ESMC
Ecosystem Services
Market Consortium

ESMC PLET Module

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Acronym List

BMP	Best management practice (also referred to as practice changes)
CN	Curve Number
ESMC	Ecosystem Services Market Consortium
gNATSGO	Gridded National Soil Survey Geographic Database
MMRV	Measuring, Monitoring, Reporting, and Verification platform
N	Nitrogen
NASS	National Agriculture Statistics Service (branch of the USDA)
NHDPlusV2	National Hydrography Data Plus – Version 2
NLCD	National Land Cover Dataset
NRCS	Natural Resources Conservation Service (branch of the USDA)
P	Phosphorus
PLET	Pollutant Load Estimator Tool (USEPA)
ESMC PLET Module	Pollutant Load Estimator Tool Module (ESMC integrated PLET tool)
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
USEPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USGS	United States Geological Survey

1. Executive Summary

This document provides a brief overview of the United States Environmental Protection Agency's (USEPA) Pollutant Load Estimator Tool (PLET) and ESMC's version of this tool, henceforth referred to as the **PLET Module**. Specifically, ESMC integrated the USEPA PLET module into the ESMC Eco-Harvest Measurement, Monitoring, Reporting, and Verification platform (MMRV). This automated solution allows efficient and integrated quantification of water quality and water quantity impacts for approved best management practices (BMPs; also referred to as practice changes) into ESMC's MMRV platform. The result enables reduced data collection burdens on producers and project partners, and faster reporting of outcomes to producers and project partners.

This document provides a high-level, non-technical summary of the ESMC PLET Module, including: (1) required inputs, (2) external datasets used, (3) outputs, and (4) other considerations for ESMC's program.

Section 2 provides information on the motivation for the development of the PLET Module. Input data requirements are described in *Section 3.1*, external datasets are described in *Section 3.2*, and ESMC PLET Module outputs are described in *Section 3.3*. *Section 4* provides information on quality assurance documentation. For more detailed technical documentation, see the PLET USEPA PLET resources (Section 5).

2. Background

2.1 Overall Goals of the PLET Module

ESMC and its members, including participants in ESMRC's Water Technical Working Group, reviewed a wide range of water quantity and water quality models and rated their applicability to ESMC (ESMC, 2021). Of the models evaluated, the Spreadsheet Tool for Estimating Pollutant Load (STEPL), which is the precursor to PLET, was identified as the most appropriate model based on ESMC's selection criteria (ESMC, 2021).

ESMC previously utilized a spread-sheet based simplified version of STEPL and USDA's ecoregion-level runoff export coefficients dataset (White et al., 2015). To streamline and scale water impact calculations for larger-scale projects, ESMC upgraded to the Python-based ESMC PLET Module. This new tool builds on the scientifically-driven components of PLET while making it easier and faster for ESMC to generate water quality and water quantity benefits, thus improving scalability and efficiency of the Eco-Harvest MMRV.

ESMC identified two important motivations to incorporate the PLET Module into the Eco-Harvest MMRV. First, the PLET Module automates water impact quantification methods, which is an improvement on past reliance of spreadsheet-based water impact calculators. While the previous water quantity and water quality calculators leveraged a scientific knowledge base drawn from earlier versions of PLET, the spread-sheet version of the tools hampered scalability and utility. The automated ESMC PLET Module also provides spatially-explicit water impact calculations using up-

to-date datasets such as those provided by the USEPA, United States Department of Agriculture (USDA), United States Geological Survey (USGS), and others, making the tool consistent with federal agency uses.

2.2 Description of the USEPA PLET and the ESMC PLET Module

PLET is the newest iteration of the USEPA Spreadsheet Tool for Estimating Pollutant Load (STEPL), which was first released over 20 years ago as an Excel-based tool leveraging Visual Basic to calculate watershed surface runoff, nutrient loads, and sediment loads for a variety of land use types and BMPs (USEPA, 2018; 2020; 2022). STEPL can be used to determine nutrient and sediment load reductions due to the implementation of specific BMPs of interest to ESMC.

The USEPA motivation for developing STEPL was to support state recipients of USEPA grants. Specifically, recipients are required to report their project load reduction results to the USEPA under Section 319 of the Clean Water Act. In 2022 the USEPA migrated STEPL to a web-based interface; this migration represents PLET version 1.0 (USEPA, 2022). The underlying assumptions, algorithms, and functions of PLET are identical to STEPL; however, PLET does not rely on Excel software and PLET results can more seamlessly be integrated in USEPA online grant reporting and tracking portals (USEPA, 2022; 2023a). Additional details on the applicability of PLET to ESMC and a technical description of water quantity and quality processes included in PLET are provided in Sections 1.3 and 2.0, respectively.

2.3 Software Architecture

ESMCs PLET Module is a Python-based version of USEPA PLET. ESMC's PLET Module includes both Python code and static datasets; and provides field-scale estimates of baseline and practice change water quantity (i.e., runoff volume) and water quality (i.e., nitrogen, phosphorus, and sediment loads) at an annual time step. Figure 1 gives an overview of the ESMC PLET Module as integrated into ESMC's MMRV.

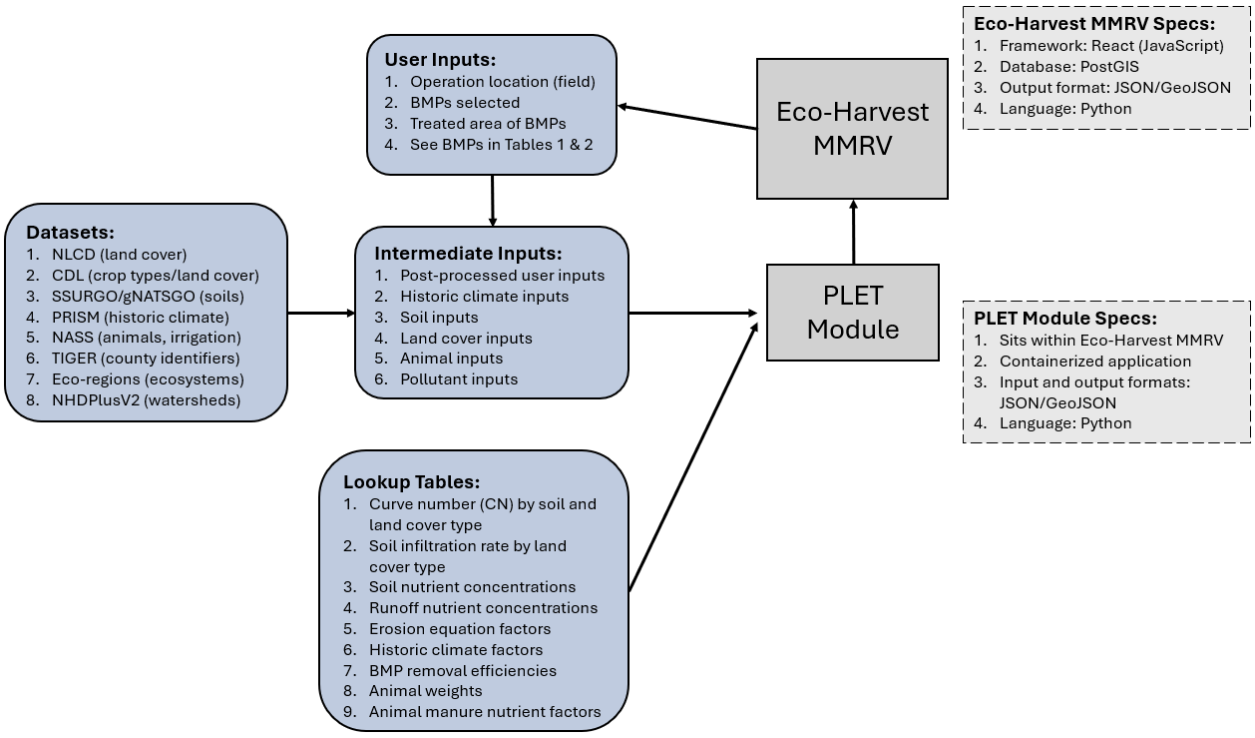

Figure 1. A schematic visualizing the software architecture and information flows into and out of the PLET Module.

3. PLET Module Inputs and Outputs

3.1 Required Inputs

The fundamental input to the PLET Module is a geojson file. This file will be provided by ESMC based on information provided by the user (i.e., the producer) via the Eco-Harvest MMRV. The geojson file must include the information described in Table 1.

Table 1. Description of PLET Module required inputs.

Description	Units
unique field identifier (i.e. "field_001")	-
user-defined land use for the field	-
number of months manure is applied to the field	-
area of manure application to the field	acres
bmp practice change name	-
bmp treated area which is the area of the field that the bmp treats	acres
field geometry	-

3.2 External Datasets

PLET Module external datasets and the suggested update frequency are described in Table 2.

Table 2. Description of external datasets used by the ESMC PLET Module.

Dataset Name	Dataset Developer	URL	Current Version (year)	Type	Suggested Update Frequency
County-level Animal Counts	US Department of Agriculture, National Agriculture Statistics Survey	https://quickstats.nass.usda.gov/api	varies	tabular	every 2 years (synchronous with landcover data updates)
gNATSGO Database - Hydrologic Soil Group	US Department of Agriculture, Natural Resources Conservation Service	https://www.nrcs.usda.gov/resources/data-and-reports/gridded-national-soil-survey-geographic-database-gnatsgo#download	2023	spatial - raster	every 5 years
Level 3 Ecoregions	US Environmental Protection Agency	https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states	2013	spatial - vector	as dataset developer releases updates
National Hydrography Dataset Plus v2 - Hydrologic Unit Code 04 Watershed Boundaries	US Environmental Protection Agency and US Geological Survey	https://www.epa.gov/waterdata/get-nhdplus-national-hydrography-dataset-plus-data#Download	2019	spatial - vector	as dataset developer releases updates
PLET Lookups	US Environmental Protection Agency	https://ordspub.epa.gov/ords/grts/f?p=112:9000	2023	tabular	as dataset developer releases updates
National Land Cover Dataset	Multi-Resolution Land Characteristics Consortium	https://www.mrlc.gov/data/nlcd-2019-land-cover-conus	2019	spatial - raster	every 2 years (synchronous with animal counts data updates)
TIGER State Line Boundaries	US Census Bureau	https://www.census.gov/cgi-bin/geo/shapefiles/index.php	2023	spatial - vector	every 5 years
TIGER County Line Boundaries	US Census Bureau	https://www.census.gov/cgi-bin/geo/shapefiles/index.php	2023	spatial - vector	every 5 years

3.3 Outputs

ESMC PLET Module outputs include water quantity and quality impact calculations for baseline and practice change conditions of each enrolled field. Water quantity calculations include runoff volume (acre-feet/year). Water quality calculations include nitrogen and phosphorus load (pounds/year), and sediment load (tons/year). The ESMC PLET Module also provides the calculated percent change in water quantity and water quality outputs between the baseline condition and the practice change selected by the producer. The percent change output value should be used when comparing one field to another, as this value is normalized by the baseline condition. Additional outputs, including intermediate calculations and other ancillary data outputs are described in further detail in Table 3. The ESMC PLET Module is intended to be run once per year, typically during the winter months (December – February), when ESMC is preparing water quantity and water quality impact reports to be sent to producers. Consequently, outputs will be generated once per year and passed back to the Eco-Harvest MMRV in the form of a geojson with columns appended.

Table 2. Description of ESMC PLET Module outputs.
Note that the output will be appended to the input; therefore, it will also include the columns described in Table 1.

Description	Units
state and county FIPS code (e.g., 17113 for McLean County, IL)	-
full state name (e.g., Illinois)	-
state abbreviation (e.g., IL)	-
county name (e.g., McLean)	-
National Hydrography Dataset Plus version 2 hydrologic unit code level 4 number	-
hydrologic unit code level 4 name	-
USEPA level 3 ecoregion code	-
USEPA ecoregion level 3 name	-
USEPA ecoregion level 2 name	-
USEPA ecoregion level 1 name	-
hydrologic soil group, calculated by taking the zonal stats "majority"	-
field area	acres
animal density	units

Description	Units
animal equivalent units	units
animal intensity (values: low, medium, high)	-
average annual rainfall	inches
average number of rainy days in a year	-
rainfall correction factor (percent of rainfall events that exceed 5 mm/event)	percent
rainy day correction factor (percent of rainy day events that generate runoff)	percent
curve number	-
average rainfall factor	-
average soil erodability factor	-
average topographic factor	-
average cropping management factor	-
average erosion control practice factor	-
concentration of nitrogen in runoff not during manure application	mg/L
concentration of phosphorus in runoff not during manure application	mg/L

Description	Units
concentration of nitrogen in runoff during manure application	mg/L
concentration of phosphorus in runoff during manure application	mg/L
BMP water quantity efficiency (values: 0 for no water quantity benefits, 1 for water quantity benefits)	-
BMP nitrogen efficiency	-
BMP phosphorus efficiency	-
BMP sediment efficiency	-
rainfall per event	inches/event
potential maximum water retention after runoff begins	inches
runoff depth	inches/event
baseline annual runoff volume	acre-feet
baseline annual nitrogen load in runoff	lbs
baseline annual phosphorus load in runoff	lbs
annual sediment loss due to sheet and rill erosion	tons
annual sediment delivery ratio	-

Description	Units
baseline annual sediment load in runoff due to sheet and rill erosion	tons
practice change curve number value	-
practice change annual runoff volume	acre-feet
annual sediment loss due to sheet and rill erosion	lbs
practice change annual sediment-bound nitrogen load	lbs
practice change annual sediment-bound phosphorus load	lbs
practice change annual nitrogen load in runoff	lbs
practice change annual phosphorus load in runoff	lbs
practice change runoff sediment load	tons
percent change in runoff volume between baseline and practice change conditions	percent
percent change in nitrogen load in runoff between baseline and practice change conditions	percent
percent change in phosphorus	percent
percent change in sediment load in runoff between baseline and practice change conditions	percent

4. Additional Considerations

4.1 Quality Assurance

A hypothetical geojson input file was used to programmatically calculate and compare results from the ESMC PLET Module as a quality assurance that it appropriately reflects the USEPA PLET tool. The same inputs were used to calculate USEPA STEPL results. On average (n = 9 fields) there was a <0.2% difference between in baseline runoff volume, nitrogen load, phosphorus load values and practice change nitrogen load, phosphorus load values between the ESMC PLET Module and USEPA STEPL. Differences were due to rounding errors between Python and Excel. It should be noted that USEPA STEPL does not estimate practice change runoff, so this could not be evaluated.

If you have any questions about USEPA PLET, please visit https://www.epa.gov/nps/plet for more information.

5. USEPA PLET Documentation

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