

TECHNICAL MEMORANDUM

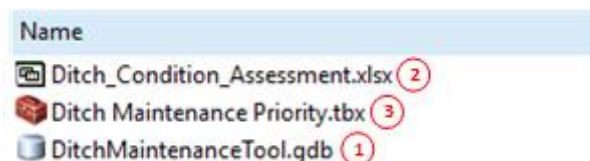
Date: April 3, 2019
To: Jessica Engel, King County
From: Jennifer Schmidt and Rebecca Dugopolski, PE,
Herrera Environmental Consultants, Inc.
Subject: Guide to Roadside Ditch Inventory and Assessment Tools

INTRODUCTION

This guide provides instructions on using a set of GIS and field data collection tools to support a roadside ditch inventory and assessment. These tools were developed as part of a National Estuary Program (NEP) grant from the Washington State Department of Ecology (Ecology) received by King County. The overall goal of the project is to improve the condition of roadside ditches (and associated water quality) by improving maintenance procedures, and by improving tracking and prioritization methods for inspection and maintenance efforts.

The GIS and field data collection tools outlined in this guide include:

1. Geodatabase framework to facilitate desktop GIS evaluation of ditch significance.
2. Survey123 field form template to facilitate collecting data on ditch condition in the field.
3. ArcGIS toolbox for processing the desktop ditch significance and field evaluation ditch condition data to produce cumulative scores and assign maintenance priorities.



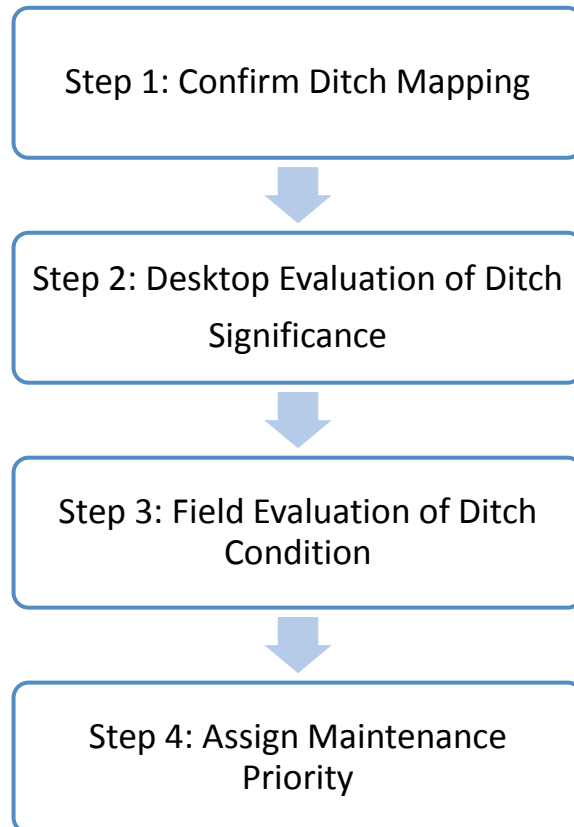
These tools are accompanied by a series of eight fact sheets and a field guide for roadside ditch maintenance in Western Washington for maintenance crews and administrative/office staff. Four of the eight fact sheets provide information related to mapping recommendations and requirements and include:



- **Fact Sheet A1: Ditch Mapping Recommendations**
 - *Spatial data resources*
 - *Recommendations for desktop analysis*
- **Fact Sheet A2: Prioritizing Ditches for Inspection and Maintenance**
 - *Example of ditch significance scoring*
 - *Example of ditch condition scoring*
- **Fact Sheet A3: Permit Requirements for Ditch Maintenance**
 - *Mapping requirements for the National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit*
- **Fact Sheet F1: Considerations for Field Evaluation of Roadside Ditches**
 - *Mobile data collection*
 - *Ditch condition assessment criteria*

PROCESS OVERVIEW

The figure below provides an overview of the steps involved with using this set of tools to prioritize ditches for inspection and maintenance. More detail and guidance on each step are provided in the following sections.



Step 1: Confirm Ditch Mapping

The workflow outlined in this guide assumes that roadside ditches have already been mapped as linear features and assigned a unique identifier. If ditch mapping has been completed, proceed to Step 2. If ditch mapping is not available, please refer to the following resources for additional guidance on building a ditch database:

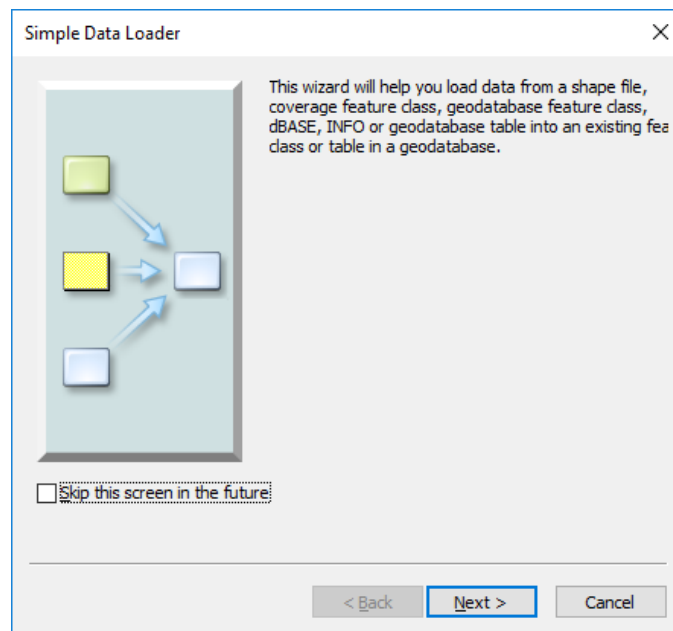
- **Fact Sheet A1: Ditch Mapping Recommendations**
- [Washington Stormwater Center Stormwater Infrastructure Framework](#) web page

Step 2: Desktop Evaluation of Ditch Significance

Ditch significance (i.e., ditch importance) can be used to prioritize ditches for inspection and maintenance activities. A geodatabase (DitchMaintenanceTool.gdb) with a linear feature class (Ditch_Significance) is provided as part of this toolset to help support assessing ditch significance in desktop GIS. The attributes recommended for data collection and the drop-down values associated with each field in the template are documented in detail in Table 1 of **Fact Sheet A2: Prioritizing Ditches for Inspection and Maintenance**.

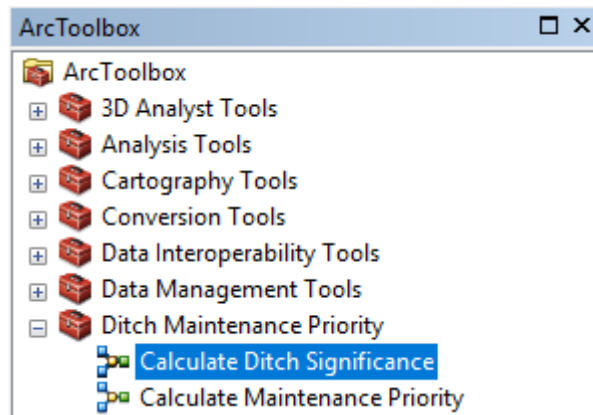
Procedure

1. Load your mapped ditch polylines into the Ditch Significance feature class. This can be done by manually copying and pasting the ditch polylines in ArcMap into the provided feature class or by using the Simple Data Loader tool in ArcCatalog. This second option will allow you to map the fields in your existing ditch dataset into the appropriate fields in the Ditch_Significance feature class.



2. Make sure that each ditch has been assigned a unique identifier in the **Ditch ID** field. This can be an ID from your asset management system or just a sequential identifier (i.e., 1, 2, 3, etc.).
3. Download and compile the GIS data sources for your area of interest that will allow you to populate each field from the drop-down values provided. See **Fact Sheet A1: Ditch Mapping Recommendations** for recommendations on where to obtain data if you do not already have it available.

4. Use the appropriate GIS datasets to assign values for each ditch significance category to each ditch by selecting the appropriate drop-down value for each one.
5. Add the Ditch Maintenance Priority toolbox (**Ditch Maintenance Priority.tbx**) to ArcToolbox and open the **Calculate Ditch Significance** tool.



6. Select the ditch significance dataset and click **OK**. The tool will add a new field to your dataset and assign each ditch an inspection priority based on your desktop analysis and the prioritization scoring criteria from **Fact Sheet A2: Prioritizing Ditches for Inspection and Maintenance**.

Applying the Results

The ditch significance scoring results can then be used for planning inspection and maintenance activities:

1. **Prioritize ditches for inspection.** When deciding which ditches should be inspected first, focus on ditches with known issues and/or a high ditch significance score.
2. **Prioritize ditches for maintenance.** See Step 4.

Step 3: Field Evaluation of Ditch Condition

Evaluating ditch condition requires a visual assessment in the field to identify current maintenance issues that may reduce ditch capacity or ditch integrity, potentially leading to issues with flooding or transport of pollutants to waterways. The geodatabase included with this documentation (**DitchMaintenanceTool.gdb**) contains a table for storing ditch condition information collected in the field (**Ditch_Condition**). There are two options for populating this table:

1. Use Survey123 to collect field data using an electronic field form.
2. Collect the data using other methods and then manually entering it into the **Ditch_Condition** table in the geodatabase.

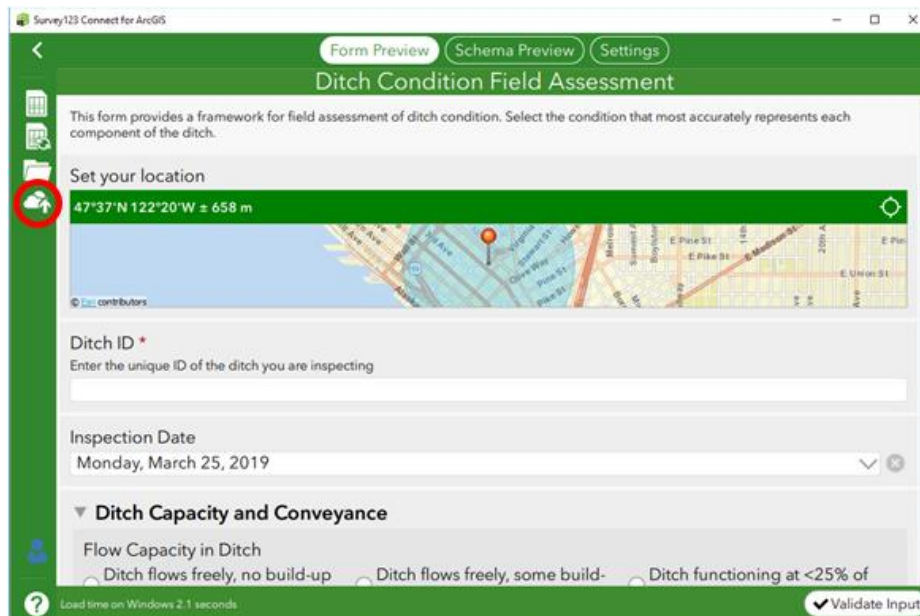
Note: The following instructions are specific to users with access to an ArcGIS Online (AGOL) account. Speak with your GIS Administrator to confirm your AGOL access and policies. Alternatively, other questionnaire-format mobile applications may be used to collect this data in the field, but the results will need to be uploaded into the **Ditch_Condition** table to run the scoring tools.

Procedure

1. Download the Survey123 **Ditch_Condition_Assessment.xlsx** file provided with this toolkit.
2. Download and install the Survey123 Connect for ArcGIS desktop application:
www.arcgis.com/home/item.html?id=9a0a850521174e78b8d08d3a66cbf34c.
3. Launch Survey123 Connect for ArcGIS and log in using your AGOL credentials.
4. Select **New Survey** and the **File** radio button from the list. Click on **Browse for XLSForm** and navigate to the location where you saved **Ditch_Condition_Assessment.xlsx**. Change the title of the survey to **Ditch Condition Inspection** and click **Create Survey**.

The screenshot shows the 'New Survey' dialog box in Survey123 Connect for ArcGIS. The title is 'Ditch Condition Inspection'. The table name will be 'Ditch_Condition_Inspection'. The initial XLSForm design is selected as 'File'. The XLSForm file is '/Ditch_Maintenance_Toolbox/Ditch_Condition_Assessment.xlsx'. The user is Jennifer Schmidt, GISP. The 'Create Survey' button is highlighted.

- To publish the survey to your AGOL account so that it is available on your mobile device, click the cloud on the left side of the form preview and then click **Publish Survey**.



The screenshot displays the Survey123 Connect for ArcGIS interface for a 'Ditch Condition Field Assessment' form. The form is titled 'Ditch Condition Field Assessment' and includes a navigation bar with 'Form Preview', 'Schema Preview', and 'Settings' tabs. The main content area contains a map with a red location pin and coordinates '47°37'N 122°20'W ± 658 m'. Below the map is a 'Ditch ID' field with a red asterisk, an 'Inspection Date' field set to 'Monday, March 25, 2019', and a section for 'Ditch Capacity and Conveyance' with radio button options: 'Ditch flows freely, no build-up', 'Ditch flows freely, some build-up', and 'Ditch functioning at <25% of'. A red circle highlights the cloud icon in the top left corner of the form preview. The bottom of the interface shows a 'Validate Input' button and a 'Load time on Windows 2: 1 seconds' indicator.

- Download the free Survey123 data collection app to your mobile device from your device's app store. Log in using the same AGOL credentials that you used to publish the form.
- Complete ditch inspections in the field by filling out the form for each ditch. **The ditch ID that you enter must match the ditch ID from the desktop evaluation in Step 2.** Make sure to:
 - Identify your location using the interactive map.
 - Take detailed notes and photos for any ditch components that require follow-up action. Schedule the ditch for urgent or routine maintenance, if needed.
 - If maintenance needs are addressed during the field visit, be sure to update the condition status as needed.
- After completing the ditch inspections in the field, log in to <http://survey123.arcgis.com> using your AGOL credentials and click on your published form.
- Click on the **Data** tab on the top of the page and then select **Export** and **File Geodatabase**. This will download all of your inspection data (point locations) and any attached photos. This may take several minutes depending on the number of photos you have taken.

Applying the Results

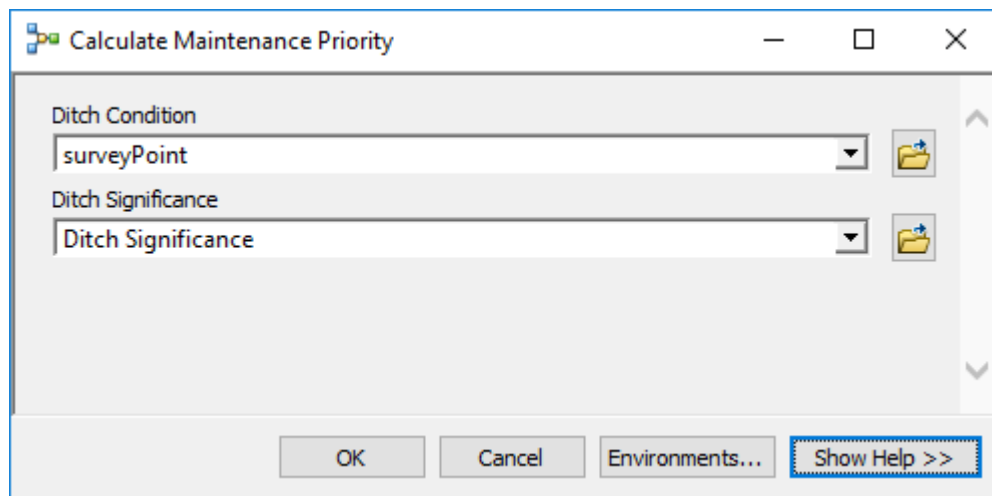
The ditch condition scoring results can then be used for planning maintenance activities. See Step 4.

Step 4: Assign Maintenance Priority

Planning for and allocating resources to ditch maintenance requires consideration of both ditch significance and ditch condition. Ditch significance will influence the order of ditch inspections, but can also inform planning for maintenance activities later on. Immediate maintenance needs may also be apparent based on the ditch condition determined through a field evaluation in Step 3. Ditch significance and ditch condition should be combined and evaluated together when planning maintenance activities and assigning maintenance priorities.

Procedure

1. To assign a ditch condition score and maintenance priority to each ditch, open the **Ditch Maintenance Priority** toolbox in ArcMap and select the **Calculate Maintenance Priority** tool.
2. If you completed Step 3 using Survey123, select the **Ditch Condition** point file that you exported from the Survey123 website. This file is named **surveyPoint** by default. If you entered your information manually into the **Ditch Condition** table included with the template geodatabase, select that file.
3. Select the **Ditch Significance** line feature class that you created in Step 2.



4. Hit **OK**. Three new fields will be added to your **Ditch Significance** line feature class:
 - a. **Ditch Condition Score:** Ditch condition scores can be used to determine which ditches require the most urgent maintenance attention and to plan maintenance activities accordingly. A high ditch condition score indicates poor condition and therefore high maintenance priority.
 - b. **Combined Ditch Score:** This score reflects the sum of your ditch significance and ditch condition scores.
 - c. **Maintenance Priority:** This field indicates the maintenance priority of each ditch based on the combined ditch score ranging from None to Urgent.