ISG

Alternative Side Inlet Calculator User Guide

Calculator Overview

The Alternative Side Inlet (ASI) calculator is a tool to assist in the design of alternative side inlets and Water and Sediment Control Basins (WASCOB) along open ditches for surface drainage through the bank of the open channel. This tool is a guide for drainage staff members to utilize when flooding, erosion, washouts, or failure of existing side inlets is occurring along the banks of open ditches. The goal of the tool is to provide local staff with knowledge in designing alternative side inlets for proper inlet sizing, long term ditch maintenance, and to eliminate the design and installation of tradition "silt sucker" side inlets.

The calculator requires the designer knowledge and use of ESRI ArcMap and Microsoft Excel. Data inputs for the calculator include watershed area, landscape topography, runoff hydrology, soil type, rainfall, and land management. Designs for alternative inlets are based on ditch bank (embankment) dimensions, intake type(s), pipe dimensions, soil erosion, outlet flow rate, and draw down time. The designer will also be required to entre data from USGS Web Soil Survey and NOAA Atlas 14 rainfall frequency estimator.

The calculator is not a one size fits all template and several different designs are possible. The tool is a trial and error method and the designer shall analyze several different intake scenarios based on the design outcomes. The designer has several options that may be selected for analysis that can be used based on site specific conditions. The following document outlines step-by-step instructions for the ASI calculator.

Step-by-Step Instructions

1. Open ESRI ArcMap
    a. Zoom to the location of the identified ASI
    b. Location may be identified from site inspections, aerial photo reviews, ACPF tool, or other methods.
    c. Add in background aerial, LiDAR contours, 3-meter Digital Elevation Model, and any other desired data for design
2. Open ASI Calculator
    a. Once the ASI calculator is open, it will prompt you to enable macros, if not already enabled. Click the enable macros button that will appear in the location of the first row of the worksheet. It will then proceed to ask if the file is a trusted document. Click Yes.
3. Enter General Inputs
    a. County information: a key factor in determining rainfall erosivity for soil loss calculations
    b. Optional: Township, section, latitude/longitude is general information used for documentation purposes
    c. Optional: ditch system and main/branch
    d. Optional: enter the organization, designer, and landowner
    e. Optional: additional blank description cells have been added for specific documentation needs.
4. Enter Soil Inputs
    a. Open USGS Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
    b. Zoom in to ASI location and create and AOI polygon
    c. Enter soil type:

i. Select the "Soil Data Explorer" tab and then the "Soil Properties and Qualities Tab." Choose the blue identify button (i) and click on the ASI location. A table will appear with general soil properties. Find the soil map unit name and enter soil type into ASI calculator

d. Enter the soil Kw factor: This is a factor in determining the soil erodibility and soil loss.
   i. Once Area of Interest is selected in the location of catchment area. Click "Soil Erosion Factors," Click "K Factor, Whole Soil". Click View Rating. Enter the average Kw factor for the catchment area.
e. Enter Hydrologic Soil Group (HSG). This is a factor in determining the runoff depth for your design storm.
   i. Click "Soil Qualities and Features". Click "Hydrologic Soil Group". Click view rating. Enter the predominate rating for the catchment area. When two ratings are shown C/D, the first is the HSG for drained areas and the second is in its natural state. Use the rating based on your site's conditions.
f. Enter Land Management. This is a factor in determining soil loss.

5. Enter hydrologic inputs
   a. Select design storm. The recommended design storm is 10 years.
   b. Enter design rainfall depths.
      i. Open NOAA Atlas 14: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html
      ii. Zoom in on the map and draw the red X to the side inlet location.
      iii. Enter the 24 hour 10-year and 25-year rainfall depths.
6. Enter embankment design inputs
   a. Optional: Enter the embankment length
      i. Although this does not affect the calculations in designing an ASI, it is available for documentation purposes. The length of the ASI is the length needed to fill existing washout and to tie into the high points of the adjacent ditch bank.
   b. Enter sedimentation maintenance schedule
      i. This represents how often sediment will be removed from the ASI area and returned to the elevations when constructed. This plays a role in sediment storage calculations. The recommended maintenance schedule is 10 years.
7. Enter watershed information
   a. Enter catchment area
      i. Using ArcMap 3-meter DEM and LiDAR contours, delineate the catchment area to the ASI.
   b. Enter flow path length
      i. Measure the length of concentrated flow path perpendicular to ASI basin. This can be estimated and measured in ArcMap where the concentrated flow path is expected to enter the ASI basin. This is a key factor in determining soil loss and sedimentation.
8. Enter ASI basin topographic data
   a. Enter washout depth
      i. This is the maximum depth of washout in feet. This can be estimated from ArcMap or for physical measurements. The depth of the washout will be the maximum allowed berm height. Refer to image.
   b. Enter base area width and length
      i. The ASI basin is the lowest area or otherwise described as the area that will be utilized for water storage. The width will be parallel to the ASI, while length is perpendicular to the ASI. Refer to image.

c. Enter side-slope information
    i. Enter slope information in XX:1 (ft/ft) format for the three adjacent sides of the ASI basin. This can be determined by LiDAR contours

9. Enter ASI Design Criteria. This data is the trial and error inputs that will be analyzed for design. Multiple iterations will be made to determine the appropriate design.
    a. Enter the embankment back and front slope ratios
        i. Optional: Slope will affect the amount of fill the embankment requires. Steepest slope recommended is 2:1.
    b. Enter inlet diameter
        i. This is the diameter of the pipe that is connected to the outlet and should be sized based on intake type. Trash grates can have multiple sizes while hickenbottom intakes are restricted to the intake size.
    c. Enter outlet pipe diameter and slope
        i. The outlet pipe diameter along with pipe outlet slope will determine the outlet capacity. It is important that the outlet pipe diameter and slope are large enough that the outlet is not controlling the flow.
    d. Enter pipe length
        i. Optional: the pipe length will depend on the location of the WASCOB. Calculate the necessary length of pipe needed to outlet.
    e. Enter riser height (Trash Grate Only)
        i. Riser Height is the height the trash grate inlet is above the ground. This allows for ponded water to drain through the slits in the riser for extra sedimentation. It is recommended that the perforated riser is 0.5-1 feet above ground
    f. Enter drop inlet depth
        i. Drop inlet depth is the depth of piping beneath the ground surface. Drop inlet height will depend on ditch invert elevation or existing tile for connection. A maximum of 3 feet is used for rock inlet flow calculations, although the drop inlet depth may be greater.
    g. Choose intake type
        i. Hickenbottom Intake
            1. A hickenbottom intake is a water quality intake riser installed on top of subsurface tile. Currently, there are two types of hickenbottom intakes commercially available: standard hickenbottom and slotted hickenbottom. A standard hickenbottom has holes 1’’ in diameter and a slotted hickenbottom has 1’’ holes in addition to 1’’ X 4” slots for increased flow. Hickenbottom intakes are recommended for catchment areas less than 10 acres.
        ii. Trash Grate
            1. A trash grate intake is a metal intake cover that allows surface flow to enter the intake with little restriction but prevents large debris such as corn stalks or bean stubble from entering. Trash grate intakes are recommended for large catchment areas greater than 20 acres.
        iii. Rip rap overflow
            1. A rip rap overflow is recommended when the 25-year storm event overtops the designed washout depth. This is typically where there are large contributing catchment areas or ASI basins with little storage volume.
    h. Choice of rock inlet

1. Rock inlets provide more infiltration into the ASI and sedimentation around the ASI basin. Although this will slightly adjust storage and therefore berm height design, rock inlets provide other benefits such as sediment capture. When soil erosion in the area is high, a rock inlet is suggested. Rock inlets can be implemented with both Hickenbottom and trash grate inlets.

i. Enter debris factor
    i. Input that will assume that inlet will be partially blocked by debris such as corn stalks, accumulated soil, trash, etc. It is recommended that 25% is entered to allow for conservative and realistic conditions.

j. Enter piping type
    i. Enter the type of piping that will be used for the outlet pipe. This will determine the Manning's roughness for flow calculations. If other is chosen, a manual input for the Manning's "n" value needs to be entered.

k. Optional: Do not restrict berm height
    i. Check "Do not restrict embankment height base on existing conditions" if you would like the calculator to calculate the berm higher than the depth of existing washout. This will trigger the rip rap recommendation for the ASI.

10. Click Calculate button
11. Examine results in the Summary Table
    a. Recommended drain time: 15-24hr
    b. Target berm height: reasonable height based on catchment area, should not exceed existing washout depth, unless unrestricted height is allowed
    c. Flow restricted by intake type, not outlet flow. Observe the flow contributions from each intake, if all flow is through the outlet pipe, increase outlet pipe size or slope to increase capacity.
    d. Target storage: 100% desired volume
12. Repeat with re-determined design criteria. The designer should adjust intake type, inlet diameter, and outlet diameter until the above criteria in 11 is met.