

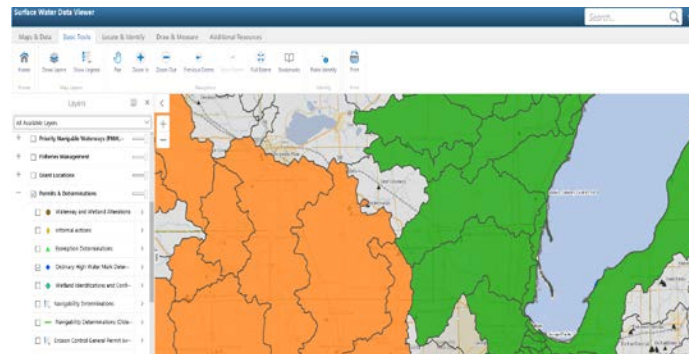
SPARROW How-to Guide

Using the SPARROW Model to Calculate Delivery Factors in Trade Ratios

Find Data



Locate



Calculate

$$1 - \frac{\text{Delivery Fraction} = (\text{user del_frac} - \text{generator del_frac})}{\text{user del_frac}}$$

model data provided by:



EGAD#3400-2018-02

SPARROW How-to Guide

Overview

Summary:

The SPARROW (Spatially Referenced Regressions On Watershed Attributes) Model, created by the United States Geological Survey, provides estimates of phosphorus (P), nitrogen (N), and total suspended solids (TSS) transport between upstream and downstream waterbodies. One component of the model, delivery fraction, is used to calculate the delivery factor in trade ratios when pollutant reductions occur upstream from a credit user's location.

Why use delivery fractions?

Delivery fractions account for the mass of pollutant removed by natural attenuation processes within rivers, lakes, and reservoirs. By using delivery fractions in trade ratios, permittees ensure their trades offset a sufficient amount of pollutant required to protect water quality at the downstream reach or outfall.

SPARROW informational webpage (USGS):

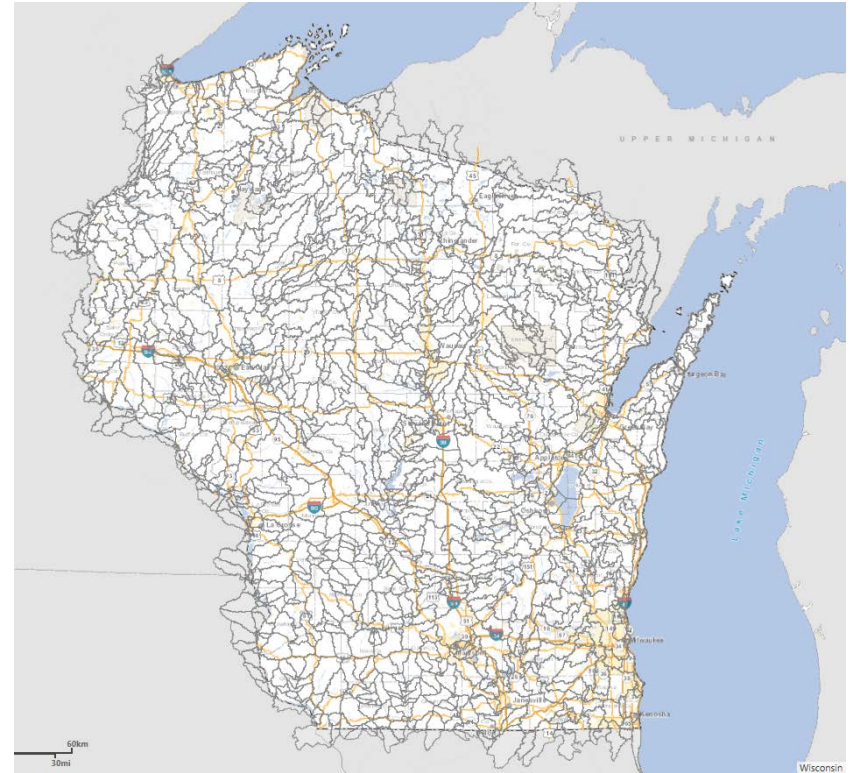
<https://water.usgs.gov/nawqa/sparrow/#>

SPARROW How-to Guide

SPARROW Basics

SPARROW is a catchment-based model. The land's surface is divided into watersheds, and all SPARROW values apply to the waterbodies contained within a given catchment.

There are 1378 SPARROW catchments fully or partially within the borders of Wisconsin. Each one has a specific delivery fraction, calculated using regression equations from monitoring data.



SPARROW How-to Guide

SPARROW Basics

All delivery fractions are based upon downstream connectivity to a final target. In Wisconsin, downstream targets are either Lake Superior, Lake Michigan, or the Upper Mississippi River.

When a credit user does not directly discharge to one of these targets, the relative difference between the credit user and credit generator watershed determines the delivery factor.

Using specific delivery fractions for credit generator and credit user locations, as explained later, provides a value tailored to unique project locations.



SPARROW How-to Guide

Using SPARROW for your Water Quality Trading Project

SPARROW data can be accessed at two locations:

WDNR Surface Water Data Viewer:

Quickly find your facility, credit generation location, and respective SPARROW delivery fractions at: [WDNR Surface Water Viewer – SPARROW Theme](#)

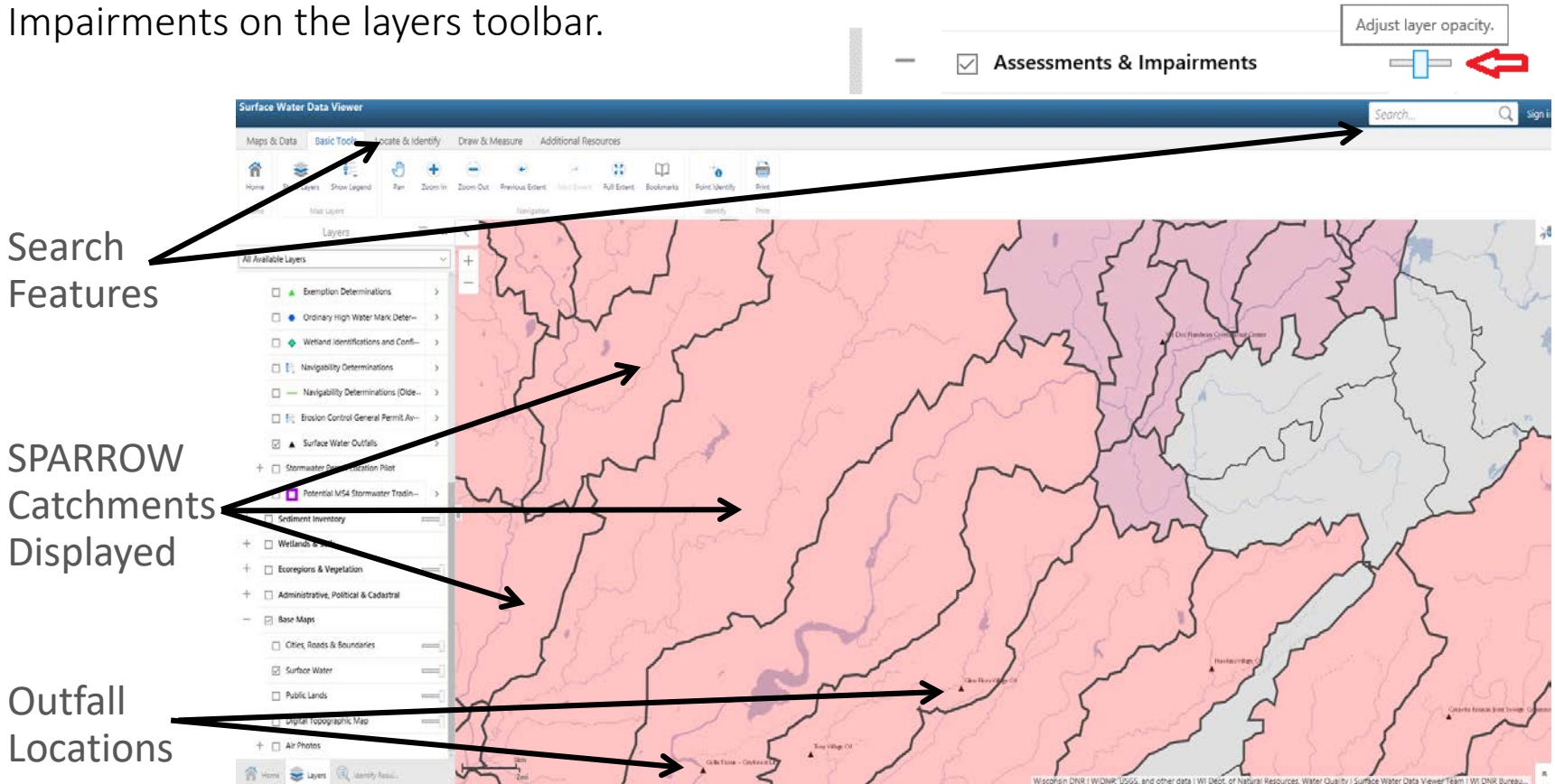
Shapefile Download (for use with ESRI ArcMap or other GIS program)

Users with GIS capabilities may wish to import the SPARROW catchment shapefile, available at: [https://dnr.wi.gov/topic/surfacewater/documents/AmWqt/SPARROW Output.zip](https://dnr.wi.gov/topic/surfacewater/documents/AmWqt/SPARROW_Output.zip)

SPARROW How-to Guide

Using SPARROW for your Water Quality Trading Project

Once SPARROW catchments are displayed (either in Surface Water Data Viewer or other GIS program), navigate to the location where credits will be used. Surface Water Data Viewer has functions that aid locating WPDES facilities and other relevant features. The user may wish to adjust the opacity settings for Assessments & Impairments on the layers toolbar.

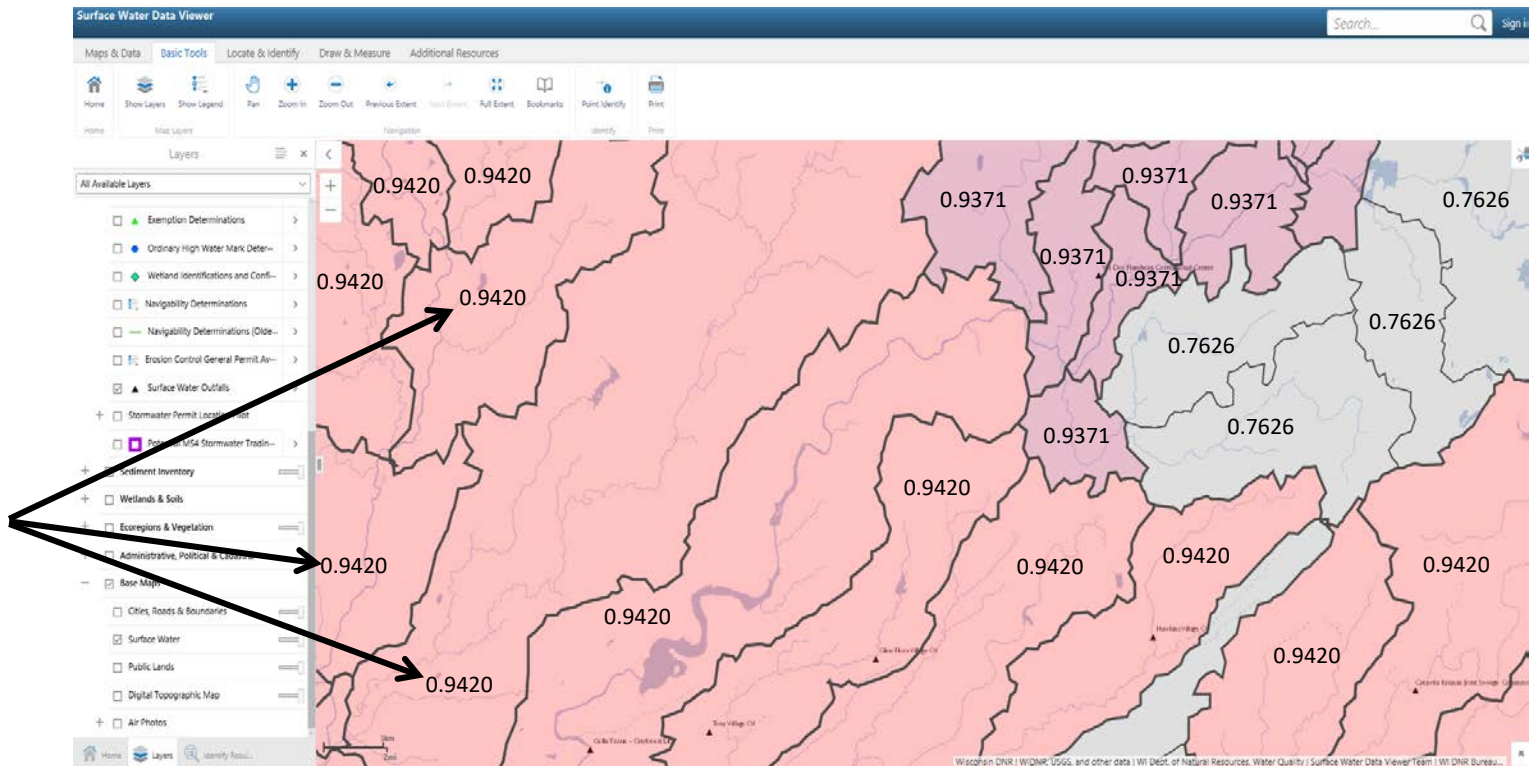


SPARROW How-to Guide

Using SPARROW for your Water Quality Trading Project

Each SPARROW catchment has an associated delivery fraction, labeled on the Surface Water Data Viewer map. For users who imported the SPARROW layer into an alternative GIS, delivery fractions are found in field “del_frac”. Note the delivery fractions pertaining to the credit generator location and the credit user location .

Catchment
Delivery
Fraction
Values



SPARROW How-to Guide

Using SPARROW for your Water Quality Trading Project

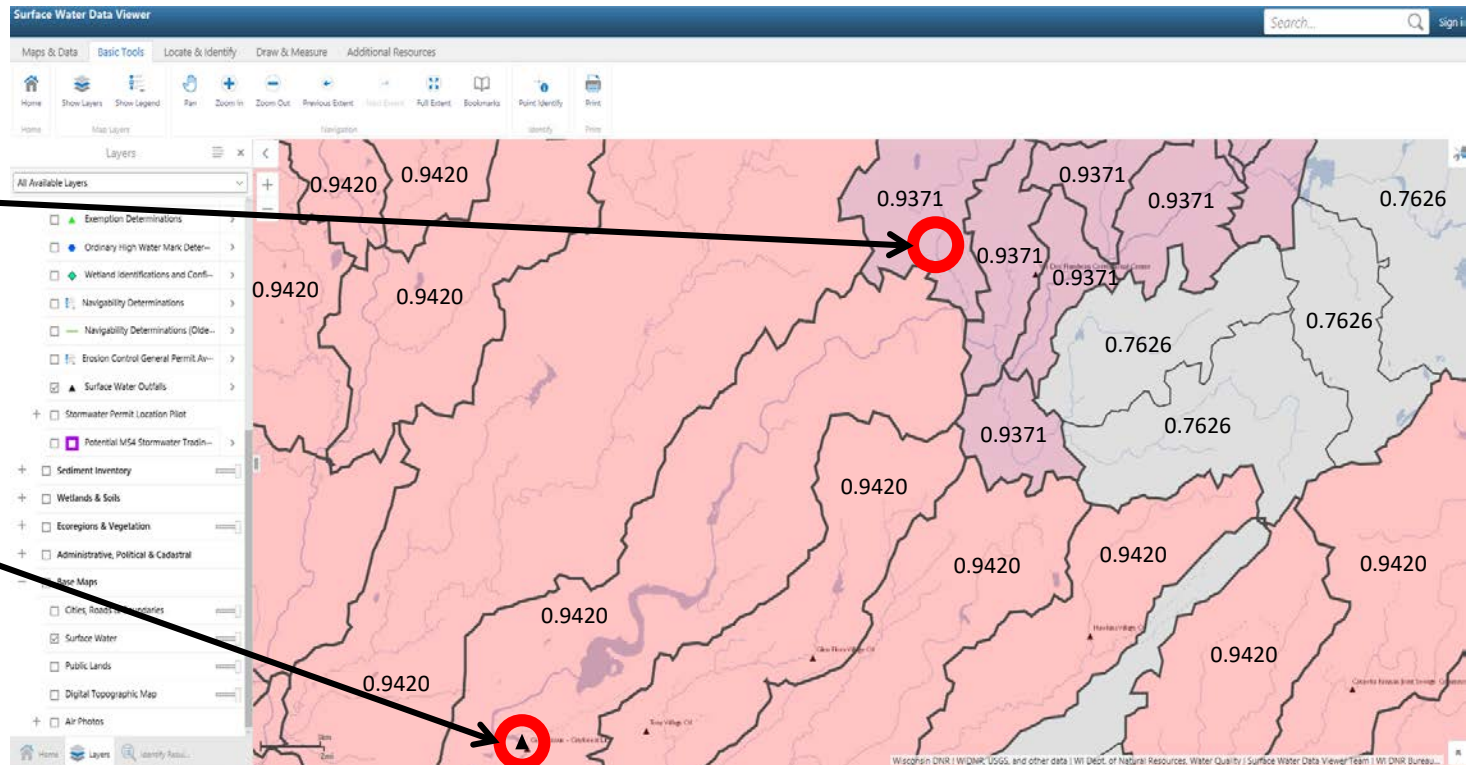
Once delivery fraction values have been identified for the upstream (generator) and downstream (user) locations, use them in the following equation:

$$\text{Delivery Fraction} = 1 - \frac{(\text{user del_frac} - \text{generator del_frac})}{\text{user del_frac}}$$

The following example shows values derived for project locations circled in red

Credit Generator
Location
del_frac=
0.9371

Credit User
Location
del_frac=
0.9420



SPARROW How-to Guide

Using SPARROW for your Water Quality Trading Project

By using values derived for each catchment (0.9420 and 0.9371), delivery can be calculated using the equation:

$$\textit{Delivery Fraction} = 1 - \frac{(\textit{user del_frac} - \textit{generator del_frac})}{\textit{user del_frac}}$$

$$\textit{Delivery Fraction} = 1 - \frac{(0.9420 - 0.9371)}{0.9420} = 0.994$$

$$\text{Delivery Fraction} = 0.994$$

A delivery fraction of 0.994 means that 99.4% of pollutants entering waterways in the credit generator's catchment will be delivered to the credit user's catchment. Incorporating this fraction into the trade ratio ensures that natural attenuation of pollutants is accounted for, thereby protecting downstream water quality when trading. The delivery fraction must first be converted to a delivery factor, as shown on the next page.

SPARROW How-to Guide

Using SPARROW for your Water Quality Trading Project

To obtain the Delivery Factor (used in the trade ratio), use the following equation :

$$\textit{Delivery Factor} = \frac{1}{\textit{Delivery Fraction}} - 1$$

$$\textit{Delivery Factor} = \frac{1}{0.994} - 1 = 0.006$$

$$\textit{Delivery Factor} = 0.006$$

The calculated delivery factor can then be used in the trade ratio equation:

$$\textbf{Trade Ratio} = (\text{Delivery} + \text{Downstream} + \text{Equivalency} + \text{Uncertainty}) : 1$$

Refer to WNDR's water quality trading guidance document for more information regarding other components of the trade ratio.

SPARROW How-to Guide

Using SPARROW for your Water Quality Trading Project

Important points to remember:

- Delivery fractions are tied to a specific catchment, encompassing all waterbodies in that catchment, regardless of stream order.
- Delivery factors calculated by SPARROW are 0 if credit generation and use occurs within the same catchment.
- Raw SPARROW delivery fraction values estimate delivery percentage through a stream's entire flow path to a Great Lake or the Mississippi River. Using specific generator and user delivery fractions, as explained here, provide a value tailored to a specific project location.
- SPARROW is a valuable tool for estimating delivery across large spatial scales. Fine-scale factors such as small lakes, impoundments, or other connectivity issues may influence delivery and will need to be accounted for separately from the model.



Questions?

Contact: DNRphosphorus@Wisconsin.gov