Water Quality Module (WQM)
Computation and Data Services
Specification

Input Data
Computational Logic
Output Data

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Introduction

This document contains the process and data definitions for the computational and data services of the USDA Natural Resources Conservation Service (NRCS) Water Quality Module (WQM). WQM integrates the concepts and logic of farm-field level conservation planning and analysis of water quality related resource concerns, specifically (from the list of NRCS resource concerns):

11a. Water Quality Degradation: Excess nutrients in surface water
11b. Water Quality Degradation: Excess nutrients in ground water
12a. Water Qualiy Degradation: Pesticides transported to surface waters
12b. Water Quality Degradation: Pesticides transported to ground waters
16. Water Quality Degradaton: Excess sediment in surface waters

WQM computes mitigation scores, comparing to thresholds necessary to mitigate these concerns, as follows:

Nitrogen in Ground Water
Nitrogen in Surface Water
Phosphorus in Surface Water
Sediment in Surface Water
Pesticides in Ground Water – Human
Pesticides in Ground Water – Fish
Pesticides in Solution Runoff – Human
Pesticides in Solution Runoff – Fish
Pesticides in Adsorbed Runoff – Human
Pesticides in Adsorbed Runoff – Fish
Pesticide Drift to Surface Water – Human
Pesticide Drift to Surface Water – Fish

NRCS analysis of resource concerns has two steps: screening and assessment. Screening is an initial process to identify whether a resource concern should have a more detailed assessment. WQM is a resource concern assessment tool.

NRCS assesses resource concerns at the farm field level as a routine step in the conservation planning process. Assessment assists the selection of conservation practices, techniques, and management operations for the farmer's conservation plan. The planner performs screening and as necessary assessment of resource concerns for each field in the conservation plan. In NRCS syntax, the farmer's field is called a planning land unit (PLU), which is defined as a unit of land that has a contiguous boundary and a common management. For WQM, we use the concept of area of analysis (AoA), which like the PLU usually has a contiguous boundary and a common management and is congruent with a PLU (has the same area). However, there will be cases where an AoA will not be congruent with a PLU. Therefore WQM assessments will be associated with AoAs, which then can be related to PLUs through geospatial association.

This document is organized by services and components. Services are web services intended to interact with a requesting application, for example, with the NRCS Customer Service Toolkit. The application

sends a request payload (expected by the service), and the service returns a results payload to the application. Also sometimes/often a service may interact with other services.

Services contain one or more components. Components encode one or more particular processes (algorithms, computational logic, data access, etc.). Computational efficiency drives component design, whereas requirements of expected requesting applications drive service scope and design. Therefore we should consider this document to be at least somewhat fluid in the early phases of WQM development as business and system requirements settle. We intend to have this document stable enough to begin programming the services by March 2015.

The following references underpin WQM requirements:

Agronomy Technical Note 5 – Pest Management in the Conservation Planning Process

2010 Integrated Pest Management Conservation Practice (595) Standard

2012 Nutrient Management Conservation Practice (590) Standard

Windows Pesticide Screening Tool (Win-PST), Version 3.1 User Guide

2012 CEAP Upper Mississippi River Basin Report – protocols for soil nutrient leaching andrunoff potential

2014 Resource Stewardship Tool – Phase 1, spreadsheet of data and process development for the tool to be piloted for the Conservation Stewardship Program (CSP)

2013 CDSI Approach to Alternative System Effects for Water Quality – Sediment, Nutrient and Pesticide Resource Concerns

Service WQM-1: Water Quality Sensitivity Rating (WQSR)

Purpose: Assign a water quality sensitivity rating and required treatment level designation to an area of analysis (AoA).

NRCS is creating a national Water Quality Sensitivity Rating (WQSR) spatial layer and attributes based on state-defined criteria. The layer will have state level data stewards. At the outset, the map will be a set of state boundary polygons with a WQSR rating of BASE. WQSR is a starting point for WQM analysis.

Service Signature

Request Payload

AoAId… integer, one or more; Area of Analysis Identifier

aoa_geometry… one set of coordinates per AoA; Area of Analysis Geometry

Result Payload

AoA identifier … integer, one or more from the request

aoa_wqs_rating … character varying(20); Water Quality Sensitivity Rating for the Area of Analysis; values are Base, Sensitive, Critical

aoa_treatment_level … character varying(10); Treatment Level Required to Mitigate Water Quality Resource Concerns; values are I, II, or III

Reference Data Sources

WQSR layer (national in scope) and attribute table; the layer initially is the boundary of the United States and its territories having a WQSR of Base and treatment level of I. Over time, NRCS state offices will create WQSR polygons with Sensitive or Critical ratings and associated treatment levels.

Component

1. Water Quality Sensitivity Rating for an Area of Analysis (AoAWQSR)

1.1. Inputs

AoA identifier

AoA polygon geometry

1.2. Data

WSQR layer attributes

wqsr_polygon_id

wqs_rating… Base, Sensitive, or Critical

wqs_treatment_level… I, II, or III

1.3. GIS Operations

Intersect AoA and WQSR layers producing set of AoA x WQSR polygons

1.4. Methods

For each AoA

#Compute areas for each sensitivity-rating category in the AoA

aoa_base_area = sum intersected polygon areas where wqs_rating == Base
aoa_sensitive_area = sum intersected polygon areas where wqs_rating == Sensitive
aoa_critical_area = sum intersected polygon areas where wqs_rating == Critical

#Compute WQS rating for the AoA
If aoa_critical_area >= aoa_sensitive_area and and >= aoa_base_area
    aoa_wqs_rating = Critical
    aoa_treatment_level = III
Else if aoa_sensitive_area and >= aoa_base_area and > aoa_critical_area
    aoa_wqs_rating = Sensitive
    aoa_treatment_level = II
Else if aoa_base_area > aoa_sensitive_area and > aoa_critical_area
    aoa_wqs_rating = Base
    aoa_treatment_level= I

1.5. Outputs
AoA identifier
    aoa_wqs_rating
    aoa_treatment_level

Service WQM-2: Soil Component Attributes (WQMSoilAttributes)

Purpose: Compile a list of soil components for the area of analysis, and for each component get attributes needed for subsequent WQM ratings. The results are returned to the requesting application for display, with some attributes available for editing.

Service Signature

Request Payload

AoAId … integer, one per request; Area of Analysis Identifier
aoa_geometry … one set of coordinates; Area of Analysis Geometry
aoa_filter_pct … numeric(); Percent AoA Threshold for Including Soil Components in Result Payload; default is no filter value

Result Payload

AoAId… one
cokey… character varying(60), one or more per AoA; Soil Component Key
compname … character varying(120); Soil Component Name
mukey… character varying (60); Soil Mapunit Key
muname… character varying(350); Soil Mapunit Name
aoa_comp_area_r … numeric(); Area of the AoA Represented by the Soil Component Area (Acres) in the Area of Analysis
aoa_comp_pct_r … numeric(); Percentage of the AoA Represented by the Soil Component
aoa_comp_hsg … charater varying(10); Hydrologic Soil Group of the Soil Component
aoa_comp_taxorder … character varying(120); Taxonomic Order of the Soil Component
aoa_comp_kfact … numeric(); K factor of the Soil Component
aoa_comp_slope … integer; Slope Percentage of the Soil Component
aoa_comp_coarse_frag … numeric(); Weighted Average Coarse Rock Fragment Volume Percentage through the Profile of the Soil Component
aoa_comp_om … numeric(); Organic Matter Percentage of the Surface Horizon of the Soil Component; application may edit later
aoa_comp_hzdepth … numeric(); Depth (inches) of the Surface Horizon of the Soil Component; application may edit later
aoa_comp_wtbl … character varying(30); Kind of Water Table of the Soil Component; values are None, Apparent, Perched
aoa_comp_cracksgr24 … Boolean; Surface Connected Macropores (Cracks) at Least 24 Inches Deep; default set to False by this service
aoa_comp_slopegr15 … Boolean; Field Slope is Greater Than 15%; value set by this service
aoa_comp_hwt_lt_24 … Boolean; High Water is Less than 24 Inches Under the Surface; value set by this service

Reference Data Sources

SSURGO layer and attribute tables
component table

cokey … character varying(60)
compname … character varying(120)
taxorder … character varying(508)
slope_r … numeric
hydgrp … character varying(508)
chkey … character varying(60)

chorizon table
chkey … character varying(60)
hzdept_r … integer
hzdepb_r … integer
hzthk_r … integer
kwfact … character varying(508)
kffact … character varying(508)
cokey
chfragskey … character varying(60)

chfrags table
chfragskey
fragvol_r … integer
chkey

comonth table
comonthkey
month
monthseq
cokey

cosoilmoist table
soimoistdept_r
soimoistdepb_r
soimoiststat
cosoilmoistkey
comonthkey

Components

2. List of Soil Components in an Area of Analysis (AoASCList)

2.1. Input
aoa_id … AoA identifier
aoa_geometry

2.2. Reference Data
SSURGO soil mapunit layer
See SSURGO Metadata- Table Column Descriptions

2.3. GIS Operations
#Compute area of AoA
aoa_area = area of aoa_geometry

#AoA x SSURGO intersection

Clip SSURGO layer with AoA geometry producing attribute table
gid… polygon identifier
aoa_id… AoA identifier
mukey … soil mapunit key
gid_area… area of clipped polygon

2.4. Methods

For the aoa_id

#Compile list of unique AoA soil mapunits and compute their areas

```
Select
    aoa_id
    mukey
    sum(gid_area) As aoa_mu_area
    mapunit.muname
Into temp_aoa_mu
From clipped attribute table
Inner Join ssurgo.mapunit On mapunit.mukey=clipped attribute table mukey
Group by mukey, muname, aoa_id, aoa_mu_area
Order by mukey
```

#Compile list of soil components per mapunit and compute their areas

```
Select
    temp_aoa_mu.aoa_id
    temp_aoa_mu.mukey
    temp_aoa_mu.muname
    temp_aoa_mu.aoa_mu_area
    component.cokey
    component.compname
    temp_aoa_mu.aoa_mu_area * component.comppct_r As aoa_comp_area
Into temp_aoa_comp
From temp_aoa_mu Inner Join ssurgo.component On component.mukey =
temp_aoa_mu.mukey
Order By mukey, cokey
```

#Sum component perentages for each mapunit

```
    temp_aoa_comp.mukey
    sum(temp_aoa_comp.aoa_comp_area) / aoa_mu_area As mu_comp_pct
Into temp_mu_comp_adj_pct
From temp_aoa_comp
Group by temp_aoa_comp.mukey
```

#Adjust mapunit component percentage and compute AoA percentage of each component

```
Select
    temp_aoa_comp.aoa.id
    temp_aoa_comp.mukey
    temp_aoa_comp.muname
```

temp_aoa_comp.cokey
temp_aoa_comp.compname
temp_aoa_comp.aoa_comp_area /mu_comp_adj_pct.mu_comp_pct As
aoa_comp_area_r
aoa_comp_area_r / aoa_area As aoa_comp_pct_r
Into temp_output
From temp_aoa_comp Inner Join temp_mu_comp_adj_pct On
temp_mu_comp_adj_pct.mukey=temp_aoa_comp.mukey

#Remove soil components from list less than the AoA filter percentage
Delete From temp_output
Where aoa_pct_r < aoa_filter_pct

2.5. Output
#List of soil components in the AoA with following attributes
aoa_id
mukey
muname
cokey
compname
aoa_comp_area_r
aoa_comp_pct_r

3. <u>Soil Component Attributes for WQM (WQMSCAttr)</u>
Note: this WQM component gets soil component attributes to feed WQM components for computing soil leaching and runoff potential for sediment, nutrient, and pesticide WQM concerns

3.1. Input
#AoA soil component list (output from WQM component 2 - AoASCList)
Aoa identifier
cokey
compname
aoa_comp_area

3.2. Reference Data
SSURGO mapunit component tables and attributes

3.3. Methods
For each AoA
For each soil component (cokey) in the AoA
#Get component-level parameters (hydrologic soil group, slope, taxonomic order)
cokey in this iteration = this_cokey
Select
component.hydgrp (hydrologic soil group)
component.slope_r (representative slope)
component.taxorder (soil taxonomic order)
Into temp_comp_attr

From ssurgo.component
Where component.cokey=this_cokey

#For this cokey
If any value in temp_comp_attr NULL
    Break and go to next cokey
Else
    aoa_comp_hsg = component.hydgrp
    aoa_comp_slope = component.slope_r
    aoa_comp_taxorder = component.taxorder

If aoa_comp_slope > 15
    aoa_comp_slope15 = True
Else
    aoa_comp_slope15 = False

#Get following attributes for the horizons (layers) of this soil component
Select
    chorizon.chkey
    chorizon.kffact
    chorizon.kwfact
    chorizon.om_r
    chorizon.hzthk_r
    chorizon.hzdept_r
    chorizon.hzdepb_r
Into temp_hz_attr
From ssurgo.component
Inner Join ssurgo.chorizon On chorizon.cokey=this_cokey
Order by chkey (surface horizon on top, bottom horizon on bottom.. ordering by hzdept_r ascending may be better)

For the first horizon of this soil component
    #Get first horizon thickness
    If hzthk_r for this_horizon is NULL
        aoa_comp_hzthk = hzdepb_r – hzdept_r
    Else
        aoa_comp_hzthk = hzthk_r

    #Get first horizon organic matter
    aoa_comp_om = component.chorizon.om_r
If aoa_comp_om NULL
    Break and go to next cokey

#Resolve and get K Factor
For each horizon of this soil component
    If aoa_comp_hsg == D and aoa_comp_taxorder == Histosols and kffact NULL and kwfact NULL

aoa_comp_kfact = 0.02
Else if kffact NULL and kwfact NULL
Go to the next horizon
Else if kffact NOT NULL
aoa_comp_kfact = kffact
Terminate iteration
Else if kffact NULL and kwfact NOT NULL
aoa_comp_kfact = chorizon.kwfact
Terminate iteration

If aoa_comp_kfact NULL
Break and go to next cokey

#Iterate through each horizon (profile) of the soil component to get data for computing a weighted average rock fragment volume
For each soil horizon of this soil component (chkey where chorizon.cokey == this_cokey)
this_horizon = chkey of this iteration

#Get and sum rock fragment volumes in this horizon (horizon can have volumes broken down by size)
Select
chfrags.chfragskey
chfrags.fragvol_r
From ssurgo.chfrags
Inner Join ssurgo.shfrags On chfrags.chkey=this_horizon

For each chfragskey of this_horizon
hz_frag_vol = hz_frag_vol + fragvol_r

#Compute running total soil component profile thickness
If hzthk_r for this_horizon is NULL
this_hz_thk = hzdepb_r – hzdept_r
Else
this_hz_thk = hzthk_r

profile_thk = profile_thk + this_hz_thk

#Compute volume x horizon thickness product for this horizon and add to product for soil component
this_hz_product = this_hz_thk * hz_frag_vol
this_comp_product = this_comp_product + this_hz_product

#Compute weighted average rock fragment volume for this soil component
aoa_comp_coarse_frag = this_comp_product / profile_thk

#Compute whether this soil component has perched, apparent, or no water table

```
With WT1 As (Select
    component.cokey,
    component.compname,
    component.comppct_r,
    MIN(cosoilmoist.soimoistdept_r) As wtbl_top_min,
    MAX(cosoilmoist.soimoistdepb_r) As wtbl_bot_max
From ssurgo.component
Inner Join ssurgo.comonth On component.cokey=comonth.cokey
Inner Join ssurgo.cosoilmoist On comonth.comonthkey=cosoilmoist.comonthkey
Where component.cokey='this cokey value' and cosoilmoist.soimoiststat='Wet'
Group By component.cokey, component.compname, component.comppct_r
Order By component.cokey),
WT2 As (Select
    WT1.cokey,
    WT1.compname,
    WT1.comppct_r,
    WT1.wtbl_top_min,
    WT1.wtbl_bot_max,
    MAX(cosoilmoist.soimoistdept_r) As nonwet_top_max
From WT1
Left Outer Join ssurgo.comonth On WT1.cokey=comonth.cokey
Left Outer Join ssurgo.cosoilmoist On comonth.comonthkey=cosoilmoist.comonthkey
Where WT1.cokey='this_cokey value' and (cosoilmoist.soimoiststat NOT IN ('Wet') OR
cosoilmoist.soimoiststat IS NULL)
Group By WT1.cokey, WT1.compname, WT1.comppct_r, WT1.wtbl_top_min,
WT1.wtbl_bot_max)
Select
    WT2.cokey,
    WT2.compname,
    WT2.comppct_r,
    WT2.wtbl_top_min,
    WT2.wtbl_bot_max,
    WT2.nonwet_top_max,
    case when (wtbl_bot_max < 183 or nonwet_top_max >= wtbl_bot_max) then
    'Perched' else 'Apparent' end as wtkind
From WT2

If wtkind NULL
    aoa_comp_wtbl = None
Else
    aoa_comp_wtbl = wtkind

If wtbl_top_min <= 61 (24 inches in round centimeters)
    aoa_comp_hwt_lt_24 = True
Else
    aoa_comp_hwt_lt_24 = False
```

#Set macropores (soil cracks) parameter
aoa_comp_cracksgr24 = False

3.4. Output

#AoA soil component list containing all components with following WQM attributes

AoA identifier
- cokey
- compname
- aoa_comp_area
- aoa_comp_hsg
- aoa_comp_taxorder
- aoa_comp_kfact
- aoa_comp_slope
- aoa_comp_coarse_frag
- aoa_comp_om
- aoa_comp_hzdepth
- aoa_comp_wtbl
- aoa_comp_cracksgr24
- aoa_comp_slopegr15
- aoa_comp_hwt_lt_24

Service WQM-3: Pesticide Product List (PestProdList)

Purpose: This service returns a list of pesticide products and their active ingredients from the wqm_pesticide_products table of the WQM Data Mart. The list is filtered by criteria provided in the request payload.

Service Signature

Request Payload

pp_filter_name … character varying(20); Pesticide Product Filter Name; values are reg_no, prod_name, type_desc, pc_code, and ai_name
pp_filter_value … character varying(255); Pesticide Product Filter Value
begins_with … Boolean; Pesticide Product Begins With
contains … Boolean; Pesticide Product Contains
ends_with … Boolean; Pesticide Product Ends With

Result Payload

reg_no … character varying(30); EPA product registration number (EPA Reg. No.)
prod_name … character varying(120); Pesticide Product Name
type_desc … character varying(60); Pesticide Product Type
pc_code … character varying(10); Pesticide Chemical Code
ai_name … charater varying(255); Active Ingredient Name
pc_pct … numeric(4,1); Active Ingredient Percentage

Reference Data Sources

WQM Data Mart wqm_pesticide_products table
833 pesticide active ingredients (pc_code/ai_name)
7,433 EPA registered pesticides (reg_no)
18,075 pesticide product names (prod_name)
44 pesticide product types (type_desc)
44,179 total records in wqm_pesticide_products table

The wqm_pesticides_products table contains content from the Product, Formula, Ais, Prodtype, and Typename tables of the NRCS Pesticide Database, which can be downloaded from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/crops/npm/?cid=stelprdb1044769. The latest version is March 25, 2015.

Component

4. Pesticide Product Attributes for WQM (PestProdAttr)

4.1. Input
pp_filter_name
pp_filter_value
begins_with
contains
ends_with

Note: inputs can be partial strings of the actual character string in the wqm_pesticide_products table; also only one Boolean can be True for each pesticide product filter value

The mostly likely application scenarios will involve the user entering the pesticide active ingredient name and/or product name (or partial name) as filter criteria.

4.2. Methods

```
For each pp_filter_name
    If begins_with True
        add_to_where_clause = pp_filter_name Like %pp_filter_value
        If end of iteration
            where_clause = where_clause + add_to_where_clause
        Else
            where_clause = where_clause + add_to_where_clause + "And"
    Else if contains True
        add_to_where_clause = pp_filter_name = %pp_filter_value%
        If end of iteration
            where_clause = where_clause + add_to_where_clause
        Else
            where_clause = where_clause + add_to_where_clause + "And"
    Else if ends_with True
        add_to_where_clause = pp_filter_name = pp_filter_value%
        If end of iteration
            where_clause = where_clause + add_to_where_clause
        Else
            where_clause = where_clause + add_to_where_clause + "And"
    Else
        add_to_where_clause = pp_filter_name = pp_filter_value
        If end of iteration
            where_clause = where_clause + add_to_where_clause
        Else
            where_clause = where_clause + add_to_where_clause + "And"

Select
    reg_no
    prod_name
    type_desc
    pc_code
    ai_name
    pc_pct
From wqm_pesticide_products
Where where_clause
Order By ai_name
```

4.3. Output

Table or array containing the following attributes rendered to JSON result payload

- reg_no
- prod_name
- type_desc
- pc_code
- ai_name
- pc_pct

Service WQM-4: Pesticide Loss Potentials (WQMPestLossPot)

Purpose: Consume a request payload of one or more pesticide application operations from the crop rotation for an area of analysis, get attributes from the NRCS pesticide database for each instance of pesticide active ingredient applied, and populate the results payload with the added attributes. The pesticide active ingredient attributes will be used later in WQM to compute hazard ratings.

The default application populating the request payload will be the NRCS Rotation Builder (also called the Management Editor). The expected workflow:

a. User selects land management operation (LMOD) template containing one or more pesticide application operations.
b. User associates one or more pesticide products and application rate to each pesticide application operation (see previous WQM service PestProdList)
c. User chooses application area for each pesticide application operation
d. User chooses application method for each pesticide application operation
e. Application populates the request payload defined below.

Service Description

Get pesticide attributes from the WQM data mart for each farm operation pesticide applied in the crop rotation or management, and compute leaching, solution runoff, and adsorbed runoff potentials for each pesticide applied.

Service Signature

Request Payload

AoA identifier… one or more
Operation identifier… Pesticide application operation identifier … one or more
op_pest_id … Pesticide identifier, EPA Pesticide Chemical Code (PC_CODE) … one or more per operation
app_rate… Pesticide application rate … one per pesticide
choices are STANDARD, LOW, ULTRA LOW
app_area… Pesticide application operation area … one per operation
choices are Broadcast, Banded, Spot Treatment
app_method… Pesticide application operation method … one per operation
choices are Surface Applied, Soil Incorporated, Foliar Application

Result Payload

AoA identifier
Operation identifier… Pesticide application operation identifier … one or more
op_pest_id …Pesticide identifier, EPA Pesticide Chemical Code (PC_CODE) … one or more per operation
app_rate … Pesticide application rate … one per pesticide
ai_name… Active ingredient name (AI_NAME)
ai_ph… Active ingredient pH of associate properties (PH)
ai_hl… Active ingredient field half life (HL)

ai_koc… Active ingredient soil organic carbon sorption coefficient (KOC)
ai_sol... Active ingredient solubility in water (SOL)
ai_humtox… Active ingredient human toxicity value – long term
ai_humtoxtype… Active ingredient human toxicity type
ai_fishtox… Active ingredient maximum acceptable toxicant concentration – fish
ai_fishtoxtype… Active ingredient fish toxicity type
ai_plp… Active ingredient pesticide leaching potential
ai_psrp… Active ingredient pesticide soil leaching potential
ai_parp… Active ingredient pesticide adsorbed runoff potential
op_app_area… Pesticide application operation area
op_app_method… Pesticide application operation method

Note: Some crop rotations (managements) will have repeated identical pesticide applications through the rotation, which would result in duplicate data using the results payload construct above. There may be a better way to model the results payload.

Reference Data Sources

WinPST 3.1 database August 2014 is the source of pesticide data for the WQM Data Mart. Data from 9 data elements across four tables populated the wqm_pesticide data table containing 838 records.

Component

5. Pesticide Active Ingredient Attributes for WQM (PestAIAttr)

5.1. Input

AoA identifier
operation_id … one or more
op_pest_id … one or more
app_rate
app_area
app_method

AoAId	1	1	1
operation_id	1	1	2
op_pest_id	101101	101702	101101
app_rate	STANDARD	LOW	LOW
app_area	Broadcast	Broadcast	Banded
app_method	Surface Applied	Surface Applied	Soil Incorporated

5.2. Reference Data

WQM Data Mart wqm_pesticides table

PC_CODE [PK] character varying(10)	AI_NAME character varying(255)	PH double precision	SOL_RV double precision	KOC_RV double precision	SOIL_HL_RV double precision	FISH_TOX_PPB double precision	FISH_TOX_TYPE character varying(255)	HUMAN_TOX_PPB double precision	HUMAN_TOX_TYPE character varying(255)
100053	Brewer's yeast extract hyc		1	3500	20	510	MATC	50000	HA*
100101	Cyanazine		170	190	14	1411	MATC	1	HA
100104	Kaolin		1	3500	12	510	MATC	50000	HA*
100137	Corn gluten meal		1	3500	12	510	MATC	50000	HA*
100201	Isopropalin		0.1	10000	100	99	MATC	105	HA*
100249	Penflufen		10.9	365	274	23	NOEL	28	HA*
100301	Methidathion		220	400	7	0.15	MATC	0.7	HA*
100501	Methiocarb		24	300	30	0.05	MATC	35	HA*
100601	Fenamiphos		400	100	50	0.33	MATC	0.7	HA
100628	Meat meal		1	3500	12	9	MATC	50000	HA*
101101	Metribuzin		1220	60	40	3000	MATC	70	HA
101103	Pymetrozine	6.5	290	1100	491	11700	MATC	9.1	CHCL
101201	Methamidophos		1000000	5	6	165	MATC	7	HA*
101601	Cyhexatin		1	4000	50	0.08	MATC	5.2	HA*
101701	Propyzamide		15	200	60	1187	MATC	10	CHCL

5.3. Methods

For each AoA

For each pesticide application operation

For each operation pesticide (PC_CODE)

Get wqm attributes from the NRCS Pesticide Database

AI_NAME as ai_name

PH as ai_ph

SOIL_HL_RV as ai_hl… Field half life

KOC_RV as ai_koc… Soil organic carbon sorption coefficient

SOL_RV as ai_sol... Solubility in water

HUMAN_TOX_PPB as ai_humtox … Human toxicity value – long term

HUMAN_TOX_TYPE as ai_humtoxtype … Human toxicity type

FISH_TOX_PPB as ai_fishtox … Maximum acceptable toxicant concentration – fish

FISH_TOX_TYPE as ai_fishtoxtype … Fish toxicity type

#Compute pesticide leaching potential fore each operation pesticide

log_val = log(ai_hl) * (4 – log(ai_koc))

If log_val => 2.8

If (app_area == Spot Treatment) or (app_rate == ULTRA LOW)

ai_plp = LOW

Else if (app_area == Banded) or (app_method == Foliar Application) or (app_rate == LOW)

ai_plp = INTERMEDIATE

else

ai_plp = HIGH

Else if log_val < 0.0 or (ai_sol < 1 and ai_hl <= 1)

ai_plp = VERY LOW

Else if log_val <= 1.8

If (app_area == Banded or Spot Treatment) or (app_method == Foliar Application) or (app_rate == LOW or ULTRA LOW)

ai_plp = VERY LOW

Else

ai_plp = LOW

Else

If (app_area == Spot Treatement) or (app_rate == ULTRA LOW)
ai_plp = VERY LOW
Else if (app_area == Banded) or (app_method == Foliar Application) or (app_rate == LOW)
ai_plp = LOW
else
ai_plp = INTERMEDIATE

#Compute pesticide solution runoff potential for each operation pesticide
If ((ai_sol >= 1) and (ai_hl > 35) and (ai_koc < 100000)) or ((ai_sol >= 10) and (ai_sol < 100) and (ai_koc <= 700))
If (app_area == Spot Treatment) or (app_rate == ULTRA LOW)
ai_psrp = LOW
Else if (app_area == Banded) or (app_method == Foliar Application or Soil Incorporated) or (app_rate == LOW)
ai_psrp = INTERMEDIATE
Else
ai_psrp = HIGH
Else if (ai_koc >= 100000) or ((ai_koc .+ 1000) and (ai_hl <= 1)) or ((ai_sol < 0.5) and ai_hl < 35))
If (app_area == Banded or Spot Treatment) or (app_method == Foliar Application or Soil Incorporated) or (app_rate == LOW or ULTRA LOW)
ai_psrp = VERY LOW
Else
ai_psrp = LOW
Else
If (app_area == Spot Treatment) or (app_rate == ULTRA LOW)
ai_psrp = VERY LOW
Else if (app_area == Banded) or (app_method == Foliar Application or Soil Incorporated) or (app_rate == LOW)
ai_psrp = LOW
Else
ai_psrp = INTERMEDIATE

#Compute pesticide adsorbed runoff potential for each operation pesticide
If ((ai_hl >= 40) and (ai_koc >= 1000)) or ((ai_hl >= 40) and (ai_koc >= 500) and ai_sol <= 0.5))
If (app_area == Spot Treatment) or (app_rate == ULTRA LOW)
ai_parp = LOW
Else if (app_area == Banded) or (app_method == Foliar Application or Soil Incorporated) or (app_rate == LOW)
ai_parp = INTERMEDIATE
Else
ai_parp = HIGH
Else if (ai_hl <= 1) or ((ai_hl <=2) and ai_koc <= 500)) or ((ai_hl <=4) and (ai_koc <= 900) and (ai_sol >= 0.5)) or ((ai_hl <= 40) and (ai_koc <= 500) and (ai_sol >= 0.5)) or ((ai_hl <= 50) and (ai_koc <= 900) and (ai_sol >= 2))

If (app_area == Banded or Spot Treatment) or (app_method == Foliar Application or Soil Incorporated) or (app_rate == LOW or ULTRA LOW)
ai_parp = VERY LOW
Else
ai_parp = LOW
Else
If (app_area == Spot Treatment) or (app_rate == ULTRA LOW)
ai_parp = VERY LOW
Else if (app_area == Banded) or (app_method == Foliar Application or Soil Incorporated) or (app_rate == LOW)
ai_parp = LOW
Else
ai_parp = INTERMEDIATE

5.4. Output

AoA identifier

Operation identifier

op_pesticide_id (PC_CODE)

app_rate
ai_name
ai_ph
ai_hl
ai_koc
ai_sol
ai_humtox
ai_humtoxtype
ai_fishtox
ai_fishtoxtype
ai_plp
ai_psrp
ai_parp

op_app_area
op_app_method

Service WQM-5: Nutrient Soil Leaching Potential (NutrientSLP)

Purpose: Compute nutrient soil leaching potential for soil components (comp_nslp) in an area of analysis, and compute soil leaching potential for the area of analysis (aoa_nslp). Although there may be multiple uses of this service, the primary use will be to consume data from the WQMSoilAttributes service to compute aoa_nslp values for subsequent use in computing WQM threshold treatment level scores.

Service Signature

Request Payload

#Usually from WQMSoilAttributes service (WQM-2)
AoA identifier… one
#Soil component key (character)
cokey… one or more soil components in the AoA
#Soil component area in the area of analysis (double)
aoa_comp_area
#Hydrologic soil group of the soil component (character)
aoa_comp_hsg
#Taxonomic order of the soil component (character)
aoa_comp_taxorder
#Representative K factor of the soil component (character)
aoa_comp_kfact
#Representative slope of the soil component (double)
aoa_comp_slope
#Representative coarse rock fragments of the soil component (integer)
aoa_comp_coarse_frag
#Whether this soil component instance is drained (Boolean)
aos_comp_drained
#Kind of water table, character varying(30), values are None, Apparent, Perched
aoa_comp_wtbl
#High water table within 24 inches of soil surface; Boolean; FALSE if aoa_comp_wtbl None
aoa_comp_hwt_lt_24

Result Payload

AoA identifier… one
#Soil leaching potential of the area of analysis
aoa_nslp (char)
#Soil component key
cokey… one or more
#Soil leaching potential of the soil component
comp_nslp (char)

Reference Data Source

None

Components

6. Computation of Nutrient Leaching Potential for a Soil Component (SCNutSLP)

6.1. Input

AoAid	1							
cokey	11150284	11150285	11150286	11150287	11150288	11150289	11150290	11150291
compname	Test1	Test2	Test3	Test4	Test5	Test6	Test7	Test8
aoa_comp_area	45.84	63.72	25.6	33.5	10.77	36.93	44.33	21.76
aoa_comp_hsg	B	A	A/D	C	D	B/D	D	B
aoa_comp_taxorder	Aridisols	Mollisols	Spodosols	Inceptisols	Histosols	Entisols	Mollisols	Mollisols
aoa_comp_kfact	0.24	0.37	0.21	0.42	0.02	0.28	0.32	0.48
aoa_comp_slope	8	12	15	16	3	1	14	5
aoa_comp_coarse_frag	3.7	0	12	6	2	3	7	5
aoa_comp_drained	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
aoa_comp_wtbl	None	Apparent	None	None	Apparent	Perched	None	Perched
aoa_comp_hwt_lt_24	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE

6.2. Methods

For each AoA

#Compute nutrient soil leaching potential for each soil component in the AoA

For each soil component in the AoA

If aoa_comp_taxorder == Histosols

comp_nslp = HIGH

comp_nslp_number = 3

Else if aoa_comp_wtbl == (Apparent and aoa_comp_drained FALSE) or aoa_comp_hwt_lt_24 TRUE

comp_nslp = HIGH

comp_nslp_number = 3

Else if aoa_comp_hsg == A (and not Histosol)

If aoa_comp_slope > 12

If aoa_comp_coarse_frag > 10%

comp_nslp = HIGH

comp_nslp_number = 3

Else

comp_nslp = MODERATELY HIGH

comp_nslp_number = 2

Else if aoa_comp_slope <= 12

comp_nslp = HIGH

comp_nslp_number = 3

Else if aoa_comp_hsg == B (and not Histosol)

If (aoa_comp_slope <= 12 and aoa_comp_kfact >= 0.24) or (aoa_comp_slope > 12)

If aoa_comp_coarse_frag >10% and <= 30%

comp_nslp = MODERATELY HIGH

comp_nslp_number = 2

Else if aoa_comp_coarse_frag > 30%

comp_nslp = HIGH

comp_nslp_number = 3

```
        Else
            comp_nslp = MODERATE
            comp_nslp_number = 1
    Else if aoa_comp_slope >=3 and <=12 and aoa_comp_kfact < 0.24
        If aoa_comp_coarse_frag >10%
            comp_nslp = HIGH
            comp_nslp_number = 3
        Else
            comp_nslp = MODERATELY HIGH
            comp_nslp_number = 2
    Else if aoa_comp_slope <3 and aoa_comp_kfact <0.24
        comp_nslp = HIGH
        comp_nslp_number = 3
Else aoa_comp_hsg == C (and not Histosol)
    If aoa_comp_coarse_frag >30%
        comp_nslp = HIGH
        comp_nslp_number = 3
    Else if aoa_comp_coarse_frag >10% and <=30%
        comp_nslp = MODERATELY HIGH
        comp_nslp_number = 2
    Else
        comp_nslp = MODERATE
        comp_nslp_number = 1
Else if not Histosol and aoa_comp_hsg == D (and not Histosol)
    If aoa_comp_coarse_frag >30%
        comp_nslp = MODERATELY HIGH
        comp_nslp_number = 2
    Else if aoa_comp_coarse_frag >10% and <=30%
        comp_nslp = MODERATE
        comp_nslp_number = 1
    Else
        comp_nslp = LOW
        comp_nslp_number = 0
Else if not Histosol and aoa_comp_hsg == A/D (and not Histosol)
    If aoa_comp_drained TRUE (A HSG applies)
        If aoa_comp_slope > 12
            If aoa_comp_coarse_frag > 10%
                comp_nslp = HIGH
                comp_nslp_number = 3
            Else
                comp_nslp = MODERATELY HIGH
                comp_nslp_number = 2
        Else if aoa_comp_slope <= 12
            comp_nslp = HIGH
            comp_nslp_number = 3
    Else if aoa_comp_drained FALSE (D HSG applies)
        If aoa_comp_coarse_frag >30%
```

```
                comp_nslp = MODERATELY HIGH
                comp_nslp_number = 2
            Else if aoa_comp_coarse_frag >10% and <=30%
                comp_nslp = MODERATE
                comp_nslp_number = 1
            Else
                comp_nslp = LOW
                comp_nslp_number = 0
Else if not Histosol and aoa_comp_hsg == B/D (and not Histosol)
    If aoa_comp_drained TRUE (B HSG applies)
        If (aoa_comp_slope <= 12 and aoa_comp_kfact >= 0.24) or (aoa_comp_slope
        > 12)
            If aoa_comp_coarse_frag >10% and <= 30%
                comp_nslp = MODERATELY HIGH
                comp_nslp_number = 2
            Else if aoa_comp_coarse_frag > 30%
                comp_nslp = HIGH
                comp_nslp_number = 3
            Else
                comp_nslp = MODERATE
                comp_nslp_number = 1
        Else if aoa_comp_slope >=3 and <=12 and aoa_comp_kfact < 0.24
            If aoa_comp_coarse_frag >10%
                comp_nslp = HIGH
                comp_nslp_number = 3
            Else
                comp_nslp = MODERATELY HIGH
                comp_nslp_number = 2
        Else if aoa_comp_slope <3 and aoa_comp_kfact <0.24
            comp_nslp = HIGH
            comp_nslp_number = 3
    Else if aoa_comp_drained FALSE (D HSG applies)
        If aoa_comp_coarse_frag >30%
            comp_nslp = MODERATELY HIGH
            comp_nslp_number = 2
        Else if aoa_comp_coarse_frag >10% and <=30%
            comp_nslp = MODERATE
            comp_nslp_number = 1
        Else
            comp_nslp = LOW
            comp_nslp_number = 0
Else if not Histosol and aoa_comp_hsg == C/D
    If aoa_comp_drained TRUE (C HSG applies)
        If aoa_comp_coarse_frag >30%
            comp_nslp = HIGH
            comp_nslp_number = 3
        Else if aoa_comp_coarse_frag >10% and <=30%
```

comp_nslp = MODERATELY HIGH
comp_nslp_number = 2
Else
comp_nslp = MODERATE
comp_nslp_number = 1
Else if aoa_comp_drained FALSE (D HSG applies)
If aoa_comp_coarse_frag >30%
comp_nslp = MODERATELY HIGH
comp_nslp_number = 2
Else if aoa_comp_coarse_frag >10% and <=30%
comp_nslp = MODERATE
comp_nslp_number = 1
Else
comp_nslp = LOW
comp_nslp_number = 0

6.3. Output

#This output goes into the Results Payload and the next component (or method)

AoA soil component list containing all components and their NSLP ratings
AoA identifier
cokey
compname
aoa_comp_area
comp_nslp
comp_nslp_number

7. Computation of Nutrient Soil Leaching Potential for an Area of Analysis (AoANutSLP)

7.1. Input

#AoA soil component list containing all components and their NSLP ratings (output from SCNutSLP component 6)

AoA identifier
cokey
compname
aoa_comp_area
comp_nslp
comp_nslp_number

7.2. Methods

#Compute weighted average nutrient soil leaching potential for the AoA

For each AoA
For each AoA soil component
cum_NSLP_product = cum_NSLP_product + (comp_nslp_number * aoa_comp_area)
aoa_area = aoa_area + aoa_comp_area
aoa_nslp_fract = cum_NSLP_product / aoa_area
If aoa_nslp_fract <= 0.50
aoa_nslp = LOW
Else if aoa_nslp_fract >0.50 and <=1.50

aoa_nslp = Moderate
Else if aoa_nslp_fract > 1.50 and <=2.50
aoa_nslp = MODERATELY HIGH
Else
aoa_nslp = HIGH

7.3. Output

#This output goes into the Results Payload

AoA identifier

aoa_nslp

Service WQM-6: Sediment and Nutrient Soil Runoff Potential (SedNutSRP)

Purpose: Compute sediment and nutrient soil runoff potential for soil components (comp_srp) in an area of analysis, and compute soil runoff potential for the area of analysis (aoa_srp). Although there may be multiple uses of this service, the primary use will be to consume data from the WQMSoilAttributes service to compute aoa_srp values for subsequent use in computing WQM threshold treatment level scores.

Service Signature

Request Payload

#Usually from WQMSoilAttributes service (WQM-2)
AoA identifier… one
#Soil component key (character)
cokey… one or more soil components in the AoA
#Soil component area in the area of analysis (double)
aoa_comp_area
#Hydrologic soil group of the soil component (character)
aoa_comp_hsg
#Taxonomic order of the soil component (character)
aoa_comp_taxorder
#Representative K factor of the soil component (character)
aoa_comp_kfact
#Representative slope of the soil component (double)
aoa_comp_slope
#Representative coarse rock fragments of the soil component (integer)
aoa_comp_coarse_frag
#Whether this soil component instance is drained (Boolean)
aos_comp_drained
#Kind of water table, character varying(30), values are None, Apparent, Perched
aoa_comp_wtbl
#High water table within 24 inches of soil surface; Boolean; FALSE if aoa_comp_wtbl None
aoa_comp_hwt_lt_24

Result Payload

AoA identifier
#Soil runoff potential for the area of analysis
aoa_srp
#Soil component key
cokey… one or more
#Soil runoff potential for soil component
comp_srp

Reference Data Source

None

Components

8. Computation of Sediment and Nutrient Runoff Potential for a Soil Component (SCSedNutSRP)

8.1. Input

AoAid	1							
cokey	11150284	11150285	11150286	11150287	11150288	11150289	11150290	11150291
compname	Test1	Test2	Test3	Test4	Test5	Test6	Test7	Test8
aoa_comp_area	45.84	63.72	25.6	33.5	10.77	36.93	44.33	21.76
aoa_comp_hsg	B	A	A/D	C	D	B/D	D	B
aoa_comp_taxorder	Aridisols	Mollisols	Spodosols	Inceptisols	Histosols	Entisols	Mollisols	Mollisols
aoa_comp_kfact	0.24	0.37	0.21	0.42	0.02	0.28	0.32	0.48
aoa_comp_slope	8	12	15	16	3	1	14	5
aoa_comp_coarse_frag	3.7	0	12	6	2	3	7	5
aoa_comp_drained	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
aoa_comp_wtbl	None	Apparent	None	None	Apparent	Perched	None	Perched
aoa_comp_hwt_lt_24	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE

8.2. Methods

For each AoA

#Compute sediment and nutrient soil runoff potential for each soil component in the AoA

For each soil component (cokey) in the AoA

If aoa_comp_hsg == A

comp_srp = LOW

comp_srp_number =0

Else if aoa_comp_hsg == B

If aoa_comp_slope < 4

comp_srp = LOW

comp_srp_number = 0

Else if aoa_comp_slope >=4 and <=6 and aoa_comp_kfact < 0.32

comp_srp = MODERATE

comp_srp_number = 1

Else if aoa_comp_slope >=4 and <=6 and aoa_comp_kfact >= 0.32

comp_srp = MODERATELY HIGH

comp_srp_number = 2

Else if aoa_comp_slope > 6

comp_srp = HIGH

comp_srp_number = 3

Else if aoa_comp_hsg == C

If aoa_comp_slope < 2

comp_srp = LOW

comp_srp_number = 0

Else if aoa_comp_slope >=2 and <=6 and aoa_comp_kfact < 0.28

comp_srp = MODERATE

comp_srp_number = 1

Else if aoa_comp_slope >=2 and <=6 and aoa_comp_kfact >= 0.28

comp_srp = MODERATELY HIGH

comp_srp_number = 2

Else if aoa_comp_slope > 6

```
            comp_srp = HIGH
            comp_srp_number = 3
Else if aoa_comp_hsg == D
    If aoa_comp_wtbl == Perched or Apparent and aoa_comp_hwt_lt_24 TRUE
            comp_srp = HIGH
            comp_srp_number = 3
    Else if aoa_comp_slope <2 and aoa_comp_kfact < 0.28
            comp_srp = LOW
            comp_srp_number = 0
    Else if aoa_comp_slope <2 and aoa_comp_kfact >= 0.28
            comp_srp = MODERATE
            comp_srp_number = 1
    Else if aoa_comp_slope >=2 and <=4
            comp_srp = MODERATELY HIGH
            comp_srp_number = 2
    Else if aoa_comp_slope > 4
            comp_srp = HIGH
            comp_srp_number = 3
 Else if aoa_comp_hsg == A/D
     If aoa_comp_drained TRUE (A HSG applies)
            comp_srp = LOW
            comp_srp_number = 0
     Else if aoa_comp_drained FALSE (D HSG applies)
            If aoa_comp_slope <2 and aoa_comp_kfact < 0.28
                    comp_srp = LOW
                    comp_srp_number = 0
            Else if aoa_comp_slope < 2 and aoa_comp_kfact >= 0.28
                    comp_srp = MODERATE
                    comp_srp_number = 1
            Else if aoa_comp_slope >=2 and <=4
                    comp_srp = MODERATELY HIGH
                    comp_srp_number = 2
            Else if (aoa_comp_slope >4) or (aoa_comp_wtbl == Perched or Apparent and
            aoa_comp_hwt_lt_24 TRUE)
                    comp_srp = HIGH
                    comp_srp_number = 3
 Else if aoa_comp_hsg == B/D
     If aoa_comp_drained TRUE (B HSG applies)
            If aoa_comp_slope < 4
                    comp_srp = LOW
                    comp_srp_number = 0
            Else if aoa_comp_slope >=4 and <=6 and aoa_comp_kfact < 0.32
                    comp_srp = MODERATE
                    comp_srp_number = 1
            Else if aoa_comp_slope >=4 and <=6 and aoa_comp_kfact >= 0.32
                    comp_srp = MODERATELY HIGH
                    comp_srp_number = 2
```

```
        Else if aoa_comp_slope > 6
            comp_srp = HIGH
            comp_srp_number = 3
    Else if aoa_comp_drained FALSE (D HSG applies)
        If aoa_comp_slope <2 and aoa_comp_kfact < 0.28
            comp_srp = LOW
            comp_srp_number = 0
        Else if aoa_comp_slope <2 and aoa_comp_kfact >= 0.28
            comp_srp = MODERATE
            comp_srp_number = 1
        Else if aoa_comp_slope >=2 and <=4
            comp_srp = MODERATELY HIGH
            comp_srp_number = 2
        Else if (aoa_comp_slope >4) or (aoa_comp_wtbl == Perched or Apparent and
        aoa_comp_hwt_lt_24 TRUE)
            comp_srp = HIGH
            comp_srp_number = 3
Else if aoa_comp_hsg == C/D
    If aoa_comp_drained TRUE (C HSG applies)
        If aoa_comp_slope < 2
            comp_srp = LOW
            comp_srp_number = 0
        Else if aoa_comp_slope >=2 and <=6 and aoa_comp_kfact < 0.28
            comp_srp = MODERATE
            comp_srp_number = 1
        Else if aoa_comp_slope >=2 and <=6 and aoa_comp_kfact >= 0.28
            comp_srp = MODERATELY HIGH
            comp_srp_number = 2
        Else if aoa_comp_slope > 6
            comp_srp = HIGH
            comp_srp_number = 3
    Else if aoa_comp_drained FALSE (D HSG applies)
        If aoa_comp_slope <2 and aoa_comp_kfact < 0.28
            comp_srp = LOW
            comp_srp_number = 0
        Else if aoa_comp_slope <2 and aoa_comp_kfact >= 0.28
            comp_srp = Moderate
            comp_srp_number = 1
        Else if aoa_comp_slope >=2 and <=4
            comp_srp = MODERATELY HIGH
            comp_srp_number = 2
        Else if (aoa_comp_slope >4) or (aoa_comp_wtbl == Perched or Apparent and
        aoa_comp_hwt_lt_24 TRUE)
            comp_srp = HIGH
            comp_srp_number = 3
```

8.3. Output
AoA identifier
cokey
compname
aoa_comp_area
comp_srp
comp_srp_number

9. Computation of Sediment and Nutrient Runoff Potential of an Area of Analysis (AoASedNutSRP)

9.1. Input
#From SCSedNutSRP component 8
AoA identifier
cokey
compname
aoa_comp_area
comp_srp
comp_srp_number

9.2. Methods
#Compute weighted average nutrient soil leaching potential for the AoA
For each AoA
For each AoA component
cum_srp_product = cum_srp_product + (comp_srp_number * aoa_comp_area)
aoa_area = aoa_area + aoa_comp_area
aoa_srp_fract = cum_srp_product / aoa_area
If aoa_srp_fract <= 0.50
aoa_srp = LOW
Else if aoa_srp_fract >0.50 and <=1.50
aoa_srp = MODERATE
Else if aoa_srp_fract > 1.50 and <=2.50
aoa_srp = MODERATELY HIGH
Else
aoa_srp = HIGH

9.3. Output
AoA identifier
aoa_srp

Service WQM-7: Pesticide Soil Leaching Potential (PesticideSLP)

Purpose: Compute pesticide soil leaching potential for soil components (comp_pslp) in an area of analysis, and compute soil leaching potential for the area of analysis (aoa_pslp). Although there may be multiple uses of this service, the primary use will be to consume data from the WQMSoilAttributes service to compute aoa_pslp values for subsequent use in computing WQM threshold treatment level scores.

Service Signature

Request Payload

#Usually from WQMSoilAttributes service (WQM-2)
AoA identifier… one or more
cokey… one or more soil components in the AoA
#Area of the soil component in the AoA (double: acres)
aoa_comp_area
#Hydrologic soil group of the soil component (character: A, B, C, D, A/D, B/D, or C/D)
aoa_comp_hsg
#K factor of the horizon representing the soil component; usually the surface horizon (double: 0.02 to 0.64)
aoa_comp_kfact
#Organic matter content of the horizon representing the soil component (numeric: 0.00-94.00) … most test values should be between 0.00 and 4.00.
aoa_comp_om
#Thickness of horizon representing the soil component (integer: 0-251, service assumes inches)
aoa_comp_hzdepth
#Whether the soil has surface connected macropores to 24 inches (true, false)
aoa_comp_cracksgr24
#Whether the soil has a water table less than 24 inches from the surface (true, false)
aoa_comp_hwt_lt_24

Result Payload

AoA identifier… one or more
#Pesticide soil leaching potential representing the AoA (character: HIGH, INTERMEDIATE, LOW, VERY LOW)
aoa_pslp
cokey… one or more soil components in the AoA
#Pesticide soil leaching potential representing the soil component (character: : HIGH, INTERMEDIATE, LOW, VERY LOW)
comp_pslp

Reference Data Source

SSURGO mapunit component tables and attributes

Components

10. Computation of Pesticide Leaching Potential for a Soil Component (SCPestSLP)

10.1. Input

AoA identifier

cokey

compname

aoa_comp_area

aoa_comp_hsg

aoa_comp_kfact

aoa_comp_om

aoa_comp_hzdepth

aoa_comp_cracksgr24

aoa_hwt_lt_24

10.2. Methods

For the AoA in the request payload

#Compute pesticide soil leaching potential of each soil component in the AoA

For each soil component in the AoA

If aoa_comp_hwt_lt_24 TRUE

comp_pslp = HIGH

comp_pslp_number = 4

Else if ((aoa_comp_hsg == A or A/D) and (aoa_comp_om * aoa_comp_hzdepth <= 30))
or ((aoa_comp_hsg == B or B/D) and (aoa_comp_om * aoa_comp_hzdepth <= 9) and (aoa_comp_kfact <= 0.48))
or ((aoa_comp_hsg == B or B/D) and (aoa_comp_om * aoa_comp_hzdepth <= 15) and (aoa_comp_kfact <= 0.26))

comp_pslp = HIgh

comp_pslp_number = 4

Else if ((aoa_comp_hsg == B or B/D) and (aoa_comp_om * aoa_comp_hzdepth >= 35) and (aoa_comp_kfact >= 0.40))
or ((aoa_comp_hsg == B or B/D) and (aoa_comp_om * aoa_comp_hzdepth >= 45) and (aoa_comp_kfact >= 0.20))
or ((aoa_comp_hsg == C or C/D) and (aoa_comp_om * aoa_comp_hzdepth <= 10) and (aoa_comp_kfact <= 0.28))
or ((aoa_comp_hsg == C or C/D) and (aoa_comp_om * aoa_comp_hzdepth >= 10))

If aoa_comp_cracksgr24 FALSE

comp_pslp = LOW

comp_pslp_number = 2

Else

comp_pslp = INTERMEDIATE

comp_pslp_number = 3

Else if aoa_comp_hsg == D

If aoa_comp_cracksgr24 FALSE

comp_pslp = VERY LOW

comp_pslp_number = 1

Else

comp_pslp = LOW
comp_pslp_number = 2
Else
If aoa_comp_cracksgr24 FALSE
comp_pslp = INTERMEDIATE
comp_pslp_number = 3
Else
comp_pslp = HIGH
comp_pslp_number = 4

10.3. Output
AoA identifier
cokey
compname
aoa_comp_area
comp_pslp
comp_pslp_number

11. <u>Computation of Pesticide Soil Leaching Potential for an Area of Analysis (AoAPestSLP)</u>

11.1. Input
#From SCPestSLP component 10
AoA identifier
cokey
compname
aoa_comp_area
comp_pslp
comp_pslp_number

11.2. Methods
For each AoA
#Compute weighted average pesticide soil leaching potential for the AoA
For each AoA component
cum_pslp_product = cum_pslp_product + (comp_pslp_number * aoa_comp_area)
aoa_area = aoa_area + aoa_comp_area
aoa_pslp_fract = cum_pslp_product / aoa_area
If aoa_pslp_fract <= 1.50
aoa_pslp = VERY LOW
Else if aoa_pslp_fract >1.50 and <=2.50
aoa_pslp = LOW
Else if aoa_pslp_fract > 2.50 and <=3.50
aoa_pslp = INTERMEDIATE
Else
aoa_pslp = HIGH

11.3. Output
AoA identifier
aoa_pslp

Service WQM-8: Pesticide Soil Solution Runoff Potential (PesticideSSRP)

Purpose: Compute pesticide soil solution runoff potential for soil components (comp_ssrp) in an area of analysis, and compute soil solution runoff potential for the area of analysis (aoa_ssrp). Although there may be multiple uses of this service, the primary use will be to consume data from the WQMSoilAttributes service to compute aoa_ssrp values for subsequent use in computing WQM threshold treatment level scores.

Service Signature

Request Payload

#Usually from WQMSoilAttributes service (WQM-2)
AoA identifier… one in the request
cokey… one or more soil components in the AoA
#Area of the soil component in the AoA in acres (double)
aoa_comp_area
#Hydrologic group of the soil component (character: A, B, C, D, A/D, B/D, C/D)
aoa_comp_hsg
#Whether this soil component instance is drained (true/false)
aos_comp_drained

Result Payload

AoA identifier
#Soil solution runoff potential for the area of analysis (character: HIGH, INTEMEDIATE, LOW)
aoa_ssrp
cokey (soil components in the AoA)
#Soil solution runoff potential for the soil component (character: HIGH, INTERMEDIATE, LOW)
comp_ssrp

Reference Data Source

SSURGO mapunit component tables and attributes

Components

12. Computation of Pesticide Soil Solution Runoff Potential for a Soil Component (SCPestSSRP)

12.1. Input
AoA identifier
cokey
compname
aoa_comp_area
aoa_comp_hsg

12.2. Methods
For each AoA in the request payload
#Compute pesticide soil adsorbed runoff potential for each soil component in the AoA
For each soil component in the AoA

If (aoa_comp_hsg == C, C/D, or D)
comp_ssrp = HIGH
comp_sarp_number = 3
Else if (aoa_comp_hsg == A or A/D)
If aoa_comp_drained TRUE
comp_ssrp = LOW
comp_sarp_number = 1
Else if FALSE
comp_ssrp = HIGH
comp_sarp_number = 3
Else if (aoa_comp_hsg == B or B/D)
If aoa_comp_drained TRUE
comp_ssrp = INTERMEDIATE
comp_sarp_number = 2
Else if FALSE
comp_ssrp = HIGH
comp_sarp_number = 3

12.3. Output
AoA identifier
cokey
compname
aoa_comp_area
comp_ssrp
comp_ssrp_number

13. <u>Computation of Pesticide Soil Solution Runoff Potential for an Area of Analysis (AoAPestSSRP)</u>

13.1. Input
#From SCPestSSRP component 12
AoA identifier
cokey
compname
aoa_comp_area
comp_ssrp
comp_ssrp_number

13.2. Methods
For each AoA
#Compute weighted average pesticide soil adsorbed runoff potential for the AoA
For each AoA component
cum_ssrp_product = cum_ssrp_product + (comp_ssrp_number * aoa_comp_area)
aoa_area = aoa_area + aoa_comp_area
aoa_ssrp_fract = cum_ssrp_product / aoa_area
If aoa_ssrp_fract <= 1.50
aoa_ssrp = LOW
Else if aoa_pslp_fract >1.50 and <=2.50
aoa_ssrp = INTERMEDIATE

Else
aoa_ssrp = HIGH

13.3. Output
AoA identifier
aoa_ssrp

Service WQM-9: Pesticide Soil Adsorbed Runoff Potential (PesticideSARP)

Purpose: Compute pesticide soil adsorbed runoff potential for soil components (comp_sarp) in an area of analysis, and compute soil adsorbed runoff potential for the area of analysis (aoa_sarp). Although there may be multiple uses of this service, the primary use will be to consume data from the WQMSoilAttributes service to compute aoa_sarp values for subsequent use in computing WQM threshold treatment level scores.

Service Signature

Request Payload

#Usually from WQMSoilAttributes service (WQM-2)
AoA identifier… one
cokey… one or more soil components in the AoA
#Soil component acres in the area of analysis (double)
aoa_comp_area
#Hydrologic group of the soil component (character: A, B, C, D, A/D, B/D, C/D)
aoa_comp_hsg
#K factor representing the soil component (double, 0.02 – 0.64)
aoa_comp_kfact
#Whether soil component representative slope is greater than 15% (true, false)
aoa_comp_slopegr15
#Whether this soil component instance is drained (true/false)
aos_comp_drained

Result Payload

AoA identifier… one
#Pesticide soil adsorbed runoff potential for the area of analysis (character: HIGH, INTERMEDIATE, LOW)
aoa_sarp
cokey… one or more soil components in the AoA
#Pesticide soil adsorbed runoff potential for the area of analysis (character: HIGH, INTERMEDIATE, LOW)
comp_sarp

Reference Data Source

SSURGO mapunit component tables and attributes

Components

14. Computation of Pesticide Soil Adsorbed Runoff Potential for a Soil Component (SCPestSARP)

14.1. Input
AoA identifier
cokey
compname
aoa_comp_area

aoa_comp_hsg
aoa_comp_kfact
aoa_comp_slopegr15

14.2. Methods

For each AoA in the request payload

#Compute pesticide soil adsorbed runoff potential for each soil component in the AoA

For each soil component in the AoA

If ((aoa_comp_hsg == C) and (aoa_comp_kfact >= 0.21))
or ((aoa_comp_hsg == D) and (aoa_comp_kfact >= 0.10))
or ((aoa_comp_hsg == C/D) and (aoa_comp_drained TRUE) and (aoa_comp_kfact >= 0.21))

comp_sarp = HIgh
comp_sarp_number = 3

Else if (aoa_comp_hsg == A)
or ((aoa_comp_hsg == B) and (aoa_comp_kfact <= 0.10))
or ((aoa_comp_hsg == C) and (aoa_comp_kfact <= 0.07))
or ((aoa_comp_hsg == D) and (aoa_comp_kfact <= 0.02))
or ((aoa_comp_hsg == A/D) and (aoa_comp_drained TRUE))
or ((aoa_comp_hsg == B/D) and (aoa_comp_drained TRUE) and (aoa_comp_kfact <= 0.10))
or ((aoa_comp_hsg == C/D) and (aoa_comp_drained TRUE) and (aoa_comp_kfact <= 0.07))
or ((aoa_comp_hsg == A/D, B/D, or C/D) and (aoa_comp_drained FALSE) and (aoa_kfact <= 0.02))

If aoa_comp_slopegr15 FALSE

comp_sarp = LOW
comp_sarp_number = 1

Else

comp_sarp = INTERMEDIATE
comp_sarp_number = 2

Else

If aoa_comp_slopegr15 FALSE

comp_sarp = INTERMEDIATE
comp_sarp_number = 2

Else

comp_sarp = HIGH
comp_sarp_number = 3

14.3. Output

AoA identifier

cokey
compname
aoa_comp_area
comp_sarp
comp_sarp_number

15. Computation of Pesticide Soil Adsorbed Runoff Potential for an Area of Analysis (AoAPestSARP)

15.1. Input

#From SCPestSARP component 14

AoA identifier

cokey

compname

aoa_comp_area

comp_sarp

comp_sarp_number

15.2. Methods

For each AoA

#Compute weighted average pesticide soil adsorbed runoff potential for the AoA

For each AoA component

cum_sarp_product = cum_sarp_product + (comp_sarp_number * aoa_comp_area)

aoa_area = aoa_area + aoa_comp_area

aoa_sarp_fract = cum_sarp_product / aoa_area

If aoa_sarp_fract <= 1.50

aoa_sarp = LOW

Else if aoa_sarp_fract >1.50 and <=2.50

aoa_sarp = INTERMEDIATE

Else

aoa_sarp = HIGH

15.3. Output

AoA identifier

aoa_sarp

Service WQM-10: Soil/Pesticide Interaction Loss Potentials (SoilPestLossPot)

Purpose: Compute soil x pesticide interaction leaching potentials for all pesticide instances applied in an area of analysis (AoA). The computation involves simple lookups on WQM data mart tables

To this point in the WQM computation process, adjustments have been applied to pesticide loss potentials computed for each pesticide active ingredient applied within each pesticide application operation on the AoA. Therefore although the same active ingredient may be applied in different operations, the interaction potentials may vary due to differences in area, method, and/or rate associated with the operation. Therefore interaction potentials are computed for each instance of pesticide active ingredient applied through the crop rotation, and not grouped together.

In the following WQM-11 service, operation active ingredient soil/pesticide interaction loss potentisls will be consumed to compute pesticide hazard ratings for WQM pesticide-related concerns, including a hazard rating representing the area of analysis for each concern.

Description

This service computes soil/pesticide interaction loss potentials for leaching, solution runoff, and adsorbed runoff. Several inputs are values calculated in other WQM services: pesticide loss potentials from WQM-04 and soil pesticide loss potentials from WQM-07, 08, and 09.

Service Signature

Request Payload

AoAId… integer, one in the request

#The following pesticide operation inputs come from WQM-04

operation_id … integer, one or more for AoA, Pesticide Application Operation Identifier

op_pesticide_id … character varying(10) … one or more per operation; Pesticide identifier, EPA Pesticide Chemical Code (PC_CODE)

ai_plp… character varying(20); Active Ingredient Pesticide Leaching Potential; valid values are HIGH, INTERMEDIATE, LOW, or VERY LOW

ai_psrp… character varying(20); Active Ingredient Pesticide Solution Runoff Potential; valid values are HIGH, INTERMEDIATE, LOW

ai_parp… character varying(20); Active Ingredient Pesticide Adsorbed Runoff Potential; valid values are HIGH, INTERMEDIATE, LOW,

#The following input comes from WQM-07

aoa_pslp … character varying(20); Soil Pesticide Leaching Potential for the Area of Analysis; valid values are HIGH, INTERMEDIATE, LOW, or VERY LOW

#The following input comes from WQM-08

aoa_ssrp … … character varying(20); Soil Pesticide Solution Runoff Potential for the Area of Analysis; valid values are HIGH, INTERMEDIATE, LOW

#The following input comes from WQM-09

aoa_ssrp … … character varying(20); Soil Pesticide Adsorbed Runoff Potential for the Area of Analysis; valid values are HIGH, INTERMEDIATE, LOW

#Adjustment input

aoa_rain_prob … character varying(20); Probability Rain Impacts Pesticide Soil Interaction Rating; valid values are high or low

Result Payload

AoAId … integer, Area of Analysis Identifier

operation_id … integer, one or more for AoA, Pesticide Application Operation Identifier

op_pesticide_id … character varying(10) … one or more per operation; Pesticide identifier, EPA Pesticide Chemical Code (PC_CODE)

op_pest_ilp … character varying(20); Operation Soil Pesticide Interaction Leaching Potential

op_pest_isrp … character varying(20); Operation Soil Pesticide Interaction Solution Runoff Potential

op_pest_iarp … character varying(20); Operation Soil Pesticide Interaction Adsorbed Runoff Potential

Reference Data Source

WQM Data Mart wqm_soil_pest_interaction_leaching table

wqm_ilp_id [PK] integer	wqm_slp character varying(20)	wqm_plp character varying(20)	wqm_ilp character varying(20)
1	HIGH	HIGH	HIGH
2	HIGH	INTERMEDIATE	HIGH
3	HIGH	LOW	INTERMEDIATE
4	HIGH	VERY LOW	LOW
5	INTERMEDIATE	HIGH	HIGH
6	INTERMEDIATE	INTERMEDIATE	INTERMEDIATE
7	INTERMEDIATE	LOW	LOW
8	INTERMEDIATE	VERY LOW	VERY LOW
9	LOW	HIGH	INTERMEDIATE
10	LOW	INTERMEDIATE	LOW
11	LOW	LOW	LOW
12	LOW	VERY LOW	VERY LOW
13	VERY LOW	HIGH	LOW
14	VERY LOW	INTERMEDIATE	LOW
15	VERY LOW	LOW	VERY LOW
16	VERY LOW	VERY LOW	VERY LOW

WQM Data Mart wqm_soil_pest_interaction_solution_runoff table

wqm_isrp_id [PK] integer	wqm_ssrp character varying(20)	wqm_psrp character varying(20)	wqm_isrp character varying(20)
1	HIGH	HIGH	HIGH
2	HIGH	INTERMEDIATE	HIGH
3	HIGH	LOW	INTERMEDIATE
4	INTERMEDIATE	HIGH	HIGH
5	INTERMEDIATE	INTERMEDIATE	INTERMEDIATE
6	INTERMEDIATE	LOW	LOW
7	LOW	HIGH	INTERMEDIATE
8	LOW	INTERMEDIATE	LOW
9	LOW	LOW	LOW

WQM Data Mart wqm_soil_pest_interaction_adsorbed_runoff table

wqm_iarp_id [PK] integer	wqm_sarp character varying(20)	wqm_parp character varying(20)	wqm_iarp character varying(20)
1	HIGH	HIGH	HIGH
2	HIGH	INTERMEDIATE	HIGH
3	HIGH	LOW	INTERMEDIATE
4	INTERMEDIATE	HIGH	HIGH
5	INTERMEDIATE	INTERMEDIATE	INTERMEDIATE
6	INTERMEDIATE	LOW	LOW
7	LOW	HIGH	INTERMEDIATE
8	LOW	INTERMEDIATE	LOW
9	LOW	LOW	LOW

Components

16. Computation of Soil/Pesticide Interaction Leaching Potential for Pesticides Applied in an Area of Analysis (OpSoilPestIntLeaching)

16.1. Input

AoAId	1					
operation_id	1		2		3	
op_pesticide_id	101101	101702	102301	101101	102301	101101
ai_plp	HIGH	INTERMEDIATE	HIGH	HIGH	HIGH	HIGH
ai_psrp	LOW	LOW	HIGH	LOW	INTERMEDIATE	LOW
ai_parp	INTERMEDIATE	HIGH	HIGH	INTERMEDIATE	HIGH	INTERMEDIATE
aoa_plsp	LOW					
aoa_ssrp	HIGH					
aoa_sarp	LOW					
aoa_rain_prob	high					

16.2. Methods

For the AoA in the request payload

For each operation in the AoA

For each pesticide in the operation

#Compute soil/pesticide interaction leaching potential for the pesticide

op_pest_ilp = wqm_ilp where wqm_plp == ai_plp and wqm_slp == aoa_pslp

If aoa_rain_prob == LOW

If op_pest_ilp == HIGH

op_pest_ilp = INTERMEDIATE

Else if op_pest_ilp == INTERMEDIATE

op_pest_ilp = LOW

Else if op_pest_ilp == LOW

op_pest_ilp = VERY LOW

#Compute soil/pesticide interaction solution runoff potential for the pesticide

op_pest_isrp = wqm_isrp where wqm_psrp == ai_psrp and wqm_ssrp == aoa_ssrp

If aoa_rain_prob == LOW

If op_pest_isrp == HIGH

op_pest_ isrp = INTERMEDIATE

Else if op_pest_ isrp == INTERMEDIATE

op_pest_ isrp = LOW

#Compute soil/pesticide interaction adsorbed runoff potential for the pesticide

op_pest_iarp = wqm_iarp where wqm_parp == ai_parp and wqm_sarp == aoa_sarp

If aoa_rain_prob == LOW

If op_pest_iarp == HIGH

op_pest_ iarp = INTERMEDIATE

Else if op_pest_ iarp == INTERMEDIATE

op_pest_ iarp = LOW

16.3. Output

AoAId… one

operation_id … one or more in the AoA

op_pesticide_id… one or more in the operation

op_pest_ilp

op_pest_ isrp

op_pest_ iarp

Service WQM-11: Pesticide Hazard Ratings (PestHazRating)

Purpose: Compute pesticide hazard ratings for leaching, solution runoff, and adsorbed runoff for each pesticide applied in an area of analysis. Involves simple table lookups on the WQM data mart. Then compute pesticide hazard ratings for leaching, solution runoff, and adsorbed runoff representing the area of analysis (AoA).

Service Signature

Request Payload

#Usually from SoilPestLossPot service (WQM-10)

AoA identifier… one per request

Operation identifier… one or more… same type as LMOD operation

op_pesticide_id… one or more… character varying(10)

op_pest_ilp… from SoilPestLossPot service… character varying(20)

op_pest_isrp… from SoilPestLossPot service… character varying(20)

op_pest_iarp… from SoilPestLossPot service… character varying(20)

ai_eathuman… from WQMPestAttr service… double precision

ai_eatmatc… from WQMPestAttr service … double precision

ai_koc… from WQMPestAttr service… double precision

Initial test request payload:

operation_id	1	1	2
op_pesticide_id	101101	101702	105501
op_pest_ilp	HIGH	INTERMEDIATE	LOW
op_pest_isrp	INTERMEDiATE	HIGH	HIGH
op_pest_iarp	LOW	INTERMEDIATE	HIGH
ai_eathuman	70	3360	500
ai_eatmatc	3000	4.9	12938
ai_koc	60	1211	80

Result Payload

AoA identifier

Operation identifier… one or more… same type as LMOD operation

op_pesticide_id… one or more… character varying(10)

op_phr_leach_human… character varying(20)

op_phr_leach_matcfish… character varying(20)

op_phr_sorun_human… character varying(20)

op_phr_sorun_matcfish… character varying(20)

op_phr_adrun_human… character varying(20)

op_phr_adrun_stvfish… character varying(20)

aoa_phr_leach_human… character varying(20)

aoa_phr_leach_matcfish… character varying(20)

aoa_phr_sorun_human… character varying(20)

aoa_phr_sorun_matcfish… character varying(20)

aoa_phr_adrun_human… character varying(20)
aoa_phr_adrun_stvfish… character varying(20)

Reference Data Source

WQM Data Mart: wqm_pesticide_hazard_potential table

Components

17. Computation of Hazard Ratings for Pesticide Applications in an Area of Analysis (OpPestHazRating)

17.1. Input

AoA identifier… one per request
Operation identifier… one or more
op_pesticide_id… one or more
op_pest_ilp
op_pest_isrp
op_pest_iarp
ai_eathuman
ai_eatmatc
ai_koc

17.2. Data

wqm_pesticide_hazard_potential table and following data elments:
wqm_eat… exposure adjusted toxicity, values are HIGH, INTERMEDIATE, LOW, VERY LOW
wqm_ilr… interaction loss rating, values are HIGH, INTERMEDIATE, LOW, VERY LOW
wqm_phr… pesticide hazard rating, values are HIGH, INTERMEDIATE, LOW, VERY LOW

17.3. Methods

For the AoA in the request payload
For each operation in the AoA
For each pesticide in the operation
#Compute pesticide hazard rating for leaching, solution runoff, and adsorbed runoff adjusted for toxicity to humans
If ai_eathuman < 1
eat_rating_human= EXTRA HIGH
Else if ai_eathuman >= 1 and < 10
eat_rating_human = HIGH
Else if ai_eathuman >= 10 and < 50
eat_rating_human = INTERMEDIATE
Else if ai_eathuman >= 50 and < 100
eat_rating_human = LOW
Else if ai_eathuman >= 100
eat_rating_human = VERY LOW
op_phr_leach_human = wqm_phr where wqm_ilr == op_pest_ilp and wqm_eat == eat_rating_human
op_phr_sorun_human = wqm_phr where wqm_ilr == op_pest_isrp and wqm_eat == eat_rating_human

op_phr_adrun_human = wqm_phr where wqm_ilr == op_pest_iarp and wqm_eat == eat_rating_human

#Compute pesticide hazard rating for adsorbed runoff adjusted for toxicity to fish (STV)

ai_eatstv = ai_eatmatc * ai_koc
If ai_eathstv < 10
    eat_rating_stvfish = EXTRA HIGH
Else if ai_eatstv >= 10 and < 100
    eat_rating_stvfish = HIGH
Else if ai_eatstv >= 100 and < 1500
    eat_rating_stvfish = INTERMEDIATE
Else if ai_eatstv >= 1500 and < 20000
    eat_rating_stvfish = LOW
Else if ai_eatstv >= 20000
    eat_rating_stvfish = VERY LOW
op_phr_adrun_stvfish = wqm_phr where wqm_ilr == op_pest_iarp and wqm_eat == eat_rating_stvfish

#Compute pesticide hazard rating for leaching, solution runoff, and adsorbed runoff adjusted for toxicity to fish (MATC)

If ai_eathmatc < 10
    eat_rating_matcfish = EXTRA HIGH
Else if ai_eatmatc >= 10 and < 100
    eat_rating_matcfish = HIGH
Else if ai_eatmatc >= 100 and < 1500
    eat_rating_matcfish = INTERMEDIATE
Else if ai_eatmatc >= 1500 and < 20000
    eat_rating_matcfish = LOW
Else if ai_eatmatc >= 20000
    eat_rating_matcfish = VERY LOW
op_phr_pleach_matcfish = wqm_phr where wqm_ilr == op_pest_ilp and wqm_eat == eat_rating_matcfish
op_phr_sorun_matcfish = wqm_phr where wqm_ilr == op_pest_isrp and wqm_eat == eat_rating_matcfish

17.4. Output

AoA identifier… one
    Operation identifier… one or more
        op_pesticide_id… one or more
            op_phr_leach_human
            op_phr_leach_matcfish
            op_phr_sorun_human
            op_phr_sorun_matcfish
            op_phr_adrun_human
            op_phr_adrun_stvfish

18. Computation of Hazard Ratings for an Area of Analysis (AoAPestHazRating)

18.1. Input

AoA identifier

Operation identifier… one or more

op_pesticide_id… one or more

op_phr_leach_human
op_phr_leach_matcfish
op_phr_sorun_human
op_phr_sorun_matcfish
op_phr_adrun_human
op_phr_adrun_stvfish

18.2. Method

#Consolidate pesticide hazard ratings to one representing the AOA for leaching, solution runoff, and adsorbed runoff for humans, fish (STV), and fish (MATC)

phr_leach_high = 1
phr_leach_new = 1
phr_sorun_high = 1
phr_sorun_new = 1
phr_adrun_high = 1
phr_adrun_new = 1

For each AoA

#Compute pesticide hazard rating for Pesticide Leaching – Human concern

For each operation

For each pesticide

If op_phr_leach_human = HIGH
phr_leach_new = 4
Else if op_phr_leach_human = INTERMEDIATE
phr_leach_new = 3
Else if op_phr_leach_human = LOW
phr_leach_new = 2
Else if op_phr_leach_human = VERY LOW
phr_leach_new = 1
If phr_leach_new > phr_leach_high
phr_leach_high = phr_leach_new

If phr_leach_high == 4
aoa_phr_leach_human = HIGH
Else if phr_leach_high == 3
aoa_phr_leach_human = INTERMEDIATE
Else if phr_leach_high == 2
aoa_phr_leach_human = LOW
Else if phr_leach_high == 1
aoa_phr_leach_human = VERY LOW

#Compute pesticide hazard rating for Pesticide Leaching – Fish concern

For each operation

```
    For each pesticide
        If op_phr_leach_matcfish = HIGH
            phr_leach_new = 4
        Else if op_phr_leach_matcfish = INTERMEDIATE
            phr_leach_new = 3
        Else if op_phr_leach_matcfish = LOW
            phr_leach_new = 2
        Else if op_phr_leach_matcfish = VERY LOW
            phr_leach_new = 1
        If phr_leach_new > phr_leach_high
            phr_leach_high = phr_leach_new
If phr_leach_high == 4
    aoa_phr_leach_matcfish = HIGH
Else if phr_leach_high == 3
    aoa_phr_leach_matcfish = INTERMEDIATE
Else if phr_leach_high == 2
    aoa_phr_leach_matcfish = LOW
Else if phr_leach_high == 1
    aoa_phr_leach_matcfish = VERY LOW
```

#Compute pesticide hazard rating for Pesticide Solution Runoff – Human concern

```
For each operation
    For each pesticide
        If op_phr_sorun_human = HIGH
            phr_leach_new = 3
        Else if op_phr_sorun_human = INTERMEDIATE
            phr_leach_new = 2
        Else if op_phr_sorun_human = LOW
            phr_leach_new = 1
        If phr_leach_new > phr_leach_high
            phr_leach_high = phr_leach_new
If phr_leach_high == 3
    aoa_phr_sorun_human = HIGH
Else if phr_leach_high == 2
    aoa_phr_sorun_human = INTERMEDIATE
Else if phr_leach_high == 1
    aoa_phr_sorun_human = LOW
```

#Compute pesticide hazard rating for Pesticide Solution Runoff – Fish concern

```
For each operation
    For each pesticide
        If op_phr_sorun_matcfish = HIGH
            phr_leach_new = 3
        Else if op_phr_sorun_matcfish = INTERMEDIATE
            phr_leach_new = 2
        Else if op_phr_sorun_matcfish = LOW
            phr_leach_new = 1
```

```
            If phr_leach_new > phr_leach_high
                phr_leach_high = phr_leach_new
    If phr_leach_high == 3
        aoa_phr_sorun_matcfish = HIGH
    Else if phr_leach_high == 2
        aoa_phr_sorun_matcfish = INTERMEDIATE
    Else if phr_leach_high == 1
        aoa_phr_sorun_matcfish = LOW

    #Compute pesticide hazard rating for Pesticide Adsorbed Runoff – Human concern
    For each operation
        For each pesticide
            If op_phr_adrun_human = HIGH
                phr_leach_new = 3
            Else if op_phr_adrun_human = INTERMEDIATE
                phr_leach_new = 2
            Else if op_phr_adrun_human = LOW
                phr_leach_new = 1
            If phr_leach_new > phr_leach_high
                phr_leach_high = phr_leach_new
    If phr_leach_high == 3
        aoa_phr_adrim_human = HIGH
    Else if phr_leach_high == 2
        aoa_phr_adrun_human = INTERMEDIATE
    Else if phr_leach_high == 1
        aoa_phr_adrun_human = LOW

    #Compute pesticide hazard rating for Pesticide Adsorbed Runoff – Fish concern
    For each operation
        For each pesticide
            If op_phr_adrun_styfish = HIGH
                phr_leach_new = 3
            Else if op_phr_adrun_styfish = INTERMEDIATE
                phr_leach_new = 2
            Else if op_phr_adrun_styfish = LOW
                phr_leach_new = 1
            If phr_leach_new > phr_leach_high
                phr_leach_high = phr_leach_new
    If phr_leach_high == 3
        aoa_phr_adrun_styfish = HIGH
    Else if phr_leach_high == 2
        aoa_phr_adrun_styfish = INTERMEDIATE
    Else if phr_leach_high == 1
        aoa_phr_adrun_styfish = LOW
```

18.3. Output

AoA identifier

aoa_phr_leach_human
aoa_phr_leach_matcfish
aoa_phr_sorun_human
aoa_phr_sorun_matcfish
aoa_phr_adrun_human
aoa_phr_adrun_stvfish

Service WQM-12: R Factor for an Area of Analysis (RFactor)

Purpose: Compute R Factor for an area of analysis. Source is the RUSLE2 climate database. R factors east of the Rocky Mountains mostly are by county, but from the Rocky Mountains west, elevation impacts precipitation and therefore counties usually contain multiple R factors. In the west, a farmer's field (corresponding to an AoA) may intersect more than one R Factor polygon, and therefore which one to use must be resolved.

Service Signature

Request Payload

AoA identifier (one or more)

AoA polygon geometry (one set of coordinates per AoA)

Result Payload

AoA identifier (one or more)

aoa_rfactor

Reference Data Source

RUSLE2 R Factor map and attribute table(s)

Component

19. Determination of the R Factor for an Area of Analysis (AoARFactor)

19.1. Input

AoA geometry

19.2. Data

RUSLE2 Climate data store

19.3. GIS Operations

Intersect AoA geometry with RUSLE3 climate zone map

In most cases, only one climate zone will be intersected

19.4. Methods

Compute list of climate zones in the AoA

In most cases, the list will contain one climate zone

Although rare, AoA can contain multiple instances of a climate zone

Compute area for each climate zone in the list

aoa_rfactor = R factor of climate zone having largest area

19.5. Output

AoA identifier

aoa_rfactor

Note: Whether the user can intervene and select a climate zone if there are more than one intersected is not yet resolved.

Service WQM-13: WQM Concern Treatment Level Threshold Scores (WQMThresholdScores)

Purpose: Compute treatment level threshold scores for each of the WQM concerns for an area of analysis.

Service Signature

Request Payload

AoA identifier… one per request
- aoa_nslp… from NutrientSLP service (WQM-5)
- aoa_srp… from SedNutSRP service (WQM-6)
- aoa_phr_leach_human… from PestHazRating service (WQM-11)
- aoa_phr_leach_matcfish… from PestHazRating service (WQM-11)
- aoa_phr_sorun_human… from PestHazRating service (WQM-11)
- aoa_phr_sorun_matcfish… from PestHazRating service (WQM-11)
- aoa_phr_adrun_human… from PestHazRating service (WQM-11)
- aoa_phr_adrun_stvfish… from PestHazRating service (WQM-11)
- aoa_treatment_level… from WQSR service (WQM-1)
- aoa_rfactor… from RFactor service (WQM-12)

Result Payload

AoA identifier
- aoa_nleach_threshold … integer, Nitrogen Leaching Threshold Score
- aoa_nrun_threshold … integer, Nitrogen Runoff Threshold Score
- aoa_sedrun_threshold … integer, Sediment Runoff Threshold Score
- aoa_prun_threshold … integer, Phosphorus Runoff Threshold Score
- aoa_pleach_human_threshold … integer, Pesticide Leaching Threshold Score, Human
- aoa_pleach_matcfish_threshold … integer, Pesticide Leaching Threshold Score, Fish
- aoa_psorun_human_threshold … integer, Pesticide Solution Runoff Threshold Score, Human
- aoa_psorun_matcfish_threshold … integer, Pesticide Solution Runoff Threshold Score, Fish
- aoa_padrun_human_threshold … integer, Pesticide Adsorbed Runoff Threshold Score, Human
- aoa_padrun_stvfish_threshold … integer, Pesticide Adsorbed Runoff Threshold Score, Fish
- aoa_pdrift_human_threshold … integer, Pesticide Drift Threshold Score, Human
- aoa_pdrift_fish_threshold … integer, Pesticide Drift Threshold Score, Fish

Reference Data Source

WQM Data Mart wqm_threshold_scores table

Component

20. Computation of WQM Concern Treatment Level Threshold Scores for an Area of Analysis (AoAWQMThresholdScores)

20.1. Input

Sample input values

AoAid	1	2	3
aoa_nslp	HIGH	VERY LOW	INTERMEDIATE
aoa_srp	LOW	HIGH	INTERMEDIATE
aoa_phr_leach_human	VERY HIGH	VERY LOW	HIGH
aoa_phr_leach_matfish	INTERMEDIATE	LOW	EXTRA HIGH
aoa_phr_sorun_human	LOW	INTERMEDIATE	INTERMEDIATE
aoa_phr_sorun_matfish	LOW	INTERMEDIATE	LOW
aoa_phr_adrun_human	INTERMEDIATE	HIGH	EXTRA HIGH
aoa_phr_adrun_stvfish	LOW	HIGH	LOW
aoa_treatment_level	II	I	III
aoa_rfactor	128	163	45

20.2. Data

From the WQM Data Mart wqm_threshold_scores table

	wqm_threshold_score_id [PK] integer	wqm_concern character varying(50)	hazard_loss_rating character varying(50)	rfact_range_min integer	rfact_range_max integer	treatment_level character varying(5)	threshold_treatment_score integer
1	1	Pesticide (All)	EXTRA HIGH			I	60
2	2	Pesticide (All)	HIGH			I	40
3	3	Pesticide (All)	INTERMEDIATE			I	20
4	4	Pesticide (All)	LOW			I	0
5	5	Pesticide (All)	VERY LOW			I	0
6	6	Pesticide (All)	EXTRA HIGH			II	80

20.3. Method

For the AoA in the request payload

aoa_nleach_threshold = threshold_treatment_score where wqm_concern == Nitrogen in Ground Water and hazard_loss_rating == aoa_nslp and treatment_level == aoa_treatment_level

aoa_nrun_threshold = threshold_treatment_score where wqm_concern == Nitrogen in Surface Water and hazard_loss_rating == aoa_srp and rfactor_range_min < aoa_rfactor and rfactor_max >= aoa_rfactor and treatment_level == aoa_treatment_level

aoa_sedrun_threshold = threshold_treatment_score where wqm_concern == Sediment in Surface Water and hazard_loss_rating == aoa_srp and rfactor_range_min < aoa_rfactor and rfactor_max >= aoa_rfactor and treatment_level == aoa_treatment_level

aoa_prun_threshold = threshold_treatment_score where wqm_concern == Phosphorus in Surface Water and hazard_loss_rating == aoa_srp and rfactor_range_min < aoa_rfactor and rfactor_max >= aoa_rfactor and treatment_level == aoa_treatment_level

aoa_pleach_human _threshold = threshold_score where wqm_concern == Pesticide (All) and hazard_loss_rating == aoa_phr_leach_human and treatment_level == aoa_treatment_level

aoa_ pleach_matc_threshold = threshold_score where wqm_concern == Pesticide (All) and hazard_loss_rating == aoa_phr_leach_matcfish and treatment_level == aoa_treatment_level

aoa_psorun_human_threshold = threshold_score where wqm_concern == Pesticide (All) and hazard_loss_rating == aoa_phr_sorun_human and treatment_level == aoa_treatment_level

aoa_psorun_matcfish_threshold = threshold_score where wqm_concern == Pesticide (All) and hazard_loss_rating == aoa_phr_sorun_matcfish and treatment_level == aoa_treatment_level

aoa_padrun_human_threshold = threshold_score where wqm_concern == Pesticide (All) and hazard_loss_rating == aoa_phr_adrun_human and treatment_level == aoa_treatment_level

aoa_padrun_stvfish_threshold = threshold_score where wqm_concern == Pesticide (All) and hazard_loss_rating == aoa_phr_adrun_stvfish and treatment_level == aoa_treatment_level

aoa_pdrift_human_threshold = threshold_score where wqm_concern == Pesticide (All) and hazard_loss_rating == INTERMEDIATE and treatment_level == aoa_treatment_level

aoa_pdrift_fish_threshold = threshold_score where wqm_concern == Pesticide (All) and hazard_loss_rating == INTERMEDIATE and treatment_level == aoa_treatment_level

20.4. Output

AoA identifier

- aoa_nleach_threshold
- aoa_nrun_threshold
- aoa_sedrun_threshold
- aoa_prun_threshold
- aoa_pleach_human_threshold
- aoa_pleach_matcfish_threshold
- aoa_psorun_human_threshold
- aoa_psorun_matcfish_threshold
- aoa_padrun_human_threshold
- aoa_padrun_stvfish_threshold
- aoa_pdrift_human_threshold
- aoa_pdrift_fish_threshold

Service WQM-14: Nutrient Technique Scores (NutTechScores)

Purpose: Compute nutrient technique scores for an area of analysis. A requesting application will populate the service request payload with nutrient techniques applied for each AoA to be assessed. The service will add up the technique scores by nutrient related WQM concern for each AoA and return the totals in the results payload. Also returned are subset scores for each technique mode of action (avoid, control, trap).

Service Signature

Request Payload

AoA identifier… one per request payload

plan_techn_id… one or more, integer, nutrient management technique identifier corresponding to nutrient_technique_score_id value in WQM data mart

plan_techn_discrim_type… character varying, type of discriminator for varying nutrient management technique scores; value is "soil test result"; otherwise NULL

plan_techn_discrim… character varying; value of the discriminator: HIGH, MEDIUM, LOW, NO SOIL TEST

Result Payload

AoA identifier… one

nleach_techn_score … integer, nutrient management technique mitigation score for nitrogen in ground water concern

nsurf_techn_score … integer, nutrient management technique mitigation score for nitrogen in surface water concern

psurf_techn_score … integer, nutrient management technique mitigation score for phosphorus in surface water concern

nleach_avoid_techn_score … integer, nutrient management technique mitigation score for avoiding excess nitrogen use or application and loss to groundwater

nleach_control_techn_score … integer, nutrient management technique mitigation score for controlling in-field nitrogen losses to groundwater

nleach_trap_techn_score … integer, nutrient management technique mitigation score for trapping excess nitrogen and keeping it from groundwater

nsurf_avoid_techn_score … integer, nutrient management technique mitigation score for avoiding excess nitrogen use or application and loss to surface water

nsurf_control_techn_score … integer, nutrient management technique mitigation score for controlling in-field nitrogen losses to surface water runoff

nsurf_trap_techn_score … integer, nutrient management technique mitigation score for trapping excess nitrogen and keeping it from surface water

psurf_avoid_techn_score … integer, nutrient management technique mitigation score for avoiding excess phosphorus use or application and loss to surface water

psurf_control_techn_score … integer, nutrient management technique mitigation score for controlling in-field phosphorus losses to surface water runoff

psurf_trap_techn_score … integer, nutrient management technique mitigation score for trapping excess phophorus and keeping it from surface water

Reference Data Source

WQM data mart wqm_nutrient_technique_scores table

Component

21. Nutrient Technique Scores (AoANutTechScore)

21.1. Input

AoAid	1	1	1	1	1	1
plan_techn_id	1	5	8	14	2	9
plan_techn_discrim_type			Soil Test Result			
plan_techn_discrim			Medium			

AoA identifier… one
- plan_techn_id… one or more
- plan_techn_discrim_type
- plan_techn_discrim

21.2. Data

WQM Data Mart wqm_nutrient_technique_scores table

nutrient_technique_score_id [PK] integer	nutrient_technique_id integer	nut_tech_kind character varying(50)	nut_tech_description character varying(50)	wqm_concern character varying(50)	mode_of_action character varying(10)	tech_discrim_type character varying(50)	tech_discrim character varying(50)	nut_tech_score integer
13	6	Nutrient Application Placement	Fertilzer banding at planting	Nitrogen in Surface Water	Avoid			10
14	6	Nutrient Application Placement	Fertilzer banding at planting	Phosphorus in Surface Water	Avoid			10
15	7	Nutrient Application Placement	Soil incorporation	Nitrogen in Surface Water	Avoid			10
16	7	Nutrient Application Placement	Soil incorporation	Phosphorus in Surface Water	Avoid			10
17	8	Nutrient Application Rate	Soil testing	Phosphorus in Surface Water	Avoid	Soil test result	High	15
18	8	Nutrient Application Rate	Soil testing	Phosphorus in Surface Water	Avoid	Soil test result	Medium	10
19	8	Nutrient Application Rate	Soil testing	Phosphorus in Surface Water	Avoid	Soil test result	Low	5
20	8	Nutrient Application Rate	Soil testing	Phosphorus in Surface Water	Avoid	Soil test result	No soil test	10
21	8	Nutrient Application Rate	Soil testing	Phosphorus in Surface Water	Avoid	Soil test result	Benchmark	10

21.3. Method

For the AoA in the request payload

For each Nutrient Technique (plan_techn_id) in the AoA

#Compute nutrient technique mitigation scores for Nitrogen in Ground Water concern and increment total scores

techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Nitrogen in Ground Water”
nleach_techn_score = nleach_techn_score + techn_score

avoid_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid
nleach_avoid_techn_score = nleach_avoid_techn_score + avoid_techn_score

control_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control
nleach_control_techn_score = nleach_control_techn_score + control_techn_score

trap_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap

nleach_trap_techn_score = nleach_avoid_techn_score + trap_techn_score

#Compute nutrient technique mitigation scores for Nitrogen in Surface Water concern and increment total scores
techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Nitrogen in Surface Water”
nsurf_techn_score = nsurf_techn_score + techn_score

avoid_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Nitrogen in Surface Water” and mode_of_action == Avoid
nsurf_avoid_techn_score = nsurf_avoid_techn_score + avoid_techn_score

control_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Nitrogen in Surface Water” and mode_of_action == Control
nsurf_control_techn_score = nsurf_control_techn_score + control_techn_score

trap_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Nitrogen in Surface Water” and mode_of_action == Trap
nsurf_trap_techn_score = nsurf_trap_techn_score + trap_techn_score

#Compute nutrient technique mitigation scores for Phosphorus in Surface Water concern and increment total scores
techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Phosphorus in Surface Water” and tech_discrim_type = plan_tech_discrim_type and tech_discrim == plan_tech_discrim
psurf_techn_score = psurf_techn_score + techn_score

avoid_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Phosphorus in Surface Water” and mode_of_action == Avoid
psurf_avoid_techn_score = psurf_avoid_techn_score + avoid_techn_score

control_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Phosphorus in Surface Water” and mode_of_action == Control
psurf_control_techn_score = psurf_control_techn_score + control_techn_score

trap_techn_score = nut_tech_score where nutrient_technique_id == plan_techn_id and wqm_concern == “Phosphorus in Surface Water” and mode_of_action == Trap
psurf_trap_techn_score = psurf_trap_techn_score + trap_techn_score

21.4. Output
AoA identifier
nleach_techn_score
nsurf_techn_score
psurf_techn_score

nleach_avoid_techn_score
nleach_control_techn_score

nleach_trap_techn_score

nsurf_avoid_techn_score
nsurf_control_techn_score
nsurf_trap_techn_score

psurf_avoid_techn_score
psurf_control_techn_score
psurf_trap_techn_score

Service WQM-15: Sediment-Nutrient Practice Scores (SedNutPractScores)

Purpose: Compute mitigation scores for sediment and nutrient related WQM concerns in an area of analysis. A requesting application will populate the service request payload with conservation practices applied for each AoA to be assessed. The service will add up the practice scores by relevant WQM concern for each AoA and return the totals in the results payload. Also returned are subset scores for each practice mode of action (avoid, control, trap).

Service Signature

Request Payload

AoA identifier… one per request payload

plan_practice_id… integer, one or more per AoA, Conservation Practice Identifier

plan_pract_discrim_type… character varying(30); Practice Discriminator; oncly current value is "width"; in most cases this field will be NULL

plan_pract_discrim_value… character varying(30), Practice Discriminator Value

Result Payload

AoA identifier

nleach_pract_score … integer, Nitrogen Leaching Practice Mitigation Score

ssurf_pract_score … integer, Sediment Runoff Practice Mitigation Score

nsurf_pract_score … integer, Nitrogen Runoff Practice Mitigation Score

psurf_pract_score … integer, Phosphorus Runoff Practice Mitigation Score

nleach_avoid_pract_score … integer Nitrogen Leaching Practice Score (Avoid)

nleach_control_pract_score … integer Nitrogen Leaching Practice Score (Control)

nleach_trap_pract_score … integer Nitrogen Leaching Practice Score (Trap)

ssurf_avoid_pract_score … integer, Sediment Runoff Practice Score (Avoid)

ssurf_control_pract_score … integer, Sediment Runoff Practice Score (Control)

ssurf_trap_pract_score … integer, Sediment Runoff Practice Score (Trap)

nsurf_avoid_pract_score … integer, Nitrogen Runoff Practice Score (Avoid)

nsurf_control_pract_score … integer, Nitrogen Runoff Practice Score (Control)

nsurf_trap_pract_score … integer, Nitrogen Runoff Practice Score (Trap)

psurf_avoid_pract_score … integer, Phosphorus Runoff Practice Score (Avoid)

psurf_control_pract_score … integer, Phosphorus Runoff Practice Score (Control)

psurf_control_pract_score … integer, Phosphorus Runoff Practice Score (Trap)

Reference Data Source

WQM data mart wqm_sediment_nutrient_practice_scores table containing conservation practices affecting sediment and nutrient related WQM concerns and their mitigation scores.

Currently only the filter strip practice has mitigation scores that vary by a discriminator, in this case by "width".

Component

22. Sediment Nutrient Practice Scores (AoASedNutPractScore)

22.1. Input

AoAId	1	1	1	1	1
plan_practice_id	37	16	20	322	123
plan_pract_discrim_type	Width				
plan_pract_discrim_value	45				

22.2. Data

nutrient_practice_score_id [PK] integer	practice_id integer	practice_code character varying(10)	conservation_practice character varying(100)	wqm_concern character varying(50)	mode_of_action character varying(10)	pract_discrim_type character varying(30)	min_pract_discrim character varying(30)	max_pract_discrim character varying(30)	nut_pract_score integer
35	26	356	Dike	Phosphorus in Surface Water	Trap				5
36	29	362	Diversion	Sediment in Surface Water	Control				10
37	97	554	Drainage Water Management	Nitrogen in Ground Water	Control				5
38	97	554	Drainage Water Management	Nitrogen in Surface Water	Trap				5
39	97	554	Drainage Water Management	Phosphorus in Surface Water	Trap				5
40	33	386	Field Border	Sediment in Surface Water	Trap				5
41	37	393	Fiter Strip	Sediment in Surface Water	Avoid				2
42	37	393	Fiter Strip	Sediment in Surface Water	Trap	Width	20	30	15
43	37	393	Fiter Strip	Sediment in Surface Water	Trap	Width	30		20

22.3. Methods

For each AoA identifier

For each Nutrient Practice (plan_practice_id) in the AoA

#Compute practice mitigation scores for Nitrogen in Ground Water and increment total scores

If plan_pract_discrim_type NULL

nl_avoid_pract_score = sednut_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid and pract_discrim_type NULL

Else

nl_avoid_pract_score = sednut_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim

nleach_avoid_pract_score = nleach_avoid_pract_score + nl_avoid_pract_score

If plan_pract_discrim_type NULL

nl_control_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control and pract_discrim_type NULL

Else

nl_control_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim

nleach_control_pract_score = nleach_control_pract_score + nl_control_pract_score

If plan_pract_discrim_type NULL
    nl_trap_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap and pract_discrim_type NULL
Else
    nl_trap_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim
nleach_trap_pract_score = nleach_avoid_pract_score + nl_trap_pract_score

nleach_pract_score = nleach_avoid_pract_score + nleach_control_pract_score + nleach_trap_pract_score

#Compute practice mitigation scores for Sediment in Surface Water and increment total scores
If plan_pract_discrim_type NULL
    sd_avoid_pract_score = sednut_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid and pract_discrim_type NULL
Else
    sd_avoid_pract_score = sednut_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim
ssurf_avoid_pract_score = ssurf_avoid_pract_score + sd_avoid_pract_score

If plan_pract_discrim_type NULL
    sd_control_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control and pract_discrim_type NULL
Else
    sd_control_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim
ssurf_control_pract_score = ssurf_control_pract_score + sd_control_pract_score

If plan_pract_discrim_type NULL
    sd_trap_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap and pract_discrim_type NULL
Else
    sd_trap_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim
ssurf_trap_pract_score = ssurf_avoid_pract_score + sd_trap_pract_score

ssurf_pract_score = ssurf_avoid_pract_score + ssurf_control_pract_score + ssurf_trap_pract_score

#Increment practice mitigation scores for Nitrogen in Surface Water and increment total scores

If plan_pract_discrim_type NULL
    ns_avoid_pract_score = sednut_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid and pract_discrim_type NULL
Else
    ns_avoid_pract_score = sednut_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim
nsurf_avoid_pract_score = nsurf_avoid_pract_score + ns_avoid_pract_score

If plan_pract_discrim_type NULL
    ns_control_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control and pract_discrim_type NULL
Else
    ns_control_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim
nsurf_control_pract_score = nsurf_control_pract_score + ns_control_pract_score

If plan_pract_discrim_type NULL
    ns_trap_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap and pract_discrim_type NULL
Else
    ns_trap_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim
nsurf_trap_pract_score = nsurf_avoid_pract_score + ns_trap_pract_score

nsurf_pract_score = nsurf_avoid_pract_score + nsurf_control_pract_score + nsurf_trap_pract_score

#Increment practice mitigation scores for Phosphorus in Surface Water and increment total scores

If plan_pract_discrim_type NULL
    ps_avoid_pract_score = sednut_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid and pract_discrim_type NULL
Else

ps_avoid_pract_score = sednut_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Avoid and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim

psurf_avoid_pract_score = psurf_avoid_pract_score + ps_avoid_pract_score

If plan_pract_discrim_type NULL

ps_control_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control and pract_discrim_type NULL

Else

ps_control_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Control and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim

psurf_control_pract_score = psurf_control_pract_score + ps_control_pract_score

If plan_pract_discrim_type NULL

ps_trap_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap and pract_discrim_type NULL

Else

ps_trap_pract_score = nutr_pract_score where practice_id == plan_pract_id and wqm_concern == “Nitrogen in Ground Water” and mode_of_action == Trap and plan_pract_discrim_value >= min_pract_discrim and < max_pract_discrim

psurf_trap_pract_score = psurf_avoid_pract_score + ps_trap_pract_score

psurf_pract_score = psurf_avoid_pract_score + psurf_control_pract_score + psurf_trap_pract_score

22.4. Output

AoA identifier

nleach_pract_score
ssurf_pract_score
nsurf_pract_score
psurf_pract_score

nleach_avoid_pract_score
nleach_control_pract_score
nleach_trap_pract_score

ssurf_avoid_pract_score
ssurf_control_pract_score
ssurf_trap_pract_score

nsurf_avoid_pract_score
nsurf_control_pract_score
nsurf_trap_pract_score

psurf_avoid_pract_score
psurf_control_pract_score
psurf_control_pract_score

Service WQM-16: Nutrient Application Management Scores (NutAppMgtScores)

Purpose: Compute scores for applying nutrient (nitrogen and phosphorus) applications in a way that mitigates potential loss to surface and ground water. Adjusting application rate, timing, and method can reduce nutrient loss. The management applied to an AoA contains one or more crops, although a crop rotation can contain years when no crops are grown (fallow). Each crop usually involves one or more fertilizer applications, although not always. Soil testing helps ensure application rates are not excessive. Timing applications to supply nutrients when the crop needs them and placing nutrients where crop roots can access them reduces loss.

Service Description

Compute scores for applying nutrient (nitrogen and phosphorus) applications in a way that mitigates potential loss to surface and ground water.

Service Signature

Request Payload

AoA identifier… integer, one per request payload

mgt_crop_id … integer, one or more in the request, Crop Identifier, representing one of the crops in the wqm_crops table

~~**#Usually crop identifier will come from the Land Management Operation Database (LMOD)**~~

~~from_lmod … boolean, LMOD Source Indicator, True means the source of the mgt_crop_id is from LMOD; for now the value will be False~~

crop_plant_date … date (yyyy-mm-dd), Crop Planting Date (Year-Month-Day), null if fallow “crop” period

crop_yield … double precision, Crop Yield, null if fallow “crop” period

crop_yield units … character varying, Crop Yield Units, accepted values are tons/ac, bu/ac, lbs/ac, or cwt; null if fallow “crop” period; units must match units for the crop in the wqm_crop table

nutrient_application_date … date (yyyy-mm-dd), none to many associated to crop (can be null), Nutrient Application Date (Year-Month-Day)

incorporated… boolen, Nutrient Incorporated Into Soil

nutrient_applied … character varying, one or two, Nutrient Applied, values are nitrogen or phosphorus

application_rate… double precision, Nutrient Application Rate in Lbs/Ac

p_soil_test_result… character varying, Soil Test Result for Phosphorus, values are High, Medium, Low, None

Result Payload

AoA identifier

nleach_app_mgt_score … integer, Nitrogen Application Management Score for Mitigating Leaching Loss Potential

nsurf_app_mgt_score … integer, Nitrogen Application Management Score for Mitigating Surface Runoff Loss Potential

psurf_app_mgt_score … integer, Phosphorus Application Management Score for Mitigating Surface Runoff Loss Potential

n_app_rate_score … integer, Nitrogen Application Rate Mitigation Score
n_app_timing_score … integer, Nitrogen Application Timing Mitigation Score
p_app_rate_score … integer, Phosphorus Application Rate Mitigation Score
p_app_timing_score … integer, Phosphorus Application Timing Mitigation Score
app_meth_score … integer, Nutrient Application Method Mitigation Score

Reference Data Sources

WQM Data Mart wqm_nutrient_application_mgt_scores table containing mitigation scores for nitrogen and phosphorus application management (rate, timing, method)

application_management_score_id [PK] integer	app_mgt_kind character varying(20)	nutrient character varying(30)	app_mgt_kind_descr character varying(100)	app_mgt_factor character varying(30)	soil_test_result character varying(20)	remove_ratio_1 double precision	remove_ratio_2 double precision	days_fr_plant_1 integer	days_fr_plant_2 integer	app_mgt_score integer
1	Rate	Nitrogen	Ratio total N applied/removed	other		0	1.2			20
2	Rate	Nitrogen	Ratio total N applied/removed	other		1.2	1.4			15
3	Rate	Nitrogen	Ratio total N applied/removed	other		1.4	1.6			10
4	Rate	Nitrogen	Ratio total N applied/removed	other		1.6	1.8			5
5	Rate	Nitrogen	Ratio total N applied/removed	small grain		1	1.4			20
6	Rate	Nitrogen	Ratio total N applied/removed	small grain		1.4	1.6			15
7	Rate	Nitrogen	Ratio total N applied/removed	small grain		1.6	1.8			10
8	Rate	Nitrogen	Ratio total N applied/removed	small grain		1.8	2			5
9	Rate	Nitrogen	No application	none						15
10	Timing	Nitrogen	Application 21 to 25 days befc	nosplit				-25	-21	5
11	Timing	Nitrogen	Application 7 to 20 days befor	nosplit				-20	-7	10
12	Timing	Nitrogen	Application 6 days before or c	nosplit				-6	6	15
13	Timing	Nitrogen	Application 7 to 25 days after	nosplit				7	25	20
14	Timing	Nitrogen	Split first application 7 to 2	split				-20	-7	5
15	Timing	Nitrogen	Split first application 6 days	split				-6	6	10
16	Timing	Nitrogen	Split first application 7 to 2	split				7	20	5
17	Timing	Nitrogen	No application	none						15
18	Method	Nitrogen	Surface broadcast and no incor	surface						0
19	Method	Nitrogen	Injection or immediate incorpc	incorporate						10
20	Rate	Phosphorus	Ratio total P applied/removed	app	High	0	1			10
21	Rate	Phosphorus	Ratio total P applied/removed	app	High	1	1.2			5
22	Rate	Phosphorus	No application	none	High					15

WQM Data Mart wqm_crops table containing nitrogen and phosphorus “grow out” factors

wqm_crop_id [PK] integer	wqm_crop character varying(100)	wqm_crop_units character varying(50)	wqm_crop_type character varying(50)	wqm_crop_yield double precision	wqm_crop_pct_dmat double precision	wqm_pct_nitrogen double precision	wqm_nitrogen_yield double precision	wqm_pct_phosphorus double precision	wqm_phosphorus_yield double precision
1	Asparagus	tons/ac	Truck Crops	2000	0.08	0.0632	10.11199951	0.0067	1.07199997
2	Barley all	bu/ac	Small Grain	48	0.88	0.0236	0.99686404	0.0029	0.122496
3	Barley feed	bu/ac	Small Grain	48	0.88	0.0236	0.99686404	0.0029	0.122496
4	Barley feed or malt	bu/ac	Small Grain	48	0.88	0.0236	0.99686404	0.0029	0.122496
5	Barley malt	bu/ac	Small Grain	48	0.88	0.0236	0.99686404	0.0029	0.122496
6	Barley seed	bu/ac	Small Grain	48	0.88	0.0236	0.99686404	0.0029	0.122496
7	Beans dry edible	bu/ac	Other	60	0.87	0.0375	1.95750008	0.0047	0.24534
8	Beets	tons/ac	Other	2000	0.13	0.013	3.38000007	0.002	0.52000002
9	Bermuda hay	tons/ac	Other	2000	0.9	0.0127	22.85999972	0.0021	3.77999987
10	Bluegrass seed	lbs/ac	Other	1	0.88	0.015	0.0132	0.002	0.00176
11	Broccoli	tons/ac	Truck Crops	2000	0.09	0.0512	9.21599977	0.0071	1.27800001
12	Brome grass mountain	tons/ac	Other	2000	0.9	0.015	26.9999994	0.0022	3.95999998
13	Brome grass smooth	tons/ac	Other	2000	0.9	0.023	41.40000008	0.003	5.40000005
14	Bromegrass seed	bu/ac	Other	48	0.88	0.015	0.63359999	0.0022	0.092928

Expected workflow in analyzing resource concerns, such as those addressed by WQM, involves building a crop rotation reflecting a benchmark or alternative management system, using vegetations and operations in the Land Management Operations Database (LMOD). Unfortunately LMOD vegetations do not map cleanly to the crops in the wqm_crops table, and therefore this service will not perform this mapping. Suitable mapping requires further resolution with subject matter experts, and when done a separate WQM service will be designed and coded to perform the mapping. This service therefore expects a WQM crop identifier as input. A companion service also is needed to get and return a list of WQM crops to the requesting application so that one can be selected and used as input to the WQM-16 service.

~~WQM Data Mart wqm_lmod_crop_link table relating LMOD vegetations to WQM crops~~

wqm_lmod_crop_id [PK] integer	lmod_vegetation_file_id integer	wqm_crop_id integer	lmod_vegetation_name character varying(100)	wqm_crop character varying(100)	start_date date	end_date date	last_change_date date	last_change_by character varying(50)

~~Currently there are 122 crops in the wqm_crops having "grow out" factors. There are 1000+ vegetations (crops) in LMOD. For NRCS, the mgt_crop_id in the request payload will come from the Management Editor (Crop Rotation Builder) with source template data from LMOD. The crops must be mapped to a WQM crop in order to compute nitrogen and phosphorus removal ratios. Assuming there will be data gaps (for example an LMOD strawberry crop does not have a corresponding WQM strawberry), there should be contingency "grow out" factors to resolve these gaps.~~

Components

23. Compute Nitrogen and Phosphorus Application Rate Mitigation Scores (NPAppRateScore)

23.1. Input

Winter wheat, sorghum example:

AoAId	1
p_soil_test_result	Medium
mgt_crop_id	121
crop_plant_date	2015-09-10
crop_yield	65
crop_yield_units	bu/ac
nutrient_application_date	2015-09-20
incorporated	TRUE
nutrient_applied	Nitrogen
application rate	30
nutrient_application_date	2016-02-15
incorporated	FALSE
nutrient_applied	Nitrogen
application_rate	20
nutrient_applied	Phosphorus
application_rate	20
mgt_crop_id	89
crop_plant_date	2017-05-25
crop_yield	50
crop_yield_units	bu/ac
nutrient_application_date	2017-05-21
incorporated	TRUE
nutrient_applied	Nitrogen
application rate	40
nutrient_applied	Phosphorus
application_rate	20

23.2. Methods

For the AoA in the request payload

n_app_timing_score = 100

p_app_timing_score = 100

For each mgt_crop_id (crop) in the AoA

~~**#If request payload crop is an LMOD vegetation, then convert it to a wqm_crop using the link table**~~

~~If from_lmod TRUE~~

~~**Select**~~

~~wqm_crop_id **As** this_crop_id~~

~~**From** wqm_lmod_crop_link~~

~~**Where** lmod_crop_id=mgt_crop_id~~

~~Else~~

~~this_crop_id = mgt_crop_id~~

#Determine crop type of the crop

Select

crop_type **As** this_crop_type

From wqm_crops

Where wqm_crop_id=this_crop_id

#Determine whether split nutrient applications or not

app_count = 0

For each nutrient_application_date in the crop period

app_count = app_count + 1

If app_count == 1

app_type = nosplit

Else

app_type = split

If no nutrient_application_date (no nutrient applications for the crop)

#Compute score for not fertilizing.

Select

app_mgt_score **As** n_app_rate_score

Where nutrient == nitrogen and app_mgt_kind == rate and app_mgt_factor = none

If p_soil_test_result == High

Select

app_mgt_score **As** p_app_rate_score

Where nutrient == phosphorus and app_mgt_kind == rate and app_mgt_factor = none and soil_test_result == High

Else if p_soil_test_result == Medium

Select

app_mgt_score **As** p_app_rate_score

Where nutrient == phosphorus and app_mgt_kind == rate and app_mgt_factor = none and soil_test_result == Medium

Else if p_soil_test_result == None
Select
app_mgt_score **As** p_app_rate_score
Where nutrient == phosphorus and app_mgt_kind == rate and app_mgt_factor = none and soil_test_result == None

Else
#Compute N and P application rates for the crop
For each nutrient_application_date (nutrient application) in the crop period
For each nutrient_applied
If nutrient_applied == nitrogen
nrate = nrate + application rate
Else
prate = prate + application rate

#Compute N and P removal ratios for the crop
Select
wqm_crop_pct_dmat
wqm_pct_nitrogen
wqm_pct_phosphorus
From wqm_crops table
Where wqm_crop_id=this_crop_id

n_growout = crop_yield * wqm_crop_pct_dmat * wqm_pct_nitrogen
p_growout = crop_yield * wqm_crop_pct_dmat * wqm_pct_phosphorus

n_remove_ratio = nrate / n_growout
p_remove_ratio = prate / p_growout

#Compute N application management rate score for the crop based on removal ratio and whether small grain or not
If crop_type == small grain
Select
app_mgt_score **As** ncrop_app_rate_score
From wqm_nutrient_application_mgt_scores table
Where nutrient == nitrogen and app_mgt_kind == rate and app_mgt_factor == small grain and n_remove_ratio >= remove_ratio_1 and < remove_ratio_2
Else
Select
app_mgt_score **As** ncrop_app_rate_score
From wqm_nutrient_application_mgt_scores table
Where nutrient == nitrogen and app_mgt_kind == rate and app_mgt_factor == other and n_remove_ratio >= remove_ratio_1 and < remove_ratio_2

#Compute P application management rate score for the crop based on removal ratio and soil test result
If p_soil_test_result == High

```
        If p_remove_ratio >= 1.2
            pcrop_app_rate_score = 0
        Else
            Select
                app_mgt_score As pcrop_app_rate_score
            From wqm_nutrient_application_mgt_scores table
            Where nutrient == phosphorus and app_mgt_kind == rate and
            app_mgt_factor == app and soil_test_result == High and p_remove_ratio
            >= remove_ratio_1 and < remove_ratio_2

    Else if p_soil_test_result == Medium
        If p_remove_remove ratio >= 1.6
            pcrop_app_rate_score = 0
        Else
            Select
                app_mgt_score As pcrop_app_rate_score
            From wqm_nutrient_application_mgt_scores table
            Where nutrient == phosphorus and app_mgt_kind == rate and
            app_mgt_factor == app and soil_test_result == Medium and
            p_remove_ratio >= remove_ratio_1 and < remove_ratio_2
    Else if p_soil_test_result == Low
        If p_remove_remove ratio >= 1.6
            pcrop_app_rate_score = 0
        Else
            Select
                app_mgt_score As pcrop_app_rate_score
            From wqm_nutrient_application_mgt_scores table
            Where nutrient == phosphorus and app_mgt_kind == rate and
            app_mgt_factor == app and soil_test_result == Low and p_remove_ratio
            >= remove_ratio_1 and < remove_ratio_2
    Else if p_soil_test_result == None
        If p_remove_remove ratio >= 1.2
            pcrop_app_rate_score = 0
        Else
            Select
                app_mgt_score As pcrop_app_rate_score
            From wqm_nutrient_application_mgt_scores table
            Where nutrient == phosphorus and app_mgt_kind == rate and
            app_mgt_factor == app and soil_test_result == None and p_remove_ratio
            >= remove_ratio_1 and < remove_ratio_2

    #Update N and P application management rate scores for the AoA
    n_app_rate_score = n_app_rate_score + ncrop_app_rate_score
    p_app_rate_score = p_app_rate_score + pcrop_app_rate_score

#Compute N and P application timing scores for the crop and update timin scores for
the AoA
```

For each nutrient_application_date in the crop period
app_day_diff = application_date – crop_plant_date
For each nutrient in the application
If nutrient == nitrogen
If app_type == split
Select
app_mgt_score **As** ncrop_app_timing_score
From wqm_nutrient_application_mgt_scores table
Where app_mgt_kind == timing and nutrient == nitrogen and app_mgt_factor == split and app_day_diff >= days_fr_plant_1 and < days_fr_plant_2

If ncrop_app_timing_score for this iteration NULL
n_app_timing_score = 0
Else if ncrop_app_timing score < n_app_timing score
n_app_timing_score = ncrop_app_timing_score
Else
Select
app_mgt_score **As** ncrop_app_timing_score
From wqm_nutrient_application_mgt_scores table
Where app_mgt_kind == timing and nutrient == nitrogen and app_mgt_factor == nosplit and app_day_diff >= days_fr_plant_1 and < days_fr_plant_2

If ncrop_app_timing_score for this iteration NULL
n_app_timing_score = 0
Else if ncrop_app_timing score < n_app_timing score
n_app_timing_score = ncrop_app_timing_score

Else if nutrient == phosphorus
If app_type == split
Select
app_mgt_score **As** pcrop_app_timing_score
From wqm_nutrient_application_mgt_scores table
Where app_mgt_kind == timing and nutrient == phosphorus and app_mgt_factor == split and app_day_diff >= days_fr_plant_1 and < days_fr_plant_2

If pcrop_app_timing_score for this iteration NULL
p_app_timing_score = 0
Else if pcrop_app_timing score < p_app_timing score
p_app_timing_score = pcrop_app_timing_score

Else
Select
app_mgt_score **As** pcrop_app_timing_score
From wqm_nutrient_application_mgt_scores table

Where app_mgt_kind == timing and nutrient == phosphorus and app_mgt_factor == nosplit and app_day_diff >= days_fr_plant_1 and < days_fr_plant_2

If pcrop_app_timing_score for this iteration NULL
p_app_timing_score = 0
Else if pcrop_app_timing score < p_app_timing score
p_app_timing_score = pcrop_app_timing_score

For each nutrient_application_date in the crop period
#If any nutrient application for any crop is not incorporated, the method score for the AoA is zero
If incorporated FALSE
app_method_score = 0
Break For loop
#If all nutrient applications for all crops are incorporated, the method score for incorporation applies to the AoA
Else if incorporated TRUE
Select
app_mgt_score **As** app_method_score
Where app_mgt_kind == method and app_mgt_factor == incorporate

#Compute application management scores for nitrogen in groundwater, nitrogen in surface water, and phosphorus in surface water
nleach_app_mgt_score = n_app_rate_score + n_app_timing_score + app_meth_score
nsurf_app_mgt_score = n_app_rate_score + n_app_timing_score + app_meth_score
psurf_app_mgt_score = p_app_rate_score + p_app_timing_score + app_meth_score

23.3. Output
AoA identifier
nleach_app_mgt_score
nsurf_app_mgt_score
psurf_app_mgt_score
n_app_rate_score
n_app_timing_score
p_app_rate_score
p_app_timing_score
app_meth_score

Service WQM-17: Integrated Pest Management Mitigation Scores (PestIPMScores)

Purpose: For each AoA get a mitigation score for the level of integrated pest management (IPM) to be applied. There are three levels: basic, intermediate, and advanced. Determining the level of IPM will be based on a series of questions, but these questions have not been developed yet. In the meantime this service will be a simple call to get the score for each pesticide-related WQM concern.

Service Signature

Request Payload

AoAID … integer, one per request, Area of Analysis Identifier

plan_ipm_level… character varying(6), Integrated Pest Management (IPM) Treatment Level to be Applied; values are I, II, or III

Result Payload

AoA identifier (one or more)

pleach_ipm_score … integer, Integrated Pest Mangement (IPM) Mitigation Score for Pesticide Leaching

psolsurf_ipm_score … integer, Integrated Pest Management (IPM) Mitigation Score for Pesticide Solution Runoff

padsurf_ipm_score … integer, Integrated Pest Management (IPM) Mitigation Score for Pesticide Adsorbed Runoff

pdrift_ipm_score --- integer; Integrated Pest Management (IPM) Mitigation Score for Pesticide Drift

Reference Data Source

WQM data mart wqm_ipm_scores table:

ipm_score_id [PK] integer	resource_concern character varying(50)	wqm_concern character varying(50)	ipm_level character varying(6)	ipm_level_name character varying(30)	ipm_mitigation_score integer
1	Pesticides in Ground Water	Pesticide Leaching	I	Basic	30
2	Pesticides in Ground Water	Pesticide Leaching	II	Intermediate	45
3	Pesticides in Ground Water	Pesticide Leaching	III	Advanced	60
4	Pesticides in Surface Water	Pesticide Solution Runoff	I	Basic	30
5	Pesticides in Surface Water	Pesticide Solution Runoff	II	Intermediate	45
6	Pesticides in Surface Water	Pesticide Solution Runoff	III	Advanced	60
7	Pesticides in Surface Water	Pesticide Adsorbed Runoff	I	Basic	30
8	Pesticides in Surface Water	Pesticide Adsorbed Runoff	II	Intermediate	45
9	Pesticides in Surface Water	Pesticide Adsorbed Runoff	III	Advanced	60
10	Pesticides in Surface Water	Pesticide Drift	I	Basic	30
11	Pesticides in Surface Water	Pesticide Drift	II	Intermediate	45
12	Pesticides in Surface Water	Pesticide Drift	III	Advanced	60

Component

24. Get Integrated Pest Management (IPM) Mitigation Scores

24.1. Input (sample for three requests)

AoAID	1	2	3
plan_ipm_level	III	II	I

24.2. Methods

For each AoA in the request payload

#Compute IPM level mitigation score for Pesticide Leaching

pleach_ipm_score = ipm_mitigation_score where wqm_concern == Pesticide Leaching and ipm_level == plan_ipm_level

#Compute IPM level mitigation score for Pesticide Solution Runoff

psolsurf_ipm_score score = ipm_mitigation_score where wqm_concern == Pesticide Solution Runoff and ipm_level == plan_ipm_level

#Compute IPM level mitigation score for Pesticide Adsorbed Runoff

padsurf_ipm_score score = ipm_mitigation_score where wqm_concern == Pesticide Adsorbed Runoff and ipm_level == plan_ipm_level

#Compute IPM level mitigation score for Pesticide Drift

pdrift_ipm_score = ipm_mitigation_score where wqm_concern == Pesticide Drift and ipm_level == plan_ipm_level

24.3. Output

AoA identifier

pleach_ipm_score

psolsurf_ipm_score

padsurf_ipm_score

pdrift_ipm_score

Service WQM-18: Pesticide Mitigation Technique Scores (PestTechnScores)

Purpose: Compile mitigation scores for the set of pesticide management techniques to be applied on an AoA for each pesticide-related WQM concern.

Service Signature

Request Payload

AoA identifier… one per request

plan_ipm_technique… integer, Integrated Pest Management (IPM) Technique to be Applied; valid values are 1, 2, 3, 4, 5, 6, 7, 8, or 9

Result Payload

AoA identifier (one or more)

pleach_technique_score … integer, IPM Mitigation Technique Score for Pesticide Leaching

psolsurf_technique_score … integer, IPM Mitigation Technique Score for Pesticide Solution Runoff

padsurf_technique_score … integer, IPM Mitigation Technique Score for Pesticide Adsorbed Runoff

pdrift_technique score … integer, IPM Mitigation Technique Score for Pesticide Drift

Reference Data Source

WQM Data Mart wqm_ipm_technique_score table:

ipm_technique_score_id [PK] integer	ipm_technique_id integer	ipm_technique_name character varying(50)	wqm_concern character varying(50)	ipm_technique_score integer
1	1	Application timing - Ambient Temperature	Pesticide Drift	5
2	2	Application timing - Rain	Pesticide Leaching	15
3	2	Application timing - Rain	Pesticide Solution Runoff	15
4	2	Application timing - Rain	Pesticide Adsorbed Runoff	15
5	3	Application timing - Relative Humidity	Pesticide Drift	5
6	4	Application timing - Wind	Pesticide Drift	10
7	5	Formulations and Adjuvants	Pesticide Leaching	5
8	5	Formulations and Adjuvants	Pesticide Solution Runoff	5
9	5	Formulations and Adjuvants	Pesticide Adsorbed Runoff	5
10	5	Formulations and Adjuvants	Pesticide Drift	5

Component

25. Get Pesticide Mitigation Technique Scores

25.1. Input

AoAId	1	1	1	1	1	1
plan_ipm_technique	1	2	4	5	7	8

25.2. Methods

For each AoA in the request payload

For each IPM Technique (plan_ipm_technique) in the AoA

#Compute IPM technique mitigation score for Pesticide Leaching and increment total score

pl_tech_score = ipm_technique_score where wqm_concern == Pesticide Leaching and ipm_technique == plan_ipm_technique

pleach_technique_score = pleach_technique_score + pl_tech_score

#Compute IPM technique mitigation score for Pesticide Solution Runoff and increment total score

ps_tech_score = ipm_technique_score where wqm_concern == Pesticide Solution Runoff and ipm_technique == plan_ipm_technique

psolsurf_technique_score = psolsurf_technique_score + pl_tech_score

#Compute IPM technique mitigation score for Pesticide Adsorbed Runoff and increment total score

pa_tech_score = ipm_technique_score where wqm_concern == Pesticide Adsorbed Runoff and ipm_technique == plan_ipm_technique

padsurf_technique_score = padsurf_technique_score + pl_tech_score

#Compute IPM technique mitigation score for Pesticide Drift and increment total score

pd_tech_score = ipm_technique_score where wqm_concern == Pesticide Drift and ipm_technique == plan_ipm_technique

pdrift_technique_score = pdrift_technique_score + pl_tech_score

25.3. Output

AoA identifier

pleach_technique_score

psolsurf_technique_score

padsurf_technique_score

pdrift_technique score

Service WQM-19: Pesticide Mitigation Practice Scores (PestPractScores)

Purpose: Compile WQM pesticide-related concern mitigation scores for the set of conservation practices to be applied on an AoA.

Service Signature

Request Payload

AoAId … integer, one per request; Area of Analysis Identifier

plan_ipm_practice… integer, one or more for the AoA; Integrated Pest Management (IPM) Conservation Practice; the value corresponds to the NRCS practice_id

plan_pract_variant… character varying(30); Variation of IPM Conservation Practice; a practice can have one variant only in the request payload

Result Payload

AoA identifier… one

pleach_practice_score … integer; Conservation Practice Mitigation Score for Pesticide Leaching

psolsurf_practice_score … integer; Conservation Practice Mitigation Score for Pesticide Solution Runoff

padsurf_practice_score … integer; Conservation Practice Mitigation Score for Pesticide Adsorbed Runoff

pdrift_practice-score … integer; Conservation Practice Mitigation Score for Pesticide Drift

Reference Data Source

WQM Data Mart wqm_ipm_practice_scores table:

ipm_practice_score_id [PK] integer	practice_id integer	practice_code character varying(10)	ipm_practice_name character varying(100)	practice_variant character varying(30)	wqm_concern character varying(50)	ipm_practice_score integer
1	2	311	Alley Cropping		Pesticide Leaching	5
2	2	311	Alley Cropping		Pesticide Solution Runoff	5
3	2	311	Alley Cropping		Pesticide Adsorbed Runoff	10
4	2	311	Alley Cropping		Pesticide Drift	10
5	67	450	Anionic Polyacrylamide (PAM) Application		Pesticide Solution Runoff	5
6	67	450	Anionic Polyacrylamide (PAM) Application		Pesticide Adsorbed Runoff	10
7	1	310	Bedding		Pesticide Leaching	5
8	1	310	Bedding		Pesticide Solution Runoff	5
9	1	310	Bedding		Pesticide Adsorbed Runoff	5
10	11	327	Conservation Cover		Pesticide Leaching	10
11	11	327	Conservation Cover		Pesticide Solution Runoff	10
12	11	327	Conservation Cover		Pesticide Adsorbed Runoff	10
13	12	328	Conservation Crop Rotation		Pesticide Leaching	10
14	12	328	Conservation Crop Rotation		Pesticide Solution Runoff	10
15	12	328	Conservation Crop Rotation		Pesticide Adsorbed Runoff	10

Component

26. Compute IPM Conservation Practice Mitigation Scores

26.1. Input

AoAId	1			
plan_ipm_practice	12	20	80	66
plan_pract_variant		Weed Suppression	Natural Materials	

26.2. Methods

For the AoA

For each plan_ipm_practice for the AoA

#Compute IPM practice mitigation score for Pesticide Leaching and increment total score

pl_pract_score = ipm_practice_score where wqm_concern == Pesticide Leaching and ipm_practice_code == plan_ipm_practice and ipm_practice_variant == plan_pract_variant

pleach_pract_score = pleach_practice_score + pl_pract_score

#Compute IPM practice mitigation score for Pesticide Solution Runoff and increment total score

ps_pract_score = ipm_practice_score where wqm_concern == Pesticide Solution Runoff and ipm_practice_code == plan_ipm_practice and ipm_practice_variant == plan_pract_variant

psolsurf_pract_score = psolsurf_practice_score + ps_pract_score

#Compute IPM practice mitigation score for Pesticide Adsorbed Runoff and increment total score

pa_pract_score = ipm_practice_score where wqm_concern == Pesticide Adsorbed Runoff and ipm_practice_code == plan_ipm_practice and ipm_practice_variant == plan_pract_variant

padsurf_pract_score = padsurf_practice_score + pa_pract_score

#Compute IPM practice mitigation score for Pesticide Drift and increment total score

pd_pract_score = ipm_practice_score where wqm_concern == Pesticide Drift and ipm_practice_code == plan_ipm_practice and ipm_practice_variant == plan_pract_variant

pdrift_pract_score = pdrift_practice_score + pd_pract_score

26.3. Output

AoAId … one

pleach_practice_score

psolsurf_practice_score

padsurf_practice_score

pdrift_practice score

Service WQM-20: Threshold and Mitigation Scores for WQM Scorebar (WQMScorebar)

Purpose: Compute and compile mitigation and threshold scores for each WQM nutrient and pesticide related concern for populating the WQM scorebar.

Service Signature

Request Payload

AoAId … integer; Area of Analysis (AoA) Identifier

#From WQM-14 NutTechScores service

nleach_techn_score … integer, nutrient management technique mitigation score for nitrogen in ground water concern

nsurf_techn_score … integer, nutrient management technique mitigation score for nitrogen in surface water concern

psurf_techn_score … integer, nutrient management technique mitigation score for phosphorus in surface water concern

#From WQM-15 SedNutPractScores service

nleach_pract_score … integer, Nitrogen Leaching Practice Mitigation Score

ssurf_pract_score … integer, Sediment Runoff Practice Mitigation Score

nsurf_pract_score … integer, Nitrogen Runoff Practice Mitigation Score

psurf_pract_score … integer, Phosphorus Runoff Practice Mitigation Score

#From WQM-16 NutAppMgtScores service

nleach_app_mgt_score … integer, Nitrogen Application Management Score for Mitigating Leaching Loss Potential

nsurf_app_mgt_score … integer, Nitrogen Application Management Score for Mitigating Surface Runoff Loss Potential

psurf_app_mgt_score … integer, Phosphorus Application Management Score for Mitigating Surface Runoff Loss Potential

#From WQM-17 PestIPMScores service

pleach_ipm_score … integer, Integrated Pest Mangement (IPM) Mitigation Score for Pesticide Leaching

psolsurf_ipm_score … integer, Integrated Pest Management (IPM) Mitigation Score for Pesticide Solution Runoff

padsurf_ipm_score … integer, Integrated Pest Management (IPM) Mitigation Score for Pesticide Adsorbed Runoff

pdrift_ipm_score --- integer; Integrated Pest Management (IPM) Mitigation Score for Pesticide Drift

#From WQM-18 PestTechScores service

pleach_technique_score … integer, IPM Mitigation Technique Score for Pesticide Leaching

psolsurf_technique_score … integer, IPM Mitigation Technique Score for Pesticide Solution Runoff

padsurf_technique_score … integer, IPM Mitigation Technique Score for Pesticide Adsorbed Runoff

pdrift_technique_score … integer, IPM Mitigation Technique Score for Pesticide Drift

#From WQM-19 PestPractScores service

pleach_practice_score … integer; Conservation Practice Mitigation Score for Pesticide Leaching

psolsurf_practice_score … integer; Conservation Practice Mitigation Score for Pesticide Solution Runoff

padsurf_practice_score … integer; Conservation Practice Mitigation Score for Pesticide Adsorbed Runoff

pdrift_practice_score … integer; Conservation Practice Mitigation Score for Pesticide Drift

#From WQM-13 WQMThresholdScores service

aoa_nleach_threshold … integer, Nitrogen Leaching Threshold Score

aoa_nrun_threshold … integer, Nitrogen Runoff Threshold Score

aoa_sedrun_threshold … integer, Sediment Runoff Threshold Score

aoa_prun_threshold … integer, Phosphorus Runoff Threshold Score

aoa_pleach_human_threshold … integer, Pesticide Leaching Threshold Score, Human

aoa_pleach_matcfish_threshold … integer, Pesticide Leaching Threshold Score, Fish

aoa_psorun_human_threshold … integer, Pesticide Solution Runoff Threshold Score, Human

aoa_psorun_matcfish_threshold … integer, Pesticide Solution Runoff Threshold Score, Fish

aoa_padrun_human_threshold … integer, Pesticide Adsorbed Runoff Threshold Score, Human

aoa_padrun_stvfish_threshold … integer, Pesticide Adsorbed Runoff Threshold Score, Fish

aoa_pdrift_human_threshold … integer, Pesticide Drift Threshold Score, Human

aoa_pdrift_fish_threshold … integer, Pesticide Drift Threshold Score, Fish

Result Payload

AoAId … one

bar_nleach_mit_score … integer; Mitigation Score for Nitrogen In Ground Water

bar_nleach_threshold … integer; Threshold Score for Nitrogen In Ground Water

bar_nsurf_mit_score … integer; Mitigation Score for Nitrogen In Surface Water

bar_nsurf_threshold … integer; Threshold Score for Nitrogen In Surface Water

bar_psurf_mit_score … integer; Mitigation Score for Phosphorus In Surface Water

bar_psurf_threshold … integer; Threshold Score for Phosphorus In Surface Water

bar_ssurf_mit_score … integer; Mitigation Score for Sediment In Surface Water

bar_ssurf_threshold … integer; Threshold Score for Sediment In Surface Water

bar_pleach_human_mit_score … integer; Mitigation Score for Pesticide Leaching (Human)

bar_pleach_human_threshold … integer; Threshold Score for Pesticide Leaching (Human)

bar_pleach_fish_mit_score … integer; Mitigation Score for Pesticide Leaching (Fish)

bar_pleach_fish_threshold … integer; Threshold Score for Pesticide Leaching (Fish)

bar_psorun_human_mit_score … integer; Mitigation Score for Pesticide Solution Runoff (Human)

bar_psorun_human_threshold … integer; Threshold Score for Pesticide Solution Runoff (Human)

bar_psorun_fish_mit_score … integer; Mitigation Score for Pesticide Solution Runoff (Fish)

bar_psorun_fish_threshold … integer; Threshold Score for Pesticide Solution Runoff (Fish)

bar_padrun_human_mit_score … integer; Mitigation Score for Pesticide Adsorbed Runoff (Human)

bar_padrun_human_threshold … integer; Threshold Score for Pesticide Adsorbed Runoff (Human)

bar_padrun_fish_mit_score … integer; Mitigation Score for Pesticide Adsorbed Runoff (Fish)

bar_padrun_fish_threshold … integer; Threshold Score for Pesticide Adsorbed Ruoff (Fish)
bar_pdrift_human_mit_score … integer; Mitigation Score for Pesticide Drift (Human)
bar_pdrift_human_threshold … integer; Threshold Score for Pesticide Drift (Human)
bar_pdrift_fish_mit_score … integer; Mitigation Score for Pesticide Drift (Fish)
bar_pdrift_fish_threshold … integer; Threshold Score for Pesticide Drift (Fish)

Component

27. Compute mitigation and threshold scores for each WQM concern (MitThreshWQMScores)

27.1. Input

AoAId	1	2
nleach_techn_score	10	10
nsurf_techn_score	15	10
psurf_techn_score	5	10
nleach_pract_score	30	10
ssurf_pract_score	20	10
nsurf_pract_score	15	10
psurf_pract_score	30	10
nleach_app_mgt_score	5	10
nsurf_app_mgt_score	10	10
psurf_app_mgt_score	5	10
pleach_ipm_score	15	10
psolsurf_ipm_score	20	10
padsurf_ipm_score	15	10
pdrift_ipm_score	15	10
pleach_technique_score	20	10
psolsurf_technique_scor	10	10
padsurf_technique_score	5	10
pdrift_technique score	5	10
pleach_practice_score	5	10
psolsurf_practice_score	20	10
padsurf_practice_score	10	10
pdrift_practice-score	5	10
aoa_nleach_threshold	60	60
aoa_nrun_threshold	70	60
aoa_sedrun_threshold	80	60
aoa_prun_threshold	60	60
aoa_pleach_human_threshold	80	60
aoa_pleach_matcfish_threshold	80	60
aoa_psorun_human_threshold	70	60
aoa_psorun_matcfish_threshold	60	60
aoa_padrun_human_threshold	80	60
aoa_padrun_stvfish_threshold	80	60
aoa_pdrift_human_threshold	60	60
aoa_pdrift_fish_threshold	60	60

27.2. Methods

For the AoA in the request payload

#Nitrogen in Ground Water mitigation and threshold scores

bar_nleach_mit_score = nleach_techn_score + nleach_pract_score + nleach_app_mgt_score

bar_nleach_threshold = aoa_nleach_threshold

#Nitrogen in Surface Water mitigation and threshold scores

bar_nsurf_mit_score = nsurf_techn_score + nsurf_pract_score + nsurf_app_mgt_score

bar_nsurf_threshold = aoa_nrun_threshold

#Phosphorus in Surface Water mitigation and threshold scores

bar_psurf_mit_score = psurf_techn_score + psurf_pract_score + psurf_app_mgt_score

bar_psurf_threshold = aoa_nrun_threshold

#Sediment in Surface Water mitigation and threshold scores

bar_ssurf_mit_score = ssurf_pract_score

bar_ssurf_threshold = aoa_nrun_threshold

#Pesticide in Ground Water - Human mitigation and threshold scores

bar_pleach_human_mit_score = pleach_ipm_score + pleach_technique_score + pleach_practice_score

bar_pleach_human_threshold = aoa_pleach_human_threshold

#Pesticide in Ground Water - Fish mitigation and threshold scores

bar_pleach_fish_mit_score = pleach_ipm_score + pleach_technique_score + pleach_practice_score

bar_pleach_fish_threshold = aoa_pleach_matcfish_threshold

#Pesticide in Solution Runoff - Human mitigation and threshold scores

bar_psorun_human_mit_score = psolsurf_ipm_score + psolsurf_technique_score + psolsurf_practice_score

bar_psorun_human_threshold = aoa_psorun_human_threshold

#Pesticide in Solution Runoff - Fish mitigation and threshold scores

bar_psorun_fish_mit_score = psolsurf_ipm_score + psolsurf_technique_score + psolsurf_practice_score

bar_psorun_fish_threshold = aoa_psorun_matcfish_threshold

#Pesticide in Adsorbed Runoff - Human mitigation and threshold scores

bar_padrun_human_mit_score = padsurf_ipm_score + padsurf_technique_score + padsurf_practice_score

bar_padrun_human_threshold = aoa_padrun_human_threshold

#Pesticide in Adsorbed Runoff - Fish mitigation and threshold scores
bar_padrun_fish_mit_score = padsurf_ipm_score + padsurf_technique_score + padsurf_practice_score
bar_padrun_fish_threshold = aoa_padrun_styfish_threshold

#Pesticide Drift - Human mitigation and threshold scores
bar_pdrift_human_mit_score = pdrift_ipm_score + pdrift_technique_score + pdrift_practice_score
bar_pdrift_human_threshold = aoa_psorun_human_threshold

#Pesticide Drift - Fish mitigation and threshold scores
bar_pdrift_fish_mit_score = pdrift_ipm_score + pdrift_technique_score + pdrift_practice_score
bar_pdrift_fish_threshold = aoa_psorun_matcfish_threshold

27.3. Output

AoA identifier

#For Nitrogen in Ground Water scorebar
bar_nleach_mit_score
bar_nleach_threshold
#For Nitrogen in Surface Water scorebar
bar_nsurf_mit_score
bar_nsurf_threshold
#For Phosphorus in Surface Water scorebar
bar_psurf_mit_score
bar_psurf_threshold
#For Sediment in Surface Water scorebar
bar_ssurf_mit_score
bar_ssurf_threshold
#For Pesticide in Ground Water - Human scorebar
bar_pleach_human_mit_score
bar_pleach_human_threshold
#For Pesticide in Ground Water - Fish scorebar
bar_pleach_fish_mit_score
bar_pleach_fish_threshold
#For Pesticide in Solution Runoff - Human scorebar
bar_psorun_human_mit_score
bar_psorun_human_threshold
#For Pesticide in Solution Runoff - Fish scorebar
bar_psorun_fish_mit_score
bar_psorun_fish_threshold
#For Pesticide in Adsorbed Runoff - Human scorebar
bar_padrun_human_mit_score
bar_padrun_human_threshold
#For Pesticide in Adsorbed Runoff - Fish scorebar
bar_padrun_fish_mit_score
bar_padrun_fish_threshold

#For Pesticide Drift - Human scorebar
bar_pdrift_human_mit_score
bar_pdrift_human_threshold
#For Pesticide Drift - Fish scorebar
bar_pdrift_fish_mit_score
bar_pdrift_fish_threshold

Service WQM-21: Nutrient Soil Leaching and Runoff Loss Potentials for an Area of Analysis (NutrientSLP-SRP)

This service intersects area of analysis (AoA) and soil mapunit geometries, gets soil parameters, and computes nutrient soil leaching and runoff potentials as an end-to-end process. The service combines WQM-02, WQM-05, and WQM-06 services into a single service. It returns a results payload containing the relevant attributes for each soil component in the AoA, leaching (SLP) and runoff (SRP) potentials for each soil component, and weighted average leaching and runoff loss potential values for the AoA.

The service allows for submitting parameter edits. For example, the request payload can contain just the AoA geometry and the service gets soil parameters and computes SLP and SRP and returns the results, including the parameters. If an application edits the parameters, a subsequent request payload can contain the parameter edits and not the geometry..

Service Signature

Request Payload

AoAId … integer, one per request; Area of Analysis Identifier

aoa_geometry … one set of coordinates; Area of Analysis Geometry

Result Payload

AoAId… one

cokey… character varying(60), one or more per AoA; Soil Component Key

compname … character varying(120); Soil Component Name

aoa_comp_area … numeric(); Soil Component Area (Acres) in the Area of Analysis

aoa_comp_hsg … charater varying(10); Hydrologic Soil Group of the Soil Component

aoa_comp_taxorder … character varying(120); Taxonomic Order of the Soil Component

aoa_comp_kfact … numeric(); K factor of the Soil Component

aoa_comp_slope … integer; Slope Percentage of the Soil Component

aoa_comp_coarse_frag … numeric(); Weighted Average Coarse Rock Fragment Volume Percentage through the Profile of the Soil Component

aoa_comp_om … numeric(); Organic Matter Percentage of the Surface Horizon of the Soil Component; application may edit later

aoa_comp_hzdepth … numeric(); Depth (inches) of the Surface Horizon of the Soil Component; application may edit later

aoa_comp_wtbl … character varying(30); Kind of Water Table of the Soil Component; values are None, Apparent, Perched

aoa_comp_cracksgr24 … Boolean; Surface Connected Macropores (Cracks) at Least 24 Inches Deep; default set to False by this service

aoa_comp_slopegr15 … Boolean; Field Slope is Greater Than 15%; value set by this service

aoa_comp_hwt_lt_24 … Boolean; High Water is Less than 24 Inches Under the Surface; value set by this service

#Soil leaching potential of the area of analysis

aoa_nslp (char)

#Soil component key

cokey… one or more

#Soil leaching potential of the soil component
comp_nslp (char)
#Soil runoff potential for the area of analysis
aoa_srp
#Soil component key
cokey… one or more
#Soil runoff potential for soil component
comp_srp

Reference Data Sources

SSURGO layer and attribute tables
component table
cokey … character varying(60)
compname … character varying(120)
taxorder … character varying(508)
slope_r … numeric
hydgrp … character varying(508)
chkey … character varying(60)
chorizon table
chkey … character varying(60)
hzdept_r … integer
hzdepb_r … integer
hzthk_r … integer
kwfact … character varying(508)
kffact … character varying(508)
cokey
chfragskey … character varying(60)
chfrags table
chfragskey
fragvol_r … integer
chkey
comonth table
comonthkey
month
monthseq
cokey
cosoilmoist table
soimoistdept_r
soimoistdepb_r
soimoiststat
cosoilmoistkey
comonthkey

Components

28. List of Soil Components in an Area of Analysis (AoASCList)

28.1. Input

aoa_id … AoA identifier

aoa_geometry

28.2. Reference Data

SSURGO soil mapunit layer

See SSURGO Metadata- Table Column Descriptions

28.3. GIS Operations

#Compute area of AoA

aoa_area = area of aoa_geometry

#AoA x SSURGO intersection

Clip SSURGO layer with AoA geometry producing attribute table

gid… polygon identifier

aoa_id… AoA identifier

mukey … soil mapunit key

gid_area… area of clipped polygon

28.4. Methods

For the aoa_id

#Compile list of unique AoA soil mapunits and compute their areas

```
Select
    aoa_id
    mukey
    sum(gid_area) As aoa_mu_area
Into temp_aoa_mu
From clipped attribute table
Group by mukey, aoa_id, aoa_mu_area
Order by mukey
```

#Compile list of soil components per mapunit and compute their areas

```
Select
    temp_aoa_mu.aoa_id
    temp_aoa_mu.mukey
    component.cokey
    component.compname
    temp_aoa_mu.aoa_mu_area * component.comppct_r As aoa_comp_area
Into temp_aoa_comp
From temp_aoa_mu Inner Join ssurgo.component On component.mukey =
temp_mu.mukey
Order By mukey, cokey
```

#Remove soil components from list less than 10% of AoA area
Delete From temp_aoa_comp
Where aoa_comp_area / aoa_area < 0.10

28.5. Output
#List of soil components in the AoA with following attributes
aoa_id
mukey
cokey
compname
aoa_comp_area

29. Soil Component Attributes for WQM (WQMSCAttr)
Note: this WQM component gets soil component attributes to feed WQM components for computing soil leaching and runoff potential for sediment, nutrient, and pesticide WQM concerns

29.1. Input
#AoA soil component list
aoa_id
mukey
cokey
compname
aoa_comp_area

29.2. Reference Data
SSURGO mapunit component table and attributes

29.3. Methods
For the AoA
For each soil component (cokey) in the AoA
#Get component-level parameters (hydrologic soil group, slope, taxonomic order)
cokey in this iteration = this_cokey
Select
component.hydgrp (hydrologic soil group)
component.slope_r (representative slope)
component.taxorder (soil taxonomic order)
From ssurgo.component
Where component.cokey=this_cokey

#For this cokey
aoa_comp_hsg = component.hydgrp
aoa_comp_slope = component.slope_r
aoa_comp_taxorder = component.taxorder

If aoa_comp_slope > 15
aoa_comp_slope15 = True
Else

aoa_comp_slope15 = False

#Get following attributes for the horizons (layers) of this soil component
Select
chorizon.chkey
chorizon.kffact
chorizon.kwfact
chorizon.om_r
chorizon.hzthk_r
chorizon.hzdept_r
chorizon.hzdepb_r
From ssurgo.component
Inner Join ssurgo.chorizon On chorizon.cokey=this_cokey
Order by chkey (surface horizon on top, bottom horizon on bottom.. ordering by hzdept_r ascending may be better)

For the first horizon of this soil component
#Get first horizon thickness
If hzthk_r for this_horizon is NULL
aoa_comp_hzthk = hzdepb_r – hzdept_r
Else
aoa_comp_hzthk = hzthk_r

#Get first horizon organic matter
aoa_comp_om = component.chorizon.om_r

#Resolve and get K Factor
For each horizon of this soil component
If aoa_comp_hsg == D and aoa_comp_taxorder == Histosols and kffact NULL and kwfact NULL
aoa_comp_kfact = 0.02
Else if kffact NULL and kwfact NULL
Go to the next horizon
Else if kffact NOT NULL
aoa_comp_kfact = kffact
Terminate iteration
Else if kffact NULL and kwfact NOT NULL
aoa_comp_kfact = chorizon.kwfact
Terminate iteration

#Iterate through each horizon (profile) of the soil component to get data for computing a weighted average rock fragment volume
For each soil horizon of this soil component (chkey where chorizon.cokey == this_cokey)
this_horizon = chkey of this iteration

#Get and sum rock fragment volumes in this horizon (horizon can have volumes broken down by size)
Select
chfrags.chfragskey
chfrags.fragvol_r
From ssurgo.chfrags
Inner Join ssurgo.shfrags On chfrags.chkey=this_horizon

For each chfragskey of this_horizon
hz_frag_vol = hz_frag_vol + fragvol_r

#Compute running total soil component profile thickness
If hzthk_r for this_horizon is NULL
this_hz_thk = hzdepb_r – hzdept_r
Else
this_hz_thk = hzthk_r

profile_thk = profile_thk + this_hz_thk

#Compute volume x horizon thickness product for this horizon and add to product for soil component
this_hz_product = this_hz_thk * hz_frag_vol
this_comp_product = this_comp_product + this_hz_product

#Compute weighted average rock fragment volume for this soil component
aoa_comp_coarse_frag = this_comp_product / profile_thk

#Compute whether this soil component has perched, apparent, or no water table
With WT1 As (Select
component.cokey,
component.compname,
component.comppct_r,
MIN(cosoilmoist.soimoistdept_r) As wtbl_top_min,
MAX(cosoilmoist.soimoistdepb_r) As wtbl_bot_max
From ssurgo.component
Inner Join ssurgo.comonth On component.cokey=comonth.cokey
Inner Join ssurgo.cosoilmoist On comonth.comonthkey=cosoilmoist.comonthkey
Where component.cokey='this cokey value' and cosoilmoist.soimoiststat='Wet'
Group By component.cokey, component.compname, component.comppct_r
Order By component.cokey),
WT2 As (Select
WT1.cokey,
WT1.compname,
WT1.comppct_r,
WT1.wtbl_top_min,
WT1.wtbl_bot_max,
MAX(cosoilmoist.soimoistdept_r) As nonwet_top_max

From WT1
Left Outer Join ssurgo.comonth On WT1.cokey=comonth.cokey
Left Outer Join ssurgo.cosoilmoist On comonth.comonthkey=cosoilmoist.comonthkey
Where WT1.cokey='this_cokey value' and (cosoilmoist.soimoiststat NOT IN ('Wet') OR cosoilmoist.soimoiststat IS NULL)
Group By WT1.cokey, WT1.compname, WT1.comppct_r, WT1.wtbl_top_min, WT1.wtbl_bot_max)
Select
    WT2.cokey,
    WT2.compname,
    WT2.comppct_r,
    WT2.wtbl_top_min,
    WT2.wtbl_bot_max,
    WT2.nonwet_top_max,
    case when (wtbl_bot_max < 183 or nonwet_top_max >= wtbl_bot_max) then
    'Perched' else 'Apparent' end as wtkind
From WT2

If wtkind NULL
    aoa_comp_wtbl = None
Else
    aoa_comp_wtbl = wtkind

If wtbl_top_min <= 61 (24 inches in round centimeters)
    aoa_comp_hwt_lt_24 = True
Else
    aoa_comp_hwt_lt_24 = False

#Set macropores (soil cracks) parameter
aoa_comp_cracksgr24 = False

29.4. Output

#AoA soil component list containing all components with following WQM attributes
aoa_id
    mukey
    cokey
    compname
    aoa_comp_area
    aoa_comp_hsg
    aoa_comp_taxorder
    aoa_comp_kfact
    aoa_comp_slope
    aoa_comp_coarse_frag
    aoa_comp_om
    aoa_comp_hzdepth
    aoa_comp_wtbl
    aoa_comp_cracksgr24

aoa_comp_slopegr15
aoa_comp_hwt_lt_24

30. Computation of Nutrient Leaching Potential for a Soil Component (SCNutSLP)

30.1. Input

AoAid	1							
cokey	11150284	11150285	11150286	11150287	11150288	11150289	11150290	11150291
compname	Test1	Test2	Test3	Test4	Test5	Test6	Test7	Test8
aoa_comp_area	45.84	63.72	25.6	33.5	10.77	36.93	44.33	21.76
aoa_comp_hsg	B	A	A/D	C	D	B/D	D	B
aoa_comp_taxorder	Aridisols	Mollisols	Spodosols	Inceptisols	Histosols	Entisols	Mollisols	Mollisols
aoa_comp_kfact	0.24	0.37	0.21	0.42	0.02	0.28	0.32	0.48
aoa_comp_slope	8	12	15	16	3	1	14	5
aoa_comp_coarse_frag	3.7	0	12	6	2	3	7	5
aoa_comp_drained	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
aoa_comp_wtbl	None	Apparent	None	None	Apparent	Perched	None	Perched
aoa_comp_hwt_lt_24	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE

30.2. Methods

For the AoA

#Compute nutrient soil leaching potential for each soil component in the AoA

For each soil component in the AoA

If aoa_comp_taxorder == Histosols
comp_nslp = HIGH
comp_nslp_number = 3
Else if aoa_comp_wtbl == Apparent and aoa_comp_hwt_lt_24 TRUE
comp_nslp = HIGH
comp_nslp_number = 3
Else if aoa_comp_hsg == A (and not Histosol)
If aoa_comp_slope > 12
If aoa_comp_coarse_frag > 10%
comp_nslp = HIGH
comp_nslp_number = 3
Else
comp_nslp = MODERATELY HIGH
comp_nslp_number = 2
Else if aoa_comp_slope <= 12
comp_nslp = HIGH
comp_nslp_number = 3
Else if aoa_comp_hsg == B (and not Histosol)
If (aoa_comp_slope <= 12 and aoa_comp_kfact >= 0.24) or (aoa_comp_slope > 12)
If aoa_comp_coarse_frag >10% and <= 30%
comp_nslp = MODERATELY HIGH
comp_nslp_number = 2
Else if aoa_comp_coarse_frag > 30%
comp_nslp = HIGH
comp_nslp_number = 3

```
            Else
                comp_nslp = MODERATE
                comp_nslp_number = 1
        Else if aoa_comp_slope >=3 and <=12 and aoa_comp_kfact < 0.24
            If aoa_comp_coarse_frag >10%
                comp_nslp = HIGH
                comp_nslp_number = 3
            Else
                comp_nslp = MODERATELY HIGH
                comp_nslp_number = 2
        Else if aoa_comp_slope <3 and aoa_comp_kfact <0.24
            comp_nslp = HIGH
            comp_nslp_number = 3
    Else aoa_comp_hsg == C (and not Histosol)
        If aoa_comp_coarse_frag >30%
            comp_nslp = HIGH
            comp_nslp_number = 3
        Else if aoa_comp_coarse_frag >10% and <=30%
            comp_nslp = MODERATELY HIGH
            comp_nslp_number = 2
        Else
            comp_nslp = MODERATE
            comp_nslp_number = 1
    Else if not Histosol and aoa_comp_hsg == D (and not Histosol)
        If aoa_comp_coarse_frag >30%
            comp_nslp = MODERATELY HIGH
            comp_nslp_number = 2
        Else if aoa_comp_coarse_frag >10% and <=30%
            comp_nslp = MODERATE
            comp_nslp_number = 1
        Else
            comp_nslp = LOW
            comp_nslp_number = 0
    Else if not Histosol and aoa_comp_hsg == A/D (and not Histosol)
        If aoa_comp_drained TRUE (A HSG applies)
            If aoa_comp_slope > 12
                If aoa_comp_coarse_frag > 10%
                    comp_nslp = HIGH
                    comp_nslp_number = 3
                Else
                    comp_nslp = MODERATELY HIGH
                    comp_nslp_number = 2
            Else if aoa_comp_slope <= 12
                comp_nslp = HIGH
                comp_nslp_number = 3
        Else if aoa_comp_drained FALSE (D HSG applies)
            If aoa_comp_coarse_frag >30%
```

```
            comp_nslp = MODERATELY HIGH
            comp_nslp_number = 2
        Else if aoa_comp_coarse_frag >10% and <=30%
            comp_nslp = MODERATE
            comp_nslp_number = 1
        Else
            comp_nslp = LOW
            comp_nslp_number = 0
Else if not Histosol and aoa_comp_hsg == B/D (and not Histosol)
    If aoa_comp_drained TRUE (B HSG applies)
        If (aoa_comp_slope <= 12 and aoa_comp_kfact >= 0.24) or
        (aoa_comp_slope > 12)
            If aoa_comp_coarse_frag >10% and <= 30%
                comp_nslp = MODERATELY HIGH
                comp_nslp_number = 2
            Else if aoa_comp_coarse_frag > 30%
                comp_nslp = HIGH
                comp_nslp_number = 3
            Else
                comp_nslp = MODERATE
                comp_nslp_number = 1
        Else if aoa_comp_slope >=3 and <=12 and aoa_comp_kfact < 0.24
            If aoa_comp_coarse_frag >10%
                comp_nslp = HIGH
                comp_nslp_number = 3
            Else
                comp_nslp = MODERATELY HIGH
                comp_nslp_number = 2
        Else if aoa_comp_slope <3 and aoa_comp_kfact <0.24
            comp_nslp = HIGH
            comp_nslp_number = 3
    Else if aoa_comp_drained FALSE (D HSG applies)
        If aoa_comp_coarse_frag >30%
            comp_nslp = MODERATELY HIGH
            comp_nslp_number = 2
        Else if aoa_comp_coarse_frag >10% and <=30%
            comp_nslp = MODERATE
            comp_nslp_number = 1
        Else
            comp_nslp = LOW
            comp_nslp_number = 0
Else if not Histosol and aoa_comp_hsg == C/D
    If aoa_comp_drained TRUE (C HSG applies)
        If aoa_comp_coarse_frag >30%
            comp_nslp = HIGH
            comp_nslp_number = 3
        Else if aoa_comp_coarse_frag >10% and <=30%
```

comp_nslp = MODERATELY HIGH
comp_nslp_number = 2
Else
comp_nslp = MODERATE
comp_nslp_number = 1
Else if aoa_comp_drained FALSE (D HSG applies)
If aoa_comp_coarse_frag >30%
comp_nslp = MODERATELY HIGH
comp_nslp_number = 2
Else if aoa_comp_coarse_frag >10% and <=30%
comp_nslp = MODERATE
comp_nslp_number = 1
Else
comp_nslp = LOW
comp_nslp_number = 0

30.3. Output

#This output goes to the next component and also to result payload

aoa_id
cokey
compname
aoa_comp_area
comp_nslp
comp_nslp_number

31. <u>Computation of Nutrient Soil Leaching Potential for an Area of Analysis (AoANutSLP)</u>

31.1. Input

#From previous component

aoa_id
cokey
compname
aoa_comp_area
comp_nslp
comp_nslp_number

31.2. Methods

#Compute weighted average nutrient soil leaching potential for the AoA

For the AoA
For each AoA soil component
cum_NSLP_product = cum_NSLP_product + (comp_nslp_number * aoa_comp_area)
aoa_area = aoa_area + aoa_comp_area
aoa_nslp_fract = cum_NSLP_product / aoa_area
If aoa_nslp_fract <= 0.50
aoa_nslp = LOW
Else if aoa_nslp_fract >0.50 and <=1.50
aoa_nslp = Moderate
Else if aoa_nslp_fract > 1.50 and <=2.50

aoa_nslp = MODERATELY HIGH
Else
aoa_nslp = HIGH

31.3. Output

#This output goes into the Results Payload

aoa_id

aoa_nslp

32. Computation of Sediment and Nutrient Runoff Potential for a Soil Component (SCSedNutSRP)

32.1. Input

AoAid	1							
cokey	11150284	11150285	11150286	11150287	11150288	11150289	11150290	11150291
compname	Test1	Test2	Test3	Test4	Test5	Test6	Test7	Test8
aoa_comp_area	45.84	63.72	25.6	33.5	10.77	36.93	44.33	21.76
aoa_comp_hsg	B	A	A/D	C	D	B/D	D	B
aoa_comp_taxorder	Aridisols	Mollisols	Spodosols	Inceptisols	Histosols	Entisols	Mollisols	Mollisols
aoa_comp_kfact	0.24	0.37	0.21	0.42	0.02	0.28	0.32	0.48
aoa_comp_slope	8	12	15	16	3	1	14	5
aoa_comp_coarse_frag	3.7	0	12	6	2	3	7	5
aoa_comp_drained	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
aoa_comp_wtbl	None	Apparent	None	None	Apparent	Perched	None	Perched
aoa_comp_hwt_lt_24	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE

32.2. Methods

For the AoA

#Compute sediment and nutrient soil runoff potential for each soil component in the AoA

For each soil component (cokey) in the AoA

If aoa_comp_hsg == A

comp_srp = LOW

comp_srp_number =0

Else if aoa_comp_hsg == B

If aoa_comp_slope < 4

comp_srp = LOW

comp_srp_number = 0

Else if aoa_comp_slope >=4 and <=6 and aoa_comp_kfact < 0.32

comp_srp = MODERATE

comp_srp_number = 1

Else if aoa_comp_slope >=4 and <=6 and aoa_comp_kfact >= 0.32

comp_srp = MODERATELY HIGH

comp_srp_number = 2

Else if aoa_comp_slope > 6

comp_srp = HIGH

comp_srp_number = 3

Else if aoa_comp_hsg == C

If aoa_comp_slope < 2

comp_srp = LOW

comp_srp_number = 0

```
    Else if aoa_comp_slope >=2 and <=6 and aoa_comp_kfact < 0.28
        comp_srp = MODERATE
        comp_srp_number = 1
    Else if aoa_comp_slope >=2 and <=6 and aoa_comp_kfact >= 0.28
        comp_srp = MODERATELY HIGH
        comp_srp_number = 2
    Else if aoa_comp_slope > 6
        comp_srp = HIGH
        comp_srp_number = 3
Else if aoa_comp_hsg == D
    If aoa_comp_wtbl == Perched or Apparent and aoa_comp_hwt_lt_24 TRUE
        comp_srp = HIGH
        comp_srp_number = 3
    Else if aoa_comp_slope <2 and aoa_comp_kfact < 0.28
        comp_srp = LOW
        comp_srp_number = 0
    Else if aoa_comp_slope <2 and aoa_comp_kfact >= 0.28
        comp_srp = MODERATE
        comp_srp_number = 1
    Else if aoa_comp_slope >=2 and <=4
        comp_srp = MODERATELY HIGH
        comp_srp_number = 2
    Else if aoa_comp_slope > 4
        comp_srp = HIGH
        comp_srp_number = 3
 Else if aoa_comp_hsg == A/D
     If aoa_comp_drained TRUE (A HSG applies)
        comp_srp = LOW
        comp_srp_number = 0
     Else if aoa_comp_drained FALSE (D HSG applies)
        If aoa_comp_slope <2 and aoa_comp_kfact < 0.28
            comp_srp = LOW
            comp_srp_number = 0
        Else if aoa_comp_slope < 2 and aoa_comp_kfact >= 0.28
            comp_srp = MODERATE
            comp_srp_number = 1
        Else if aoa_comp_slope >=2 and <=4
            comp_srp = MODERATELY HIGH
            comp_srp_number = 2
        Else if (aoa_comp_slope >4) or (aoa_comp_wtbl == Perched or Apparent and
        aoa_comp_hwt_lt_24 TRUE)
            comp_srp = HIGH
            comp_srp_number = 3
 Else if aoa_comp_hsg == B/D
     If aoa_comp_drained TRUE (B HSG applies)
        If aoa_comp_slope < 4
            comp_srp = LOW
```

comp_srp_number = 0
Else if aoa_comp_slope >=4 and <=6 and aoa_comp_kfact < 0.32
comp_srp = MODERATE
comp_srp_number = 1
Else if aoa_comp_slope >=4 and <=6 and aoa_comp_kfact >= 0.32
comp_srp = MODERATELY HIGH
comp_srp_number = 2
Else if aoa_comp_slope > 6
comp_srp = HIGH
comp_srp_number = 3
Else if aoa_comp_drained FALSE (D HSG applies)
If aoa_comp_slope <2 and aoa_comp_kfact < 0.28
comp_srp = LOW
comp_srp_number = 0
Else if aoa_comp_slope <2 and aoa_comp_kfact >= 0.28
comp_srp = MODERATE
comp_srp_number = 1
Else if aoa_comp_slope >=2 and <=4
comp_srp = MODERATELY HIGH
comp_srp_number = 2
Else if (aoa_comp_slope >4) or (aoa_comp_wtbl == Perched or Apparent and aoa_comp_hwt_lt_24 TRUE)
comp_srp = HIGH
comp_srp_number = 3
Else if aoa_comp_hsg == C/D
If aoa_comp_drained TRUE (C HSG applies)
If aoa_comp_slope < 2
comp_srp = LOW
comp_srp_number = 0
Else if aoa_comp_slope >=2 and <=6 and aoa_comp_kfact < 0.28
comp_srp = MODERATE
comp_srp_number = 1
Else if aoa_comp_slope >=2 and <=6 and aoa_comp_kfact >= 0.28
comp_srp = MODERATELY HIGH
comp_srp_number = 2
Else if aoa_comp_slope > 6
comp_srp = HIGH
comp_srp_number = 3
Else if aoa_comp_drained FALSE (D HSG applies)
If aoa_comp_slope <2 and aoa_comp_kfact < 0.28
comp_srp = LOW
comp_srp_number = 0
Else if aoa_comp_slope <2 and aoa_comp_kfact >= 0.28
comp_srp = Moderate
comp_srp_number = 1
Else if aoa_comp_slope >=2 and <=4
comp_srp = MODERATELY HIGH

comp_srp_number = 2
Else if (aoa_comp_slope >4) or (aoa_comp_wtbl == Perched or Apparent and aoa_comp_hwt_lt_24 TRUE)
comp_srp = HIGH
comp_srp_number = 3

32.3. Output
aoa_id
cokey
compname
aoa_comp_area
comp_srp
comp_srp_number

33. Computation of Sediment and Nutrient Runoff Potential of an Area of Analysis (AoASedNutSRP)

33.1. Input
#From previous component
aoa_id
cokey
compname
aoa_comp_area
comp_srp
comp_srp_number

33.2. Methods
#Compute weighted average nutrient soil leaching potential for the AoA
For the AoA
For each AoA component
cum_srp_product = cum_srp_product + (comp_srp_number * aoa_comp_area)
aoa_area = aoa_area + aoa_comp_area
aoa_srp_fract = cum_srp_product / aoa_area
If aoa_srp_fract <= 0.50
aoa_srp = LOW
Else if aoa_srp_fract >0.50 and <=1.50
aoa_srp = MODERATE
Else if aoa_srp_fract > 1.50 and <=2.50
aoa_srp = MODERATELY HIGH
Else
aoa_srp = HIGH

33.3. Output
#This output goes into the Results Payload
AoA identifier
aoa_srp

Appendix: Reference Information

A. Pesticide Screening Tool (PST) Algorithms

The following information was pasted from the WinPST 3.1 User Guide, downloaded from the NRCS web site at:

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/crops/npm/?cid=stelprdb1044769.

Loss Potential Algorithms

WIN-PST 3.1 calculates loss potentials using algorithms found in:

Goss, D. and D.Wachope. 1990. The SCS/ARS/CES pesticide properties database: II Using it with soils data in a screening procedure. In Pesticides in the Next Decade, The Challenges Ahead, Proceedings of the Third National Research Conference, On Pesticides. Diana L. Weigmann editor. Virginia Water Resources Research Center, Blacksburg, VA. November 8-9, 1990.

Soil Algorithms

Soil Leaching Potential (SLP): The sensitivity of a given soil to pesticide leaching below the rootzone.

SLP characterizes those soil properties that would increase or decrease the tendency of a pesticide to move in solution with water and leach below the root zone. A high rating indicates the greatest potential for leaching.

Use the following algorithm to compute the **SLP**, then adjust for site conditions.

SLP Algorithm:

HYD -- Hydrologic Group.

KFACT -- Soil K factor.

OM1 -- % surface horizon organic matter content.

Horiz_1_Depth -- Depth of the first soil horizon, in inches.

If (HYD == "D") and (KFACT is null) and the soil taxonomic class is Histisol (i.e., organic soil), use a KFACT of 0.02 in the algorithm below. If the surface horizon is organic, the KFACT is null and the soil taxonomic class is not organic (i.e., mineral) then use the KFACT of the fist mineral horizon. See the definition for KFACT.

If ((HYD == "A") and ((OM1 * Horiz_1_Depth) <= 30)) or ((HYD == "B") and ((OM1 * Horiz_1_Depth) <= 9) and (KFACT <= 0.48)) or ((HYD == "B") and ((OM1 * Horiz_1_Depth) <= 15) and (KFACT <= 0.26))

SLP = HIGH

otherwise if ((HYD == "B") and ((OM1 * Horiz_1_Depth) >= 35) and (KFACT >= 0.40)) or ((HYD == "B") and ((OM1 * Horiz_1_Depth) >= 45) and (KFACT >= 0.20)) or ((HYD == "C") and ((OM1 * Horiz_1_Depth) <= 10) and (KFACT >= 0.28)) or ((HYD == "C") and ((OM1 * Horiz_1_Depth) >= 10))

SLP = LOW

otherwise if (HYD == "D")

SLP = VERY LOW

otherwise SLP INTERMEDIATE

Site Conditions:

Macropores: +1 HWT : HIGH

Soil Solution Runoff Potential (SSRP): The sensitivity of a given soil to pesticide loss dissolved in surface runoff that leaves the edge of the field. A high rating indicates the greatest potential for solution surface loss.

Use the following algorithm to compute the **SSRP**.

SSRP Algorithm:

HYD -- Hydrologic Group.

If ((HYD == "C") or (HYD == "D"))

SRP = "HIGH"

otherwise if (HYD == "A")

SSRP = "LOW"

otherwise if (HYD == "B") SSRP = "INTERMEDIATE"

Site Conditions:

none apply

Soil Adsorbed Runoff Potential (SARP): Represents sensitivity of a soil to pesticide loss adsorbed to sediment and organic matter that leaves the edge of the field.

SARP characterizes those soil properties that would increase or decrease the tendency of a pesticide to move in surface runoff attached to soil particles. A high rating indicates the greatest potential for sediment/pesticide transport.

Use the following algorithm to compute the **SARP**, then adjust for site conditions.

SARP Algorithm:

HYD -- Hydrologic Group. KFACT -- Soil K factor.

If (HYD == "D") and (KFACT == 0) use a KFACT of 0.02 in the algorithm below. See the definition for KFACT.

If ((HYD == "C") and (KFACT >= 0.21)) or ((HYD == "D") and (KFACT >= 0.10))

SARP = HIGH

otherwise if (HYD == "A") .or ((HYD == "B") .and. (KFACT <= 0.10)) .or ((HYD == "C") .and. (KFACT <= 0.07)) .or ((HYD == "D") .and. (KFACT <= 0.02))

SARP = LOW

otherwise

SARP = INTERMEDIATE

Site Conditions:

Field slope > 15%: +1

Pesticide Algorithms

Pesticide Leaching Potential (PLP): Indicates the tendency of a pesticide to move in solution with water and leach below the root zone. A low rating indicates minimal movement and no need for mitigation.

Use the following algorithm to compute the **PLP**, then adjust for management.

PLP Algorithm:

HL -- Half-life in the soil in days.

SOL -- Solubility in water in mg/L. (ppm)

Koc -- Soil organic carbon sorption coefficient in mL/g.

Please note: The log(function used below is log, base 10.

log_val = log(HL) * (4-log(Koc))

If (log_val >= 2.8)

PLP = HIGH

otherwise if ((log_val < 0.0) or ((SOL < 1) and (HL <= 1)))

PLP = VERY LOW

otherwise if (log_val <= 1.8)

PLP = LOW

otherwise

PLP = INTERMEDIATE

Management:

Banded: -1

Spot Treatment: -2

Foliar: -1

Low rate: -1

Ultra Low rate: -2

Pesticide Solution Runoff Potential (PSRP): Indicates the tendency of a pesticide to move in surface runoff in the solution phase. A high rating indicates the greatest potential for pesticide loss in solution runoff.

Use the following algorithm to compute the **PSRP**, then adjust for management.

PSRP Algorithm:

HL -- Half-life in the soil in days.

SOL -- Solubility in water in mg/L. (ppm)

Koc -- Soil organic carbon sorption coefficient in mL/g.

If ((SOL >= 1) and (HL > 35) and (Koc < 100000)) or ((SOL >= 10) and (SOL < 100) and (Koc <= 700))

PSRP = HIGH

otherwise if (Koc >= 100000) or ((Koc >= 1000) and (HL <= 1)) or ((SOL < 0.5) and (HL < 35))

PSRP = LOW

otherwise

PSRP = INTERMEDIATE

Management:

Banded: -1

Spot Treatment: -2

Foliar: -1

Soil Incorporated: -1

Low rate: -1

Ultra Low rate: -2

Pesticide Adsorbed Runoff Potential (PARP): Indicates the tendency of a pesticide to move in surface runoff attached to soil particles. A low rating indicates minimal potential for pesticide movement adsorbed to sediment, and no mitigation is required.

Use the following algorithm to compute the **PARP**, then adjust for management.

PARP Algorithm:

HL -- Half-life in the soil in days.

SOL -- Solubility in water in mg/L. (ppm)

Koc -- Soil organic carbon sorption coefficient in mL/g.

If ((HL >= 40) and (Koc >= 1000)) or ((HL >= 40) and (Koc >= 500) and (SOL <= 0.5))

PARP = HIGH

otherwise if (HL <= 1) or ((HL <= 2) and (Koc <= 500)) or ((HL <= 4) and (Koc <= 900) and (SOL >= 0.5)) or ((HL <= 40) and (Koc <= 500) and (SOL >= 0.5)) or ((HL <= 40) and (Koc <= 900) and (SOL >= 2))

PARP = LOW

otherwise

PARP = INTERMEDIATE

Management:

Banded: -1

Spot Treatment: -2

Foliar: -1

Soil Incorporated: -1

Low rate: -1

Ultra Low rate: -2

Interaction Matrices

Leaching

Soil / Pesticide Interaction Leaching Potential (ILP)

The Soil / Pesticide Interaction Leaching Potential (**ILP**) is derived from the Soil Leaching Potential (SLP) and Pesticide Leaching Potential (PLP). The matrix below shows the how they calculated. Pesticide Leaching Potential (PLP)

		Pesticide Leaching Potential (PLP)			
		High	**Intermediate**	**Low**	**Very Low**
Soil Leaching Potential (SLP)	**High**	High	High	Intermediate	Low
	Intermediate	High	Intermediate	Low	Very Low
	Low	Intermediate	Low	Low	Very Low

	Very Low	Low	Low	Very Low	Very Low

Solution Runoff

Soil / Pesticide Interaction Solution Runoff Potential (ISRP)

The Soil / Pesticide Interaction Solution Runoff Potential (**ISRP**) is derived from the Soil Solution Runoff Potential (SSRP) and Pesticide Solution Runoff Potential (PSRP). The matrix below shows the how they calculated.

		Pesticide Solution Runoff Potential (PSRP)		
		High	**Intermediate**	**Low**
Soil Solution Runoff Potential (SSRP)	**High**	High	High	Intermediate
	Intermediate	High	Intermediate	Low
	Low	Intermediate	Low	Low

Adjustments:

Low rainfall, no irrigation: -1

Adsorbed Runoff

Soil / Pesticide Interaction Adsorbed Runoff Potential (IARP)

The Soil / Pesticide Interaction Adsorbed Runoff Potential (**IARP**) is derived from the Soil Adsorbed Runoff Potential (SARP) and Pesticide Adsorbed Runoff Potential (PARP). The matrix below shows the how they calculated.

		Pesticide Adsorbed Runoff Potential (PARP)		
		High	**Intermediate**	**Low**
Soil Adsorbed Runoff Potential (SARP)	**High**	High	High	Intermediate
	Intermediate	High	Intermediate	Low
	Low	Intermediate	Low	Low

Adjustments:

Low rainfall, no irrigation: -1

Adjustments

WIN-PST 3.1 adjusts soil, pesticide and interaction ratings based on management and site

conditions. Adjustments are as follows:

Soil Ratings

Site Conditions Adjustments:

Leaching:

Macropores: +1 HWT : HIGH

Solution Runoff:

No-adjustments

Adsorbed Runoff:

Field slope > 15%: +1

Pesticide Ratings

Management Adjustments:

Leaching

Foliar: -1

Banded: -1 Spot: -2

Low rate: -1 Ultra Low rate: -2

Solution Runoff

Banded: -1 Spot: -2

Foliar: -1 Soil Incorporated: -1

Low rate: -1 Ultra Low rate: -2

Adsorbed Runoff:

Banded: -1 Spot: -2

Foliar: -1 Soil Incorporated: -1

Low rate: -1 Ultra Low rate: -2

Interaction Ratings

Rainfall/Irrigation adjustment:

There is only one adjustment that directly effects interaction ratings and is found on the interactions tab of WIN-PST 3.1. It is the probability of Rainfall or irrigation soon after pesticide application. The selection is labeled “Rainfall” and has two possible choices “Low” or “High”. The default choice is “High”.

Leaching

Low probability of rainfall/no irrigation -1

Solution Runoff

Low probability of rainfall/no irrigation -1

Adsorbed Runoff

Low probability of rainfall/no irrigation -1

Applying the adjustments

The maximum aggregate adjustment allowed is 1 rating class (+/- 1; e.g., "High" gets reduced to an "Intermediate") for any one pathway (e.g., pesticide leaching) except for "ultra low" application rate and "spot" treatment which decrease pesticide ratings by -2. In other words, adjustments are not additive. Only one adjustment is allowed for any pathway.

For example a pesticide that is both foliar applied (-1) and banded (-1) will only receive a decrease in rating of one class since the ratings are not additive. Therefore, a pesticide leaching potential of "High" would be adjusted to "Intermediate".

A pesticide that is foliar applied (-1) and spot treated (-2) would receive a two class decrease (-2). This combination of management techniques would reduce a "High" pesticide leaching potential to a "Low".

Once the Soil Loss Ratings and Pesticide Loss Ratings are adjusted, the interaction matrix (Appendix B) is used to determine the Interaction Loss Rating. The interaction rating can be further adjusted to reflect rainfall or irrigation. If the probability of rainfall or irrigation is very low, then an adjustment factor of one class is applied to the Interaction Loss Rating.

This rating should be used for dry climates/cropping where the pattern of rainfall/irrigation does not occur soon after pesticide application. The definition of "soon after pesticide application" is based on several factors including the half life of the pesticide, formulation and placement of the pesticide (e.g., foliar, soil applied, soil incorporated. etc.). The minimum time for should be at least 10-14 days. For pesticides with moderate to long half-lives (for half life >= 45 days) at least a month of no rainfall or irrigation should be considered before "Rainfall - Low" should be chosen.

If rainfall is typically absent but the field is irrigated, then the adjustment should not be made. For many cropping situations, there will be a probability of rainfall or irrigation soon after application. In these cases the default condition should be used (i.e., Rainfall set to 'High').

Hazard Ratings - Adjustment for toxicity

WIN-PST hazard ratings are determined by a matrix created between the Interaction Loss Rating and the Exposure Adjusted Toxicity (EAT) class. The Exposure Adjusted Toxicity class assigns rating classes to long term toxicity thresholds similar to EPA's Toxicity class. EAT classes were designed by the WIN-PST group to qualify the potential hazard/risk associated with a potential long-term environmental exposure. EAT classes are broken down by resource concern in the current version of WIN-PST either humans or aquatic. The classes are follows:

Exposure Adjusted Toxicity Ratings for humans.

Class	Threshold ranges
EXTRA HIGH	1 ppb > X
HIGH	10 ppb > X >= 1 ppb
INTERMEDIATE	50 ppb > X >= 10 ppb
LOW	100 ppb > X >= 50 ppb
VERY LOW	X >= 100 ppb

Exposure Adjusted Toxicity Ratings, based on STV, for fish.

Class	Threshold ranges
EXTRA HIGH	10 ppb > X
HIGH	100 ppb > X >= 10 ppb
INTERMEDIATE	1,500 ppb > X >= 100 ppb
LOW	20,000 ppb > X >= 1,500 ppb
VERY LOW	X >= 20,000 ppb

Calculating the WIN-PST Hazard Potentials

WIN-PST Hazard Potentials are a combination of both the Interaction Loss potential and the Exposure Adjusted Toxicity. See the matrix below:

Hazard Potential Matrix

Interaction Loss Rating	Exposure Adjusted Toxicity				
	Extra High	**High**	**Intermediate**	**Low**	**Very Low**
High	Extra High	High	Intermediate	Low	Low
Intermediate	Extra High	High	Intermediate	Low	Very Low
Low	High	Intermediate	Low	Low	Very Low
Very Low	Intermediate*	Low*	Very Low*	Very Low*	Very Low*

* Leaching only

For example a pesticide/soil interaction loss potential of 'Intermediate' and an Exposure Adjusted Toxicity of 'Extra High', would receive an “Extra High” Hazard rating:

Interaction Loss Rating	Exposure Adjusted Toxicity				
	Extra High	**High**	**Intermediate**	**Low**	**Very Low**

High	Extra High	High	Intermediate	Low	Low
Intermediate	Extra High	High	Intermediate	Low	Very Low
Low	High	Intermediate	Low	Low	Very Low
Very Low	Intermediate*	Low*	Very Low*	Very Low*	Very Low*

An Interaction Loss Rating of 'Low' and an Exposure Adjusted Toxicity of 'High' would result in a Hazard rating of “Intermediate”:

Interaction Loss Rating	**Exposure Adjusted Toxicity**				
	Extra High	**High**	**Intermediate**	**Low**	**Very Low**
High	Extra High	High	Intermediate	Low	Low
Intermediate	Extra High	High	Intermediate	Low	Very Low
Low	High	Intermediate	Low	Low	Very Low
Very Low	Intermediate*	Low*	Very Low*	Very Low*	Very Low*