

# Flood Mitigation Inventory Guide

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## Introduction

This guide is a supplement to the Earth Force *Educator Guide for the Community Action and Problem Solving Process*. It provides guidance and tools for implementing a flood mitigation inventory in Step 1 of the Process with your students. There are also a few helpful tips to keep in mind for completing following steps. This guide includes information about drainage assessments and tools to conduct an inventory that are specifically adapted to drainage and flood-related issues. These tools will help you, the educator, understand how the Process is applied to drainage and flood mitigation and help you plan for working with your students. These tools are also designed to be used with the Educator Guide as you and your students work through the Process. By working with this supplemental guide in conjunction with the *Educator Guide* you will be able to work with your students in their development of a flood risk mitigation project.

## The tools and information included in this Guide are:

- 1) Drainage Assessment with Extensions- Step 1
- 2) Tips on Selecting Appropriate Criteria for Flooding - Steps 2 & 4
- 3) Sample Strategies for Change - Step 4
- 4) Drainage Vocabulary Glossary

# Step 1: Environmental Inventory - Drainage Assessment

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In Step 1 you will conduct an environmental inventory of a community area. This can be your school, a nearby park, the neighborhood these are located in, or the larger community. Choose the inventory area carefully, as it will affect the overall scope of your project.

**Property Address/Site Description:** \_\_\_\_\_

What watershed is this community area located in? \_\_\_\_\_

## **Flood Risk:**

Often the best way to learn about your community's flood risk is to consult your city or county's stormwater or floodplain management website. If you are unable to locate this resource, use this link below to access the FEMA Flood Map Service Center: <https://msc.fema.gov/portal/search>

Find your community area, and answer the following:

Where is the nearest floodplain? \_\_\_\_\_

Is this community area in or near the floodplain? \_\_\_\_\_

*"{Zl ynl : Find your home, school, or work using the Flood Map. Does your commute or daily travel pass through any flood zones?"*

*"{Zl ynl : Flood risk maps often indicate areas that are at risk of 100-year and 500-year flood events. These terms are confusing, as they are often interpreted to mean that a flood will only happen once every 100 or 500 years. To the contrary, these terms refer to risk as determined by probability. For example, a 100-year flood has a 1 in 100 or a 1% chance of occurring in any given year. A 500-year flood has a 1 in 500 or 0.2% chance of occurring in any given year. While these probabilities sound low, let's investigate the probability of smaller floods:"*

### Recurrence intervals and probabilities of occurrences

Recurrence interval, in years	Probability of occurrence in any given year	Percent chance of occurrence in any given year
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Source: USGS, <https://water.usgs.gov/edu/100yearflood.html>

*Note: Students can put the confusion around the term “100-year flood” to rest, through this simple lesson on flooding and probability developed by WOCU and the University of Colorado. See link here: <https://scied.ucar.edu/activity/flood-chances>*

*\*You may find the above extension helpful to frame the variance in the effects of weather events on disparate sites in a watershed, where individual student samples represent different locations with different rainfall totals in the watershed.*

#### Questions to Help Guide Your Observations

The following questions will help focus your environmental inventory on assessing water drainage issues. As you walk about your selected community area, take photographs or make sketches of features and conditions you observe. What other questions can you and your students develop suitable to your area of inventory?

- Does the surrounding land slope away from the building/structure?
- Are downspouts extended away from foundation and pointed to not impact others?
- Does landscaping cause water to be trapped?
- Are there any berms, curbs, or walls keeping water trapped?
- Are gutters and storm drains clear of debris?
- Are there any at-grade (flush with the ground) window openings?
- Is there slope away from door openings?
- Are there any erosion problems?
- Is there an abundance of impervious surface?
- Is there a detention pond?
- How has development changed your floodplain?

## Mapping Your Drainage

Sketch a map as accurately as possible of your inventory site. Make a special note of flood risks and mitigation features that you find there. Which way is the water flowing due to the slope of the ground? What can it get into? What can be damaged? Imagine that you are a raindrop, once you hit the ground where do you go? Use the following page for your map.

In addition to this part of the drainage assessment/inventory activity, you are encouraged to use Google Maps, Google Earth, or other mapping platforms to record the observations you make and answers to guiding questions you find during the inventory. Use map pins or tags to identify relevant features, whether flood protection features or weaknesses. Take photos of what you notice and add them to your map. If a feature is particularly interesting, take a video and record your observations.

As you complete your inventories, look for trends in where issues are located:

- Are your issues all in the same general area?
- Do certain issues group together?

Share your observations with the class and compare the features you observed with what the entire class collected. You will use this map and the observations you have recorded as a reference when you begin your background research. Share this map with experts you consult as you begin your background research.

*Extension: You may want to calculate the average slope of the ground at your site. There are several methods to do this. A relatively simple method involves a 50 inch board, a level, and a tape measure. Place the board flat on the ground in a spot that is representative of the general slope of the site, with the length of the board going up and down the slope. Place the level on top of the board, and lift the down-slope end of the board up until the board is level. Use the tape measure to find the plumbline distance in inches, from the ground to the top of the board. To find the slope, divide this distance by 50 (inches), and then multiply by 100 to get the percentage slope (e.g.,  $15''/50'' \times 100 = 30\%$ ). To find the average slope, repeat this process in several locations at the site and average the percent slopes found.*

*It is recommended that the slope be 5% or 6" in the first 10 feet away from a building. Can you draw how this would be calculated? Hint: Make sure all measurements are in the same units!*

Map your community area and its stormwater & flood risk issues:


*"The effects of pervious versus impervious surfaces."*

*Introduce your students to the concepts of pervious and impervious surfaces by beginning with the guiding question while on your inventory: What happens to water when it falls on different surfaces? Does water that falls on a parking lot move differently than if it falls on a garden? You could bring a jug of water with you outside to test your students' hypotheses as they identify all of the different surface types in the inventory site. Then prompt students to think about what happens to water that falls on impervious surfaces during a rainstorm.*

*Take your map of your inventory site that was drawn on the grid, or a google aerial view of the inventory site and overlay a grid on it. Explain to students that they will be determining the volume of water accumulated from impervious surfaces on the school campus in an average rainstorm.*

*Break students up into small groups and give each group a gridded map of the inventory site. Assign each group a region of the inventory site that has impermeable surfaces. That group will be responsible for measuring those surfaces.*

*To learn the volume of water that is accumulated on impervious surfaces in one rainstorm at your site, ask students to start with the area of all the impervious surfaces within their region. Review area formulas with your students. Make sure that everyone is using the same units, either feet/inches, or meters/centimeters.*

*Have students collect the appropriate measurements. As students take the measurements, have them observe the slope of the land and make a note of which way water would flow from the surface. They should draw arrows on their map indicating the direction of water flow, and add their measurements directly onto the map indicating the length of each piece of the plot of land.*

*Using a one inch rain storm as a typical significant rain event, have students calculate the number of gallons of stormwater running off each impervious surface within that event. Multiply the rainfall (convert inches to feet or centimeters to meters) by the area of the study plot (square feet or meters).*

*Volume should then be recorded in cubic feet or cubic meters. Convert these measurements into liters or gallons. After each group has found the number of gallons/liters for their study plot for one inch of rain, have each group share their information. Once all of the groups' gallon amounts are in one place, add them up to see how much water runs off of impervious surfaces around your school during a one-inch rain event.*

*Then discuss the implications of your findings with your students:*

*Would you say our school yard has a lot of impervious surfaces or not very many?*

*Can you think of places that have lots of impervious surfaces?*

*We know that water doesn't soak in to impervious surfaces, so where does it go? (students can use the arrows they drew on maps to discuss this)*

*What sorts of non-water substances might be in this stormwater based on the impervious surfaces you observed in the school yard?*

*Adapted from MN Sea Grant and Great Lakes Aquarium*

*\*For further investigation into different surface substrates, look for activities online about surface infiltration rates. There are great laboratory resources available.*

### **Background Research**

The observations from your walkabout provide a good start on identifying flooding and drainage issues. To help ensure the issues you identify at this point are real issues, it is important to consult expert and knowledgeable sources. This involves talking to the facility manager, personnel such as district planning and maintenance managers, the school principal, neighborhood residents, and city or county experts and officials. You can also consult a library or online official resources for maps, reports and data.

Take a minute to make a list of knowledgeable people in your community that you can speak with or invite to your flood risk inventory walkabout:

Name and Position	Contact Information

### **Guiding Questions for Background Research**

- What are the past flooding problems?
- What issues stand out as key issues?
- Have conditions gotten better, worse or stayed the same?
- Are any of the issues new or recent ones?
- Are any of the issues caused by other issues?

### **Consolidating Information on Issues**

Develop a single list of issues identified through the multiple information gathering methods. Review this list to consolidate and refine the issues, seeking to create a list of root causes.

## Steps 2 and 4: Using Criteria to Select an Issue or Action Plan

For how to go through the full Criteria Based Decision Making (CBDM) process, refer to Steps 2 and 4 in your Educator Guide! Below is just a couple helpful tips on criteria that may pertain to flooding projects in particular.

**Issue Selection:** The criteria below and the related questions will help you and your students determine the criteria needed to select an issue further in-depth research.

<b>Alignment with Academic Requirements</b>	<b>Student Interest</b>	<b>Is It a Real Flood Mitigation Issue</b>	<b>Located in our Inventory Area</b>	<b>Suitable to Available Time</b>
Curriculum: <i>Does the issue align with curriculum topics?</i>	Interest: <i>Is this issue of interest to students?</i>	Flood Mitigation Connection: <i>Is the issue identified from local flood mitigation information?</i>	Accessible: <i>Are we working within an accessible area?</i>	Adaptability: <i>Does it seem likely that a project can be developed on this issue with respect to available timeframes?</i>
Standards: <i>Does the issue align with standards requirements?</i>	Value: <i>Do students consider the issue of importance and value to the community?</i>	Expert information: <i>Was the issue vetted with flood mitigation experts?</i>	Community Connection: <i>Is the issue one of meaning to the community within the inventory area?</i>	Student experience: <i>Will students be able to research and address this issue over the course of their remaining class time?</i>
Educator Needs: <i>Does the issue fall within educator teaching responsibilities?</i>			Location: <i>Does the issue exist within the inventory area?</i>	



**Goal/Strategy for a Change:**The criteria below and the related questions will help you and your students determine the criteria needed to select a Goal/ Strategy

<b>Student Voice</b>	<b>Practicality</b>	<b>Civic Engagement/Skills</b>	<b>Flood Risk Impact</b>
<b>Participation:</b> <i>Can everyone be a part of this?</i>	<b>Time:</b> <i>Can we accomplish this action in our time frame?</i>	<b>Community:</b> <i>Does this require us to interact with local the local community?</i>	<b>Impact:</b> <i>Is there a definable and measure impact from this solution?</i>
<b>Interest:</b> <i>Is this project fun and interesting for us to work on?</i>	<b>Legality:</b> <i>Is this project legal?</i>	<b>Decision-makers:</b> <i>Will we engage with decision makers and people in power?</i>	<b>Resilience:</b> <i>Is this a project that will lead to a more flood resilient community?</i>
<b>Understanding:</b> <i>Can I explain this project? Does it make sense to me?</i>	<b>Money:</b> <i>Do we have the funds to complete this project? Can we get the funds to complete this project?</i>	<b>Policy and Practice:</b> <i>Does this solution address underlying policies and practices?</i>	<b>Research:</b> <i>Is the solution based on reliable/credible information? Does this solution use research support from stakeholders?</i>
	<b>Accessible:</b> <i>Are we working within an accessible area?</i>		<b>Data-driven:</b> <i>Is the solution based on quantitative data?</i>

## Step 4: Sample Strategies for Change

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Below is a list of real-world solutions and actions to address drainage issues that students might identify and explore as they develop their specific project proposal.

**Regrade to slope away from buildings. Pay special attention at entrances.**

Impact: !!!!

Cost: \$\$\$

Involvement: +

**Extend downspouts away from foundation**

Impact: !!

Cost: \$

Involvement: +

**Modify landscaping to not trap water against foundation**

Impact: !!!

Cost: \$\$\$

Involvement: +++

**Modify berms, curbs or walls to not trap water against foundation**

Impact: !!!

Cost: \$\$\$

Involvement: ++

**Build mini-walls around window wells or at-grade windows to prevent water entering the window.**

Impact: !!!

Cost: \$\$\$

Involvement: +

**Redirect water to grassy areas rather than bare dirt to help prevent erosion.**

Impact: !!

Cost: \$\$

Involvement: ++

**Community Flood Risk Awareness Campaign**

Impact: !!!

Cost: \$

Involvement: +++++++

**Preparing/distributing Emergency Preparedness Kits**

Impact: !!!

Cost: \$\$

Involvement: +++++++

## Proactive Community Development Advocacy

Impact: !!!

Cost: \$

Involvement: +++++

## Low Impact Development Strategies

Impact: !!

Cost: \$\$\$

Involvement: ++

# Glossary: Drainage Assessment

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## Glossary Index

Drainage Basin or Watershed

Floodplain

Slope

Downspouts

Berm

At-grade

Pervious/ Impervious

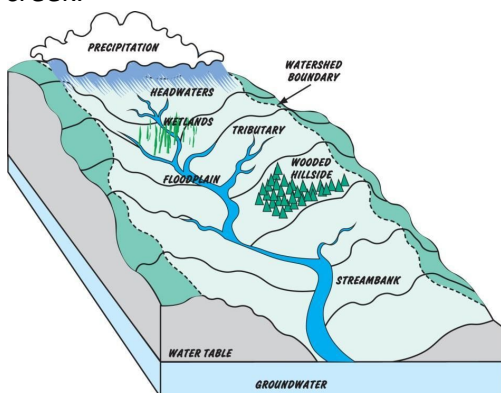
Detention Basin

Retention Basin

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## Drainage Basin or Watershed –

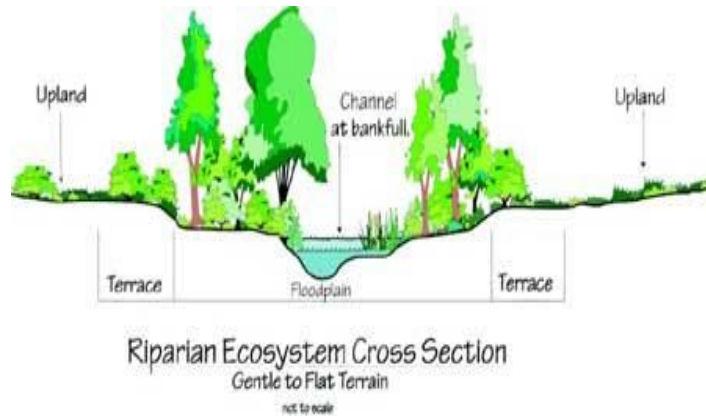
The area of land that catches precipitation (rain and snow) and funnels it to a stream or creek.



Earth Force, 2018 Use with permission.

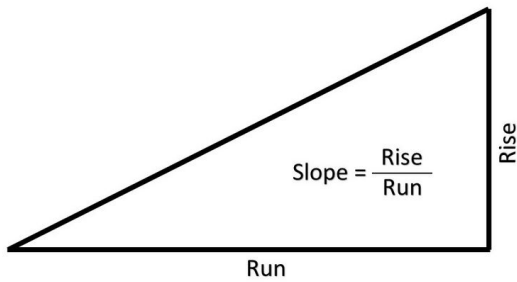
*Image: Wolf River Conservancy, 2018*

**Floodplain** – The area of land covered with water during a flood. It may include the channel and areas outside of the channel. The “regulatory floodplain” is the 100-year floodplain which is the area of land covered by a flood that has a 1% chance of occurring in any given year.



*Image: USDA, 2018*

**Slope** – the slant of the ground.



*Image: Wikipedia Commons, 2017*

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**Downspouts** – the end piece of the gutter that collects water from a building’s roof.



**Berm** – a small mound or ridge of dirt usually created as part of landscaping. Berms are created by humans.



**At-grade** – the level of the ground outside of a building



This window is at-grade.

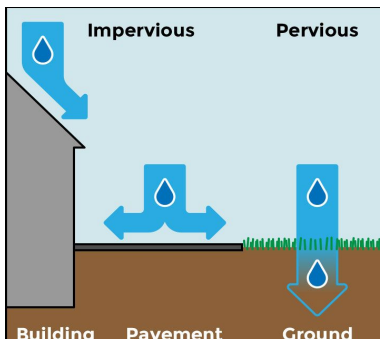


This window well is below grade.

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**Pervious** - Allowing water or fluid to pass through, used to describe materials. Permeable. Example: grass, dirt.

**Impervious** - Not allowing water or fluid to pass through. Impermeable. Example: concrete, roof tops



*Image: Science All Team, 2017*

**Detention Basin** - An excavated area used to hold back water and slowly release it through an outlet pipe. It is designed in areas where buildings and other impervious surfaces are built to help reduce flooding downstream. Almost all stormwater ponds in Fort Collins are detention ponds.

