

Stream Hydrology Trailer



Lesson Plans and Instructions for use with the USU Water Quality Extension Stream Hydrology Trailer

INTRODUCTION:

The stream hydrology trailer is a hands-on educational tool that allows participants to examine the natural movement of streams and rivers. The stream hydrology trailer contains a large flat “land area” composed of plastic grit. Water is pumped through the trailer to create a “stream” that moves along the length of the trailer. The stream trailer demonstration instructions included in this binder, focus on how slope, flow, and structure affect stream formation. Participants learn how streams behave under natural conditions and what happens when those conditions change.

In this introductory section you will find pictures of the stream trailer, requirements for using the trailer, and instructions on transporting and setting up the trailer. You should read over this entire section and familiarize yourself with the trailer before starting.

To avoid problems, you should practice set-up and lesson procedures in advance to become familiar with the controls and observe the response of the model.

OVERVIEW:

- Transport trailer to desired site
- Level trailer
- Remove cover and cover supports
- Plug in charger (if power available)
- Fill up water tank
- Prepare grit
- Build watershed model using people, cars, houses, etc.
- Conduct demonstration(s)
- Clean up
- Transport trailer back to USU Water Quality Extension

REQUIREMENT FOR USING THE STREAM TRAILER:

- Full size, ½ ton (or larger) vehicle with a class III trailer hitch
- Source of water at demonstration site (~110 gallons)
- Source of power (110-120 volts) at the demonstration site, OR fully charged batteries
- An area approximately 40' x 10' to accommodate truck and trailer

INSTRUCTIONAL MATERIALS INCLUDED WITH THE STREAM TRAILER:

- Binder with set of instructions
- Materials container 1
 - Riparian vegetation
 - Silt fence
- Materials container 2
 - People
 - Animals
 - Tiles
 - Cars

- Marbles

BEFORE YOU START:

- Locate key inside magnetic box just behind the hitch jack, or obtain key from Extension employee

TRANSPORTING THE STREAM TRAILER:

1. If needed, a ball and hitch receiver (class III) and electrical adapters for the trailer lights are located in the passenger side storage compartment in the toolbox. Use the key found in the magnetic box to unlock the storage compartment.
2. Connect trailer to the transporting vehicle and ensure coupler of the trailer is secure and latched on the ball and the lock is slid forward.
To use the hitch jack
 - a. Set the battery switch in passenger side compartment to “ALL”
 - b. Use the left switch on the hitch jack to extend or retract the jack.
3. Connect the power from vehicle to the trailer using the adapter, if needed, and ensure that all trailer lights work (taillights, brake lights and turn signals). Check safety chains and tires.
4. Remove tire chocks and place in vehicle.
5. Before driving please check the following:
 - a. Right and left storage compartments are locked
 - b. Pump compartment cover is installed correctly and locked
 - c. Cover supports are installed correctly
 - d. Cover is attached securely (all bungees are attached to trailer)
 - e. Hitch jack and rear jack stands are in the upright position
 - f. Tire chocks are in vehicle
6. In case of flat tire, the spare tire and lug wrench are located in the left storage compartment. Use the rear jack stands and hitch jack to raise the trailer.

SET-UP PROCEDURES (Allow at least 1 hour):

1. Chock the tires.
2. Unhook trailer from transporting vehicle.
3. Set the front to back slope using the hitch jack.

To use the hitch jack

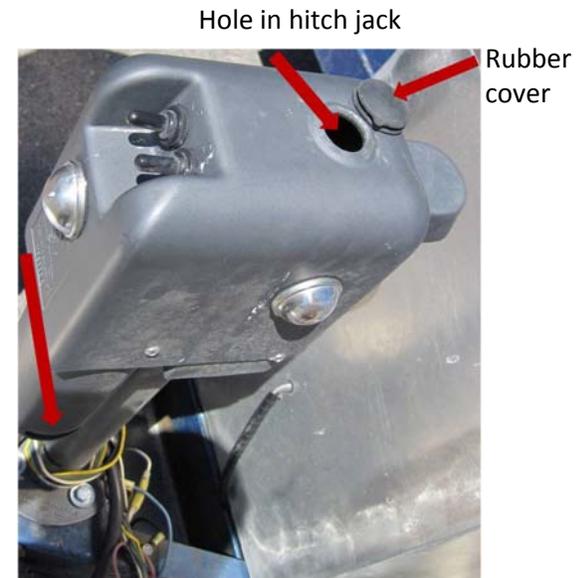
- a. Set the battery switch to “ALL”
 - b. Use the left switch (indicted with arrow in picture at right) on the hitch jack to extend or retract the jack.
4. Level the trailer from side to side using the rear jack stands.
 - a. Pull the pin on each rear jack and rotate them down.
 - b. Crank the rear jack stand until it contacts the ground
 - c. Check bubble in level near front of trailer to make sure trailer is level



To manually operate the hitch jack:

Remove hand crank and slotted key from tool box in passenger side storage compartment.

- Remove the rubber coverings on the top and side of the hitch jack.
- Place the hand crank in the hole (indicated at right) on top of the hitch jack and the slotted key in the side hole.
- While holding the hand crank, pull the slotted key forward.
- Rotate the hand crank counterclockwise to extend the hitch jack and clockwise to retract the hitch jack.
- Once the hitch jack is in the desired position slide the slotted key back and remove the hand crank.
- Replace the rubber coverings and return the slotted key and hand crank back to the tool box.



5. Remove the cover and cover supports from the trailer.
6. If 110-120 volt service is available, the trailer can be plugged in using an ordinary extension cord (found in the driver side storage compartment). Plug in the charger (charger can remain plugged in during trailer use). Turn “Battery Circuit” switch on.
7. If 110-120 volt service is not available usage time is limited to battery charge and will vary based on use and battery condition. Typically charge will last 2-6 hours.

8. Check that grit filters are in place at the back end of the trailer.
9. Unlock the pump compartment cover, located behind the hitch on the front of the trailer (see picture E). Slip the metal frame that holds the white hoses and valve B (see picture C) over the top edge of the trailer.
10. Keep the end of the clear hose in the tank because it is the return hose for Pump 1 (see picture E). One pump is generally sufficient. If the second pump is needed place the black hose near the location of the other valve using the large clip. Note: The use of both pumps empty pump compartment quicker than water can cycle through, so keep a close eye on the pump compartment water level.
11. Before filling the water tank:
 - a. Make sure the white overflow pipe is screwed into place hand tight (see picture on right).
 - b. Clean grit filter and screen by removing and flushing out with water. This should only be done before water is added to trailer and the area around the filters is completely dry and free from grit. Be sure to reinstall filter and screen before running water.
12. Using the garden hose in the left storage compartment, fill the water tank by directing flow into the pump compartment. The tank is full when water reaches the top of the white overflow pipe (approximately 110 gallons).
13. Prepare the grit bed:



- a. Use the Hitch Jack to level the trailer from front to back ***Water will leak out the overflow in the back of the trailer if it is too high.***
- b. Use the rake to smooth and level the grit, making it a constant depth throughout the upper three-fourths of the trailer bed (near the water inlet). Leave the lower one-fourth of the trailer empty (near the water outlet).
- c. Excavate a “reservoir” at the upper end of the trailer bed, about 1 foot in diameter with rocks lining the water inlet (see picture on right). This will help stop erosion at the beginning of the channel.



Reservoir and water inlet

14. For stream trailer demonstration suggestions see “Demonstrations” on page 10.

CLEAN-UP PROCEDURES

1. Rinse all materials (buildings, vegetation, etc.) to remove grit and dry them before returning them to the appropriate materials container. Return the materials boxes to the proper storage compartment.
2. Turn the pump switches off.

3. Raise the rear jack stands and rotate them back to driving position.
4. Drain the trailer
 - a. Raise hitch jack to allow water to move to the water outlet at the back end of trailer
 - b. Lower hitch jack and remove the white overflow pipe to drain. Make sure drain valve (Valve C) located under pump compartment is open to drain all water from the trailer.
5. Place hoses in pump compartment and lock it.
6. If transporting, properly hitch to your vehicle, remove tire chocks, and check that taillights are working.
7. Turn off battery.
8. Lock the front storage compartments, return the key to the magnetic key storage, and place behind hitch jack or keep in vehicle during transport.
9. Put cover supports and cover in places
10. Fasten all bungees to the trailer
11. Check that rear jack stands are fully up and locked and the hitch jack is fully up.
12. Return the key to Extension employee and complete the trailer Check out

Please report any malfunctions or missing or broken items to USU Water Quality Extension (435-797-2580)

Stream Trailer Pictures:

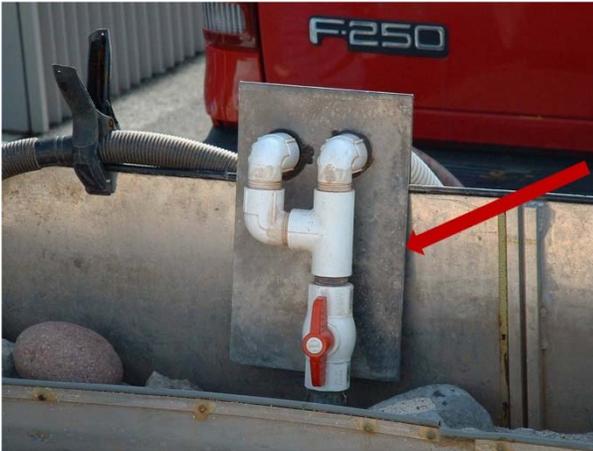


Picture A: Right storage compartment



Grit bed

Picture B: Rear View of Trailer



Metal frame

Picture C: Valve B



Battery charger

Picture D: Left storage compartment



Picture E: Pump compartment



Picture F: Pump switches/fuses



Picture G: Batteries



Picture H: Battery switch



Picture J: Grit filter and screen

BACKGROUND

A watershed is an area of land from which all the water drains to the same location such as a stream, pond, lake, river, wetland or estuary. A watershed can be large, like the Colorado River watershed, or small, such as all the water that drains to a small farm pond. Large watersheds are often called basins, and contain many small watersheds.

Rivers and streams are paths where water collects and moves from high to low elevation. Initially, water moves downhill in small streams. The small streams flow into larger streams until they eventually merge into rivers and flow into lakes or oceans. Flowing water cuts a path into the surface of the earth. Velocity (speed of water), water quantity, vegetation, and the geography of the landscape (i.e., slope, geology) all determine the shape of a river's path, or channel. Most river and stream channels develop a meandering (curving) pattern naturally as they flow across the landscape.

The riparian zone is the strip of water-loving vegetation near streams, lakes, and other bodies of water. The word "riparian" comes from the Latin word "*ripa*", which means riverbank. Riparian vegetation is crucial to the health of a river. It provides bank stability, habitat for diverse communities of plants and animals, shade (which plays a major role in determining water temperature), organic materials, protection from flooding, and storage for a sustained summer flow. In turn, the river provides water for the riparian vegetation. When the riparian zone is cleared of vegetation, or degraded, the health of the river suffers as a direct result.

Flooding occurs when water exceeds the capacity of a body of water such as a river or lake. Floods can also occur from the oceans when heavy storms, high tides, or tsunamis cause water to overflow into coastal lands and communities. Periodic flooding of rivers occurs naturally and is usually the result of heavy rain or rapid snowmelt. This flooding results in the creation of floodplains that can help hold excess water.

Communities are often developed on floodplains. As a result, land is converted from fields or woodlands to roads and parking lots (impervious surfaces), and the land loses its ability to absorb rainfall or rapid snowmelt. Impervious surfaces increase runoff in urban areas by two to six times that which would occur on a natural landscape. Flooding can be especially dangerous and destructive in urban areas where streets create corridors for swift moving water. In order to prevent flooding of developed areas, sometimes artificial levees are constructed. A levee is a natural or artificial slope or wall usually made of earth and placed parallel to the course of a river. Levees can successfully prevent flooding of the adjoining landscape. However, they can also confine the flow of the river, resulting in higher water levels and faster flows.

As water flows, it carries sediment (soil particles such as sand, clay, and rock). The movement of sediment plays an important role in shaping stream channels. Various sizes of sediment particles, ranging from clay to boulders, can move along with the water. Fast-moving water can pick up, suspend, and move larger particles more easily than slow-moving water. This is one reason why rivers can become muddier during heavy rainstorms. They are carrying much more sediment than they carry during periods of low-flow. Heavy storms can make a significant impact on sediment movement. Over half of the sediment moved during a year can be from a single storm period.

DEMONSTRATIONS

Demonstration 1: Slope

- Adjust stream trailer so that it is almost level.
- Create a shallow (1/2-1 inch) groove through the center of the grit, from the water inlet and reservoir to the water outlet. The groove should be gradually deeper at the water outlet (end).
- Start a low flow.
- After several minutes the water should create meanders. Talk with students about how areas with low slopes generally have slower moving water that form large meanders.
- Increase the slope. As the slope increases, velocity of the water will also increase and the stream will meander less.



Demonstration 2: Riparian Vegetation

- Adjust stream trailer so that it is almost level.
- Starting at the water inlet, use the scoop to trace an S-shaped channel.
- At one of the bends cover the banks with riparian vegetation (felt mats and plastic plants). Leave the banks of the other bend bare.
- Start the flow and watch the difference riparian vegetation can make. The bend without vegetation erodes much faster and more sediment is carried downstream. The bank with riparian vegetation shows very little erosion.



Extension: Put a house on the outside bend near the edge of the river portion with riparian vegetation. Turn on the flow and explain to the students that the homeowners decide they want to remove the riparian vegetation so they can have easier access to the river. Remove the riparian vegetation in front of the house. Ask the students what they think will happen. Have the students watch as the river erodes away the bank. Once the house falls in, discuss with students the importance of riparian vegetation.

Demonstration 3: Levees

- Adjust stream trailer so that it is almost level.
- Use the rake or scoop to form a long mountain along one side of the trailer.
- Create a large, flat bed of grit about a ½ inch high in the center of the trailer.
- Pile excess grit on the other side of the trailer to form a small mountain.
- Use scoop to excavate a simple arc-shaped channel along the base of the larger mountain stretching from the water inlet to the water outlet (see picture).
- Discuss with students what levees and floodplains are and how they function.
- Start the flow. Have students observe the floodplain flooding as you increase the flow.
- Turn off the flow and construct a levee using square tile slabs.
- Start the flow again and have students watch how the levee will keep the water from going onto the floodplain.
- To demonstrate how a levee can fail, turn the valve so it is completely open and simulate rain by using the watering can until the levee fails.



Demonstration 4: Wetlands

- Adjust stream trailer so that it is almost level.
- Create a wetland by installing bunches of plastic plants at the end of the channel (see picture).
- Start the flow and talk about wetland functions.
 - **Flood control**-wetlands act as sponges by capturing, storing, and slowly releasing water. Wetlands slowly release water over weeks and months.
 - **Coastal protection**-wetlands act as storm buffers. Roots hold soil in place and plant stalks reduce the energy from storm waves and wind.
 - **Groundwater recharge**-wetlands contribute to groundwater through aquifer recharge.
 - **Sediment traps**-wetland vegetation can slow water velocity and particles settle out as velocity decreases. Pesticides, heavy metals, and other potentially harmful residues can settle out. Too much sediment in water can cause clogged gills in aquatic animals, and fluctuations in water temperature.
 - **Pollution interception**-wetland plants can take up and filter some pollutants like nitrogen and phosphorous, some pollutants settle into the soil and are chemically reduced over time, other pollutants may be processed by bacteria.



- **Habitat**-wetlands provide food, shelter, resting places, or predatory opportunities to a variety of animals.
- **Waste treatment**-wetlands have a high rate of biological production that leads to a large waste consuming capacity. Also, sediment deposition buries waste and bacterial activity can break down and neutralize waste.
- Lift up the plants in the wetland to show the students how much sediment has been deposited there.

Demonstration 5: Flow

- Adjust stream trailer so that it is almost level.
- Construct a channel with meanders.
- Start a low flow and watch to see if and how the stream is affected.
- Increase the flow and discuss what affects the students think the high flow will have on the river formation of a meandering stream (low flows will generally keep the meandering channel while high flows may cause the channel to straighten).



Demonstration 6: Beavers

- Adjust stream trailer so that it is almost level.
- Construct two channels with slight meanders.
- Line both channels with riparian vegetation (felt mats and plastic plants).
- Install a few (2-3) beaver dams (pipe cleaners woven together) in one of the channels.
- Scoop out small pools behind each beaver dam.
- Start a low flow and compare the sediment load and water velocity of the channels (the beaver dams will generally reduce sediment load and water velocity).

