch file contains application dates for a single year but these dates are mapped to each year in a 30 year period during the PWC simulations.

Another shortcoming of the PWC-PT is the ability to account for more than four crop cycles. It is possible to account for up to four unique crop cycles in the APT by specifying a date range using the rate specific instructions for each rate. For example, a user could enter the same application rate and MRI for each of the four unique rate columns and for each unique rate specify a unique date range in the rate specific instructions columns. However, there currently is no way to account for more than four crop cycles.

Appendix 1: Input File Examples

Agronomic Practices Table

Table 30 below shows an example of an APT for ESA modeling. Note that an example of an APT is also included with a download of the PWC Prep Tool. You can also see an example of an APT when you download and install the PWC-PT.

Table 30: Sample Agronomic Practices Table for ESA modeling (Note this example does not show columns for rates 2 through 4).

RunDescriptor	LabeledUse	ApplicationMethod	DriftProfile	Scenario	States	MaxAnnAmt	MaxAnnNumApps	PHI	PreEmergence_MaxAmt	PreEmergence_MaxNumApps	PostEmergence_MaxAmt	PostEmergence_MaxNumApps	Rate1_MaxAppRate	Rate1_MaxNumApps	Rate1_PreEmergenceMRI	Rate1_PostEmergenceMRI	Rate1_Instructions
Alfalfa_a	HAY, ALFALFA	2	A-F-M	GrasslandESA	All	13.0	18	7					0.9			5	
Bermudagrass_6CC_a	GRASSES & LEGUMES TOTALS	2	A-F-M	GrasslandESA	All-AZ	5.4	6	3					0.9			31	
Bermudagrass_9CC_a	GRASSES & LEGUMES TOTALS	2	A-F-M	GrasslandESA	AZ	8.1	9	3					0.9			31	
Corn_a	CORN, GRAIN	2	A-F-M	CornESA	All	2.25	5	3					0.45	2		5	Y_E+14>E+21
Corn_2CC_a	CORN, GRAIN	2	A-F-M	CornESA	CA, HI, TX	4.5	10	3					0.45	2		5	Y_E+14>E+21
Cotton_East_a	COTTON	2	A-F-M	CottonESA	East of Rockies	1.35	2	15					0.675			5	
Cotton_West_a	COTTON	2	A-F-M	CottonESA	West of Rockies	1.35	2	15					0.675			3	
Peach_a	PEACHES	2	A-F-M	OrchardESA	All	5.4	6	4					0.9		5	5	
Pear_a	PEARS	2	A-F-M	OrchardESA	CT, DE, NH, NJ, NY, MD, ME, MA, PA, RI, VT	1.8	2	7					0.9		5	5	
Citrus_a	CITRUS TOTALS	2	A-F-M	CitrusESA	AZ, CA, HI	2.7	3	1					0.9		5	5	
Pecan_a	PECANS	2	A-F-M	OrchardESA	AL, AR, FL, GA, LA, KY, NC, MS, SC, TN, VA, WV	6.3	7	30					0.9		5	5	
Peanut_a	PEANUTS	2	A-F-M	OtherRowESA	All	3.6	4	21					0.9			5	
Turf_a	Sod Farms	2	A-F-M	OtherCropESA	All	3.6	4	0					0.9			5	
Sorghum_a	SORGHUM, GRAIN	2	A-F-M	OtherGrainESA	All	0.9	2	14					0.45			5	
Soybean_a	SOYBEANS	2	A-F-M	SoybeanESA	All	1.35	3	3					0.45			5	
Soybean_HiRate_a	SOYBEANS	2	A-F-M	SoybeanESA	AR, LA	2.7	3	3					0.9			5	
Tobacco_a	TOBACCO	2	A-F-M	OtherRowESA	All	2.25	5	5					0.45			5	
Vegetable_a	VEGETABLE TOTALS	2	A-F-M	VegetableESA	All-AZ	13.0	16	3					0.9			2	
Vegetable_AZ_a	VEGETABLE TOTALS	2	A-F-M	VegetableESA	AZ	13.0	24	3					0.9			2	
Wheat_a	WHEAT	2	A-F-M	WheatESA	ID, OR, WA	1.8	4	7					0.45			5	
SugarBeet_a	SUGARBEETS	2	A-F-M	OtherRowESA	All	4.5	5	21					0.9			5	
Lentils_a	LENTILS	2	A-F-M	VegetableESA	All	0.9	1	21					0.9			5	

States Field Convention

The “States” field in the APT is used to specify the states within which the labeled use and corresponding restrictions are valid. PWC model runs are prepared for all HUC2s that intersect these states. The “States” field values can be specified a variety of ways, as displayed in Table 31.

Table 31: States field convention in APT.

Value	Description
OR	A single state
OR, WA, CA	Multiple states separated by a comma
All	All states
All – OR, WA, CA	All states excluding a few
West of Rockies	All states west of the Rocky Mountains
East of Rockies	All states east of the Rocky Mountains

Census of Agriculture Crop to State Lookup Table

A crop to state lookup table is implemented to increase the accuracy of preparing PWC model runs. Although a label specifies which states the ingredient can be applied for a given use site, there is often the case where that particular use site is not grown in all states specified by the label. For example, tobacco in the APT above (Table 30) is permitted by the label to be applied in all states. However, it is only actually grown in a subset of the states (Table 32). The PWC-PT generates runs (rows in a batch input file) for all HUC2s relevant to a given use site. The PWC-PT determines which HUC2s to generate runs for using a hard-coded state to HUC2 lookup table. Therefore, for any use site (row in the APT) the PWC-PT determines which states are specified by the label, then, of those, considers only states where the crop is grown. The resulting subset of states is used to determine which HUC2s to include. A unique PWC run is generated for each corresponding HUC2.

This crop to state lookup table is included as a sheet in the default APT workbook (downloaded with the PWC-PT). Users can enter the name of the crop from the lookup table (Table 32) in the “LabeledUse” column in the APT (e.g. Table 30) using a drop down selection menu. Alternatively, the user can enter any string they like in the “LabeledUse” column to include all states specified by the label.

Table 32: Crop to state lookup table derived from USDA Census of Agriculture 2017

Crop	States Where Crop is Grown (According to 2017 USDA Census of Agriculture)
ALMONDS	AL, AZ, AR, CA, CO, FL, GA, IL, KY, MS, MO, NM, OH, SC, TN, TX, UT, VA, WA
APPLES	AL, AK, AZ, AR, CA, CO, CT, FL, GA, HI, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
APRICOTS	AL, AZ, AR, CA, CO, GA, HI, ID, IL, IA, KS, KY, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VA, WA, WV, WI
ARONIA BERRIES	CA, IL, IA, KS, KY, MD, MA, MI, MN, MO, MT, NE, NJ, NC, ND, OH, OR, PA, SD, TN, VT, VA, WA, WI
ARTICHOKES	AZ, CA, CO, HI, MD, MA, MN, MO, NH, NM, NY, NC, OH, OR, SC, TX, VT, VA, WA, WI
ASPARAGUS	AL, AK, AZ, AR, CA, CO, CT, FL, GA, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
AVOCADOS	CA, FL, HI, LA, TX
BANANAS	CA, FL, HI, SC, TX
BARLEY	AL, AK, AZ, CA, CO, CT, DE, GA, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MO, MT, NE, NV, NJ, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
BEANS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
BEANS, DRY EDIBLE, (EXCL. CHICKPEAS & LIMA)	AZ, CA, CO, HI, ID, IL, KS, ME, MA, MI, MN, MT, NE, NV, NM, NY, NC, ND, OH, OK, OR, SD, TX, VT, VA, WA, WI, WY

Crop	States Where Crop is Grown (According to 2017 USDA Census of Agriculture)
BEETS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
BLACKBERRIES	AL, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
BLUEBERRIES	AL, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, OH, OK, OR, PA, RI, SC, SD, TN, TX, VT, VA, WA, WV, WI
BOYSENBERRIES	CA, NJ, NY, OR, PA, SC, TN, TX, UT, WA
BROCCOLI	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
BRUSSELS SPROUTS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MO, MT, NE, NJ, NM, NY, NC, OH, OR, PA, RI, SC, SD, TN, TX, VT, VA, WV, WI
BUCKWHEAT	ID, IL, IA, ME, MI, MN, MO, MT, NE, NJ, NY, ND, OH, OR, PA, SD, WA, WI
CABBAGE	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
CAMELINA	MS, MT
CANOLA	CO, ID, IN, KS, KY, LA, MN, MO, MT, ND, OK, OR, PA, TN, TX, WA
CARROTS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
CAULIFLOWER	AL, AK, AZ, AR, CA, CO, CT, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
CELERY	AK, AZ, AR, CA, CO, CT, GA, HI, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MO, MT, NE, NH, NJ, NM, NY, NC, OH, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV
CHERIMOYAS	CA, HI
CHERRIES	AL, AK, AZ, AR, CA, CO, CT, FL, GA, HI, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
CHESTNUTS	AL, AR, CA, CT, FL, GA, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MS, MO, NJ, NM, NY, NC, OH, OR, PA, RI, SC, TN, TX, VT, VA, WA, WV, WI
CHICKPEAS	AZ, CA, ID, MN, MT, NE, ND, OR, SD, WA, WY
CHICORY	CA, CT, IL, KY, LA, ME, MD, MA, MT, NJ, NY, NC, OR, PA, SC, VT, VA, WA, WI
CITRUS TOTALS	AL, AZ, CA, FL, GA, HI, LA, SC, TX
CITRUS, OTHER	CA, HI, TX
COFFEE	HI
CORN, GRAIN	AL, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
CORN, SILAGE	AL, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
CORN, TRADITIONAL OR INDIAN	AZ, CA, CO, CT, IL, IN, IA, KY, ME, MD, MA, MN, NJ, NM, NY, NC, OH, OR, PA, TN, UT, WA, WI
COTTON	AL, AZ, AR, CA, FL, GA, KS, LA, MS, MO, NM, NC, OK, SC, TN, TX, VA
CRANBERRIES	ME, MA, MI, NJ, OR, WA, WI
CUCUMBERS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
CURRANTS	AK, CA, IL, IN, MD, MA, MI, MN, MT, NH, NJ, NY, ND, OH, OR, PA, SD, UT, VT, WA, WI
DAIKON	AZ, CA, CO, CT, FL, GA, HI, IL, IN, IA, KS, LA, ME, MD, MA, MI, MN, MO, MT, NE, NH, NJ, NM, NY, NC, OH, OR, PA, SC, TN, TX, VT, VA, WA, WI
DATES	AZ, CA, NM
EGGPLANT	AL, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
ELDERBERRIES	AL, CA, CO, CT, FL, GA, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MS, MO, NE, NH, NJ, NY, NC, OH, OK, OR, PA, SC, SD, TN, TX, VT, VA, WA, WV, WI
EMMER & SPELT	IL, IN, KY, ME, MD, MI, MO, MT, NY, ND, OH, PA, WA, WV, WI
ESCAROLE & ENDIVE	CA, CO, CT, FL, GA, HI, IL, IN, IA, KY, ME, MD, MA, MI, MN, MO, MT, NH, NJ, NY, NC, OH, OR, PA, TN, VT, VA, WA, WI

Crop	States Where Crop is Grown (According to 2017 USDA Census of Agriculture)
FIGS	AL, AR, CA, DE, FL, GA, IL, KY, LA, MD, MS, MO, NJ, NM, NY, NC, OK, OR, PA, SC, TN, TX, VA, WA, WV
FLAXSEED	ID, MN, MT, ND, OR, SD, WA
GARLIC	AL, AK, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, NE, NV, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TX, UT, VT, VA, WA, WV, WI, WY
GINGER ROOT	AL, AZ, CA, CT, FL, GA, HI, ID, IL, IN, KS, KY, ME, MD, MA, MI, MN, MS, MO, NJ, NY, NC, OR, PA, SC, TN, VT, VA, WI
GINSENG	CA, KY, NY, NC, SC, TN, WI
GRAPEFRUIT	AL, AZ, CA, FL, HI, LA, TX
GRAPES	AL, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
GRASSES & LEGUMES TOTALS	CA, CO, FL, GA, ID, KS, KY, MN, MT, NE, NV, OR, UT, WA, WY
GREENS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
GUAR	OK, TX
GUAVAS	CA, FL, HI, TX
HAY	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
HAY & HAYLAGE	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
HAY, (EXCL ALFALFA)	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
HAY, ALFALFA	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
HAY, IRRIGATED	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, WA, WI, WY
HAYLAGE	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
HAYLAGE, ALFALFA	AL, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
HAZELNUTS	AL, AR, CA, CO, CT, FL, GA, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MS, MO, NE, NJ, NM, NY, NC, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
HERBS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SD, TN, TX, UT, VT, VA, WA, WI, WY
HERBS, DRY	AK, CA, CO, CT, GA, HI, KY, ME, MA, MI, MT, NM, NY, NC, OR, PA, SD, TN, TX, VT, VA, WV
HOPS	AR, CO, CT, ID, IL, IN, IA, KY, ME, MD, MA, MI, MN, MO, MT, NV, NJ, NM, NY, NC, OH, OR, PA, TN, VT, VA, WA, WI
HORSERADISH	AL, AZ, CA, CO, CT, HI, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MO, NE, NH, NJ, NY, NC, OH, PA, SD, TN, VT, VA, WA, WV
JOJOBA	AZ, CA
KIWIFRUIT	AL, CA, FL, GA, MS, MO, NC, OR, PA, SC, TN, VT, VA, WA, WV
KUMQUATS	CA, FL, HI, TX
LEGUMES, ALFALFA, SEED	AZ, CA, ID, KS, MT, NE, OR, PA, SD, TX, UT, VA, WA, WY
LEMONS	AZ, CA, FL, GA, HI, LA, MS, TX
LENTILS	CA, ID, MN, MT, NE, NY, ND, SD, WA
LETTUCE	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
LIMES	AL, AZ, CA, FL, GA, HI, LA, MS, TX
LOGANBERRIES	CA, FL, MI, NC, OR, TN, WA
MACADAMIAS	CA, FL, HI

Crop	States Where Crop is Grown (According to 2017 USDA Census of Agriculture)
MANGOES	CA, FL, HI, TX
MELONS	AL, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
MINT, OIL	CA, ID, IN, OR, TN, WA, WV, WI
MISCANTHUS	MO, NC
MUSTARD, SEED	CA, ID, MT, NC, ND, OR, WA
NECTARINES	AL, AZ, AR, CA, CO, CT, FL, GA, ID, IL, IN, KS, KY, ME, MD, MA, MI, MS, MO, NH, NJ, NM, NY, NC, OH, OK, OR, PA, SC, TN, TX, UT, WA, WV
OATS	AL, AK, AR, CA, CO, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NJ, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
OKRA	AL, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, NE, NJ, NM, NY, NC, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
OLIVES	AZ, CA, GA, IL, OR, TX
ONIONS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
ORANGES	AL, AZ, CA, FL, GA, HI, LA, MS, SC, TX
ORCHARDS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
PAPAYAS	CA, FL, HI, TX
PARSLEY	AL, AK, AR, CA, CO, CT, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MO, MT, NE, NV, NH, NJ, NM, NY, NC, OH, OR, PA, RI, SD, TN, UT, VT, VA, WA, WV, WI
PASSION FRUIT	CA, FL, HI
PEACHES	AL, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
PEANUTS	AL, AR, CA, FL, GA, HI, LA, MS, NM, NC, OK, SC, TX, VA
PEARS	AL, AZ, AR, CA, CO, CT, DE, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
PEAS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
PEAS, AUSTRIAN WINTER	CO, ID, MT, OR, WA
PEAS, DRY EDIBLE	CA, CO, ID, IL, IA, KS, MI, MN, MO, MT, NE, NM, NY, ND, OK, OR, SC, SD, TX, WA, WI, WY
PECANS	AL, AZ, AR, CA, FL, GA, IL, IN, KS, KY, LA, MD, MI, MS, MO, NE, NV, NM, NY, NC, OH, OK, SC, TN, TX, UT, VA
PEPPERS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
PERSIMMONS	AL, AR, CA, CT, FL, GA, HI, IL, IN, IA, KS, KY, LA, MD, MI, MS, MO, NJ, NY, NC, OH, OK, OR, PA, SC, TN, TX, VA, WA, WV, WI
PINEAPPLES	HI
PISTACHIOS	AZ, CA, NV, NM, TX, UT
PLUMS	AL, AZ, AR, CA, CO, CT, ID, IL, IN, IA, KY, LA, ME, MA, MI, MS, MO, MT, NE, NV, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WY
POMEGRANATES	AL, AZ, CA, FL, GA, HI, LA, MS, NV, NM, SC, TX, UT
POTATOES	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SD, TN, TX, UT, VT, VA, WA, WV, WI
PRUNES	CA, CO, ID, IL, ME, MA, MI, MO, MT, NM, NY, OH, OR, PA, TN, UT, WA
PUMPKINS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
RADISHES	AL, AK, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
RAPESEED	ID, MI, NC, OR, PA, SC
RASPBERRIES	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OH, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
RHUBARB	AL, AK, AR, CO, CT, GA, HI, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MS, MO, MT, NE, NJ, NM, NY, NC, OH, OR, PA, RI, SD, TN, UT, VT, VA, WA, WV, WI, WY

Crop	States Where Crop is Grown (According to 2017 USDA Census of Agriculture)
RICE	AR, CA, FL, LA, MS, MO, TN, TX
RYE	AL, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MO, MT, NE, NJ, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, VT, VA, WA, WV, WI
SAFFLOWER	CA, ID, MT, ND, SD, UT
SESAME	FL, KS, OK, TX
SORGHUM, GRAIN	AL, AZ, AR, CA, CO, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, MD, MI, MN, MS, MO, MT, NE, NJ, NM, NY, NC, ND, OH, OK, PA, SC, SD, TN, TX, VA, WV, WI
SORGHUM, SILAGE	AL, AZ, AR, CA, CO, FL, GA, ID, IL, IN, IA, KS, KY, LA, MD, MI, MN, MO, NE, NJ, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VA, WV, WI, WY
SOYBEANS	AL, AR, CO, CT, DE, FL, GA, HI, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NJ, NM, NY, NC, ND, OH, OK, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
SPINACH	AL, AK, AZ, AR, CA, CO, DE, FL, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, OH, OK, OR, PA, RI, SC, SD, TX, UT, VT, VA, WA, WV, WI, WY
SQUASH	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
STRAWBERRIES	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
SUGARBEETS	CO, ID, MI, MN, MT, NE, ND, OR, WY
SUNFLOWER	AL, CA, CO, FL, GA, IL, IN, IA, KS, KY, MD, MI, MN, MO, MT, NE, NJ, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, VA, WA, WV, WI, WY
SWEET CORN	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
SWEET POTATOES	AL, AZ, AR, CA, CO, CT, DE, FL, GA, HI, IL, IN, IA, KS, KY, LA, ME, MD, MA, MN, MS, MT, NE, NH, NJ, NM, NY, NC, ND, OH, OK, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI
TANGELOS	AL, AZ, CA, FL, HI, TX
TANGERINES	AL, AZ, CA, FL, GA, HI, LA, MS, TX
TARO	CA, HI, ME, MA
TOBACCO	CT, FL, GA, IN, KY, MD, MA, MO, NC, OH, PA, SC, TN, VA, WI
TOMATOES	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, NE, NV, NH, NJ, NM, NY, NC, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
TRITICALE	CA, CO, ID, IL, IN, IA, KS, MD, MI, MN, MO, MT, NE, NY, NC, ND, OH, OK, OR, PA, SD, TN, TX, UT, VA, WA, WI, WY
TURNIPS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, TN, TX, VT, VA, WA, WV, WI, WY
VEGETABLE TOTALS	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
WALNUTS	AL, AZ, AR, CA, CO, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, NE, NV, NJ, NM, NY, NC, OH, OK, OR, PA, RI, SC, TN, TX, UT, VT, VA, WA, WV, WI
WATERCRESS	CA, CT, HI, IL, ME, MD, MA, MI, MN, MS, NY, NC, OH, OR, TN, VA, WA, WI
WHEAT	AL, AK, AZ, AR, CA, CO, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MI, MN, MS, MO, MT, NE, NV, NJ, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY
WHEAT, SPRING, DURUM	AZ, CA, CO, ID, MN, MT, NM, NY, ND, OR, SD
WHEAT, WINTER	AL, AR, CA, CO, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, ME, MD, MI, MN, MS, MO, MT, NE, NJ, NM, NY, NC, ND, OH, OR, PA, SC, SD, TN, TX, UT, VT, VA, WA, WV, WY
WILD RICE	CA, MN

Appendix 2: Rate-Specific Instructions

The rate-specific special instructions are used to define label restrictions for individual rates. These instructions provide the user with more flexibility when setting up use restrictions. For example, a given use might allow different application rates depending on different times of the year. Or a rate may only be valid for a certain time period before or after emergence/harvest.

Rate-specific instructions are specified in the Agronomic Practices Table (APT) using a specific convention. The convention is comprised of two components of a string. The first component is a Boolean indicator ("Y" or "N").

Y: applications for this rate *can only* be made during the instructions window

N: applications for this rate *cannot* be made in the instructions window

The second part of the convention is the instruction window. Specifically, the start and stop dates for the window. The instructions window can be defined in three ways: relative to the emergence / harvest date, a date range, or a date range relative to the emergence / harvest date. The first part (boolean yes/no) and second part (instructions window) are connected by an underscore as in the examples below (Table 33).

Table 33: Rate-specific instructions convention examples

Instruction	Description
Y_H-30	Applications can only be made in the 30 days preceding the harvest date
N_E+05	Applications cannot be made within 5 days following the emergence date
N_0501>0615	Applications cannot be made between May 1st and June 15th
N_1201>0201	Applications cannot be made between Dec 1st and Feb 1st
Y_E+15>H+15	Applications can only be made between 15 days after emergence and 15 days after harvest
Y_E-10>H+00	Applications can only be made between 10 days before emergence and harvest

If the rate instructions format is defined incorrectly in the APT, then an error will be presented to the user during execution of the PWC-PT. However, it is critical that the user ensures that the rate instructions are entered correctly in compliance with the label. For example, an error will be thrown for "YH+15" because the underscore between Y and H is missing. However, an error will not be thrown for "Y_H+500". So, the user must ensure that the day value is correct.