Wiyot Tribe
Environmental Department

Clean Water Act §319 Non-Point Source Pollution Control Program

NON-POINT SOURCE POLLUTION EDUCATION CURRICULUM

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List of Acronyms

AMWS	**Arcata Marsh & Wildlife Sanctuary**
BMP	**Best Management Practices**
HSU	**Humboldt State University**
IPM	**Integrated Pest Management**
LID	**Low Impact Development**
NPS	**Non-Point Source**
SVOC	**Semi-Volatile Organic Compounds**
TBR	**Table Bluff Reservation**
UIHS	**United Indian Health Service**

I. Introduction

The Wiyot people have a strong dependence on the Eel River, Humboldt Bay and its tributaries, and the Mad River for the valuable resources that serve tribal sustenance and cultural purposes. Non-point source (NPS) pollution threatens the quality of these water-bodies and their respective watersheds, and by extension threatens the ability for those water-bodies to provide the resources upon which the Wiyot people depend. Educating tribal youth about the causes, impacts, and prevention of NPS water pollution is an important means of instilling environmental stewardship in future generations and protecting tribal waters and their resources.

The Environmental Department of the Wiyot Tribe has been working with the Social Services Department to improve environmental education for tribal youth. Currently, the Tribe's youth program has 15-20 tribal youth members participating in both cultural and environmental activities. The purpose of this curriculum, developed by the Wiyot Tribe Environmental Department, is to strengthen the tribal youth's knowledge on issues relating to NPS pollution.

II. Program Summary

The following curriculum was established to refresh the tribal youth on their knowledge of NPS pollution on entire watersheds and introduce new concepts that were not covered in the previous year. The first lesson will serve as an overview of what the students learned last year in order to guide them towards further understanding NPS pollution. The first lesson will begin with an introduction to the water cycle, watersheds, and NPS pollution. Later, the students will dive deeper into their understanding of aquifers/groundwater and learn about how NPS pollution affects their drinking water. Next, the students look at the impacts of construction activities in urban/rural areas and how alternative methods such as Low Impact Development (LID) policies can reduce or prevent NPS pollution in these environments. Similarly, the students will also learn about agricultural environments and how, through proper management, the Tribe can play a large role in keeping the area and surrounding environments (i.e. Tribe's wetlands, Humboldt Bay) free of NPS pollution. Next, the students will visit Humboldt State University (HSU) where Dr. Matthew Hurst will lead the students on a mock investigation to discover the culprits polluting nearby Jolly Giant Creek. The lesson will also include a field trip to the Arcata Marsh & Wildlife Sanctuary (AMWS) where students can see how NPS pollution can travel from waters in higher reaches (i.e. Jolly Giant Creek) to the lower reaches (i.e. Humboldt Bay). Lastly, the curriculum will conclude with a lesson in the Tribe's Community Garden aimed at stressing the importance of reducing or eliminating NPS pollution (i.e. pesticides, fertilizers, sediment) by following proper land management practices. Students will be introduced to practices such as Integrated Pest Management (IPM), crop management, and other biological concepts (i.e. photosynthesis).

III. Environmental Education Curriculum

Lesson 1: "Revisiting NPS Pollution"

During this lesson, students will review watersheds, the water cycle, NPS pollution, and how to distinguish non-point from point source pollution. The lesson will begin by introducing the water cycle and how water moves through a watershed. Students will review the difference between point and NPS pollution and learn how pollution can affect all environments of a watershed. The lesson will also cover how pollution affects soil and air as it moves from one environmental medium to the next.

Activities:

"*NPS in the Watershed*" – Using an Enviroscape® Watershed/Non-Point Source Pollution model, this activity will show the students how non-point and point source pollution can affect all the different environments in a watershed. The different environments from which pollution is generated in the model include:

- Non-Point Sources
  - ✓ Residential
  - ✓ Stormwater runoff
  - ✓ Forestry Areas
  - ✓ Transportation
  - ✓ Recreational
  - ✓ Agricultural and Construction

- Point Sources
  - ✓ Factory
  - ✓ Sewage Treatment Plant
  - ✓ Storm Drains

The model shows how NPS pollution such as stormwater runoff, represented by soil (cocoa), chemicals (colored drink mix), and oil (cocoa plus water), can enter waterways located either in the upper reaches of a watershed (i.e. creeks, rivers, lakes) that eventually affect downstream waters or in waters located in the lower reaches of a watershed (i.e. estuaries, bays, ocean). The model also comes equipped with supplies to demonstrate Best Management Practices (BMP), in which NPS pollution is stopped from entering a waterway. The model demonstrates BMP's with vegetated buffer strips (felt) capable of capturing and biologically breaking down NPS pollution. BMP's are also demonstrated using berms (clay) capable of channelizing and holding water on a construction site, thus preventing NPS pollution from flowing offsite into a waterway. Students will have a great understanding of how all of the environments are connected through the flow of water and the runoff that is generated (see Appendix 2: Environmental Curriculum Activities – Figure 1).

- *Supplies:*
  - Enviroscape® Watershed/Non-Point Source Pollution Model (1)

"Matching NPS Pollution on a Map" – During this activity, students will use aerial and topographic maps of both the Eel River and Mad-Redwood Watersheds, the watersheds of the Table Bluff Reservation (TBR), to match the different sources of NPS pollution in the area. The students will gather a better knowledge of the Wiyot ancestral land located within the aforementioned watersheds and how NPS is generated and transported. Taking from what they learned in the previous activity, students will generate a list of NPS pollution. These can include, but are not limited to, the following:

- ✓ Fertilizers, herbicides and insecticides (Agricultural, Residential)
- ✓ Oil/Grease (Transportation, Residential, Agricultural, Industrial)
- ✓ Chemicals (Residential, Industrial, Agricultural)
- ✓ Sediment (Construction, Erosion, Residential)
- ✓ Bacteria, such as coliforms (Agricultural, Residential)
- ✓ Carbon deposition (Transportation, Industrial)

Next, students will be given an aerial and topographic map and instructed to attach the NPS pollution categories to the potential pollution sources. After, the students will use the topographic map to determine elevations and place arrows indicating the direction in which they believe water will flow. For example, a student identifies an agricultural field and places the category "bacteria" on the spot. Next, the student uses the topographic map and determines that the elevation slopes downward, places an arrow pointing in that direction, towards McNulty Slough. A brief explanation will follow for each category in order to allow the students to understand that land uses and societal practices (i.e. improper agricultural use, improper vehicle maintenance, etc.) can lead to contaminated waterways.

- *Supplies:*
  - Construction Paper booklet (1)
  - Scotch tape roll (1)
  - Permanent marker (1)
  - Topographic maps
  - Aerial Maps

Lesson 2: "NPS Pollution Effects on Your Drinking Water"

This lesson will aim to improve upon the concepts related to aquifers and drinking water that the students learned about last year. We will revisit the major concepts of aquifers, how we access these water sources, and the common uses of well water in our society today. Lastly, the students will learn the common NPS pollutants responsible for groundwater contamination, how they affect the water quality within the aquifer, and how this pollution can be prevented.

Field Trip:

TBR Wells and Pumphouse – The community drinking water wells for the TBR community are located in the southeastern and western boundaries of the reservation near neighboring farmlands, residential properties, and a public road. During this trip, introduced concepts on aquifers will be related to the Tribe's well and students will be asked to think about the origins of potential sources of NPS pollution that may affect the tribe's water quality. The Tribe's drinking water operator, George Buckley, will lead the students on a walk around TBR's drinking water pump house and wastewater leach field. The students will learn what tests the Tribe performs to be sure that residents of TBR are not ingesting NPS pollution in the form of coliforms, Semi-Volatile Organic Compounds (SVOC), metals, etc.

- *Supplies:*
  - Hach water quality test kits (1)

Lesson 3: "Low Impact Development (LID) on TBR"

During this lesson, students will focus on NPS pollution generated in construction areas. We will cover important concepts such as BMP's, the relationship between water uptake/runoff and impervious/permeable ground cover, water discharges and the effect on streambeds, and the types of pollutants most commonly found in construction settings. Examples will be provided to give students an idea of how NPS pollution can have devastating consequences if proper BMP's are not followed on a construction site. Students will also learn how these pollutants travel through our environment, the impacts of these pollutants, and the steps that can be taken to prevent NPS pollution.

Activity:

"Construction Runoff Table" – Students will use this hands-on activity to observe how NPS pollution can occur in their own backyards. Two demonstration boxes will be used; one will contain conceptual models of both an urban and a rural environment, and another that will contain a conceptual streambed. On one side of the first box, students will use concrete pavers (impermeable surface), sand and gravel to construct an environment representative of a large urban area; on the other side of the same box, students will use carpet covering sponges (permeable surface) to construct an environment representative of a rural area. Within these environments, students will add potential pollution sources in the form of miniature houses/buildings, cars, tractors, and farm animals. Pollutants will be added to the landscape in small quantities using food coloring (drops) and in large quantities using dry, colored drink powder. Additionally, sediment in the form of sand and gravel (simulating construction site runoff) will be identified as a NPS pollutant. Rain will be simulated using a water jug and students will observe how pollution moves through both environments. Students will experiment with pollution buffers in the form of sponges (representing straw mats/silt

fencing/etc.) in order to "trap" NPS pollution on site. A second box containing sand, gravel, and rock (representing a streambed) will be placed beneath the outlets (a storm drain for the urban setting) of the first box to demonstrate the effect of flow rates on the hydrology of a streambed. Students will also observe the ways NPS pollution moves through different settings, and the different rates of pollutant transmission from source to streambed. This will also give the students an opportunity to distinguish between pollution types, as storms drains are point source pollution sites (see Appendix 2: Environmental Curriculum Activities – Figure 2).

Field Trip:

United Indian Health Service (UIHS)-Potowat – During this trip, the students will learn how LID practices help to retain NPS pollution. The Potowat Health Village was designed with the intent of capturing, holding, and treating pollutants on site. At Potowat, a medical facility is surrounded by a large parking lot equipped with sloped, vegetated buffer strips to capture excess rain water and polluted runoff from vehicles. Along with these vegetated buffer strips, the facility's rain gutter system drains into wetlands around the property. These wetlands contain botanical species that biologically treat potential pollutants while heavy metals settle to the pond bottom, thus preventing pollution of offsite water resources. This is a great, local example by a Native American organization that proves that large scale construction can be accomplished with the intent of using the landscape to mitigate potential pollutants.

Lesson 4: "Agriculture in Your Backyard"

During this lesson, students will learn how agricultural practices on TBR, if not properly managed, can cause environmental destruction. The students will learn how pesticides, coliforms, high sediment loads, and other NPS pollutants on their agricultural lands can migrate offsite, thus affecting human health and environments located downstream. Local examples will be given to show the impacts of improperly managed farmlands and how proper steps could have been taken to avoid contamination.

Activity:

"Wetland Exploration" – During this activity, students will examine both wetland and upland soils to explore the biodiversity present in each soil type and determine any differences. Close observation of the soils should lead students to construct hypotheses as to why there are noticeable differences in the color, dampness, and number of organisms present in the soil. Similarly, the students will participate in a small botanical and avian survey to become more familiar with the species present in the wetland. Students will learn how different species of vegetation have adapted to live in more saturated environments compared to upland species. Similarly, the students will learn how avian species "richness" and abundance provides information into the overall health of a wetland ecosystem. Finally, the activity will conclude

with a discussion on how wetlands play the role in filtering out pollution, thus being named the "kidneys of the watershed."

- *Supplies*:
  - Boxes for soil (2)
  - Hand lenses (5)
  - Magnifying bug boxes (7)
  - Trowels (2)
  - Notepads (2)
  - Pencils (2)
  - Vegetative survey transect grid (1)
  - Binoculars (7)

Field Trip:

TBR Agricultural Fields, Bluff, and Wetlands – Students will take a walk around the agricultural fields, bluff, and the wetlands located on TBR to learn about NPS pollution in agricultural settings. Students will learn about NPS pollution topics such as pesticides, fertilizers, manure, bacteria such as coliforms, sediment from runoff, etc. There will be an interactive, hands-on activity that will demonstrate how wetlands contain different soil types and biological organisms that aid in the natural filtration of both point and NPS pollution.

Lesson 5: "Wiyot Youth Pollution Police"

During this lesson, students will learn how NPS pollution can affect the water quality of large water bodies (i.e. rivers, lakes, and oceans) and affiliated tributaries. Using what they have learned up until this point, students will trace some pathways that NPS pollution may take to eventually reach its final destination. Students will learn some of the common NPS contaminants, where they may have originated from, and some preventative methods that can be taken at the source to safeguard water quality for the entire watershed.

Activity:

"Pollution on Jolly Giant Creek" - Students will visit Jolly Giant Creek in order to investigate NPS pollution with Dr. Matthew Hurst, Chemistry professor at Humboldt State University (HSU). During this activity, students should be able to better understand how NPS pollution travels through several environments. Students will officially become part of the Wiyot "Pollution Police" squad where they will participate in a mock investigation in order to determine who is polluting Jolly Giant Creek. Multiple sites (i.e Duck Farm, Science Lab, Hospital, etc.) will be set up on the creek. At each site, students will use Hach testing kits to sample jars of prepared water that may or may not contain pollution. After completing the tests and discussing with members of the team, one student will note the result on a notebook. Once back in the lab, Dr. Hurst will go over each site and reveal if pollution was present. Dr. Hurst will also review NPS

pollutants commonly found in larger water bodies and ways to reduce or prevent these contaminants in our environment (see Appendix 2: Environmental Curriculum Activities – Figure 3).

- Supplies:
  - Hach water quality testing supplies
  - Hazardous waste containers (4)
  - Notebooks (4)

Field Trip:

HSU/Jolly Giant Creek & Arcata Marsh & Wildlife Sanctuary (AMWS) – Students will visit HSU's campus and take a short walk down to Jolly Giant Creek. The creek is of vital importance to the Wiyot Tribe as it is a tributary to Humboldt Bay. After, the students will visit AMWS, where Jolly Giant Creek connects to Humboldt Bay, in order to give a visual representation of how NPS pollution at higher reaches of the watershed can flow into Humboldt Bay. While at AMWS, students will learn about how the city of Arcata uses gravity, minor human involvement, and nature's own ability to treat wastewater influent to be filtered and treated for deposit into Humboldt Bay.

Lesson 6: "NPS Pollution in the Community Garden"

In this lesson, students will review how gardens, if not properly managed for NPS pollution, can pose an environmental and human health risk. Student will discuss topics such as composting & nutrient loading, crop rotation & management, cover crops, Integrated Pest Management (IPM) vs. pesticides, etc. A discussion will follow to demonstrate how a properly maintained community garden can provide healthy, chemical free fruits and vegetables while reducing the threat to the Tribe's groundwater, Tribal wetlands, and nearby Humboldt Bay.

Activity:

"The Micro-World of TBR's Community Garden" – During this activity, students will learn how insects, arachnids, invertebrates, and other organisms can have an effect on the harvest productivity of the community garden. Using hand lenses, magnifying bug boxes, and a guidebook, students will collect biological specimens for identification and to determinate if the animal in question is beneficial or not to the community garden. This activity will provide an opportunity to reintroduce the concepts of Integrated Pest Management and how we can manage a community garden to be chemically independent through a natural process.

- *Supplies*:
  - Hand lenses (5)
  - Mac's Guidebook to Good/Bad Garden Bugs of California (2)

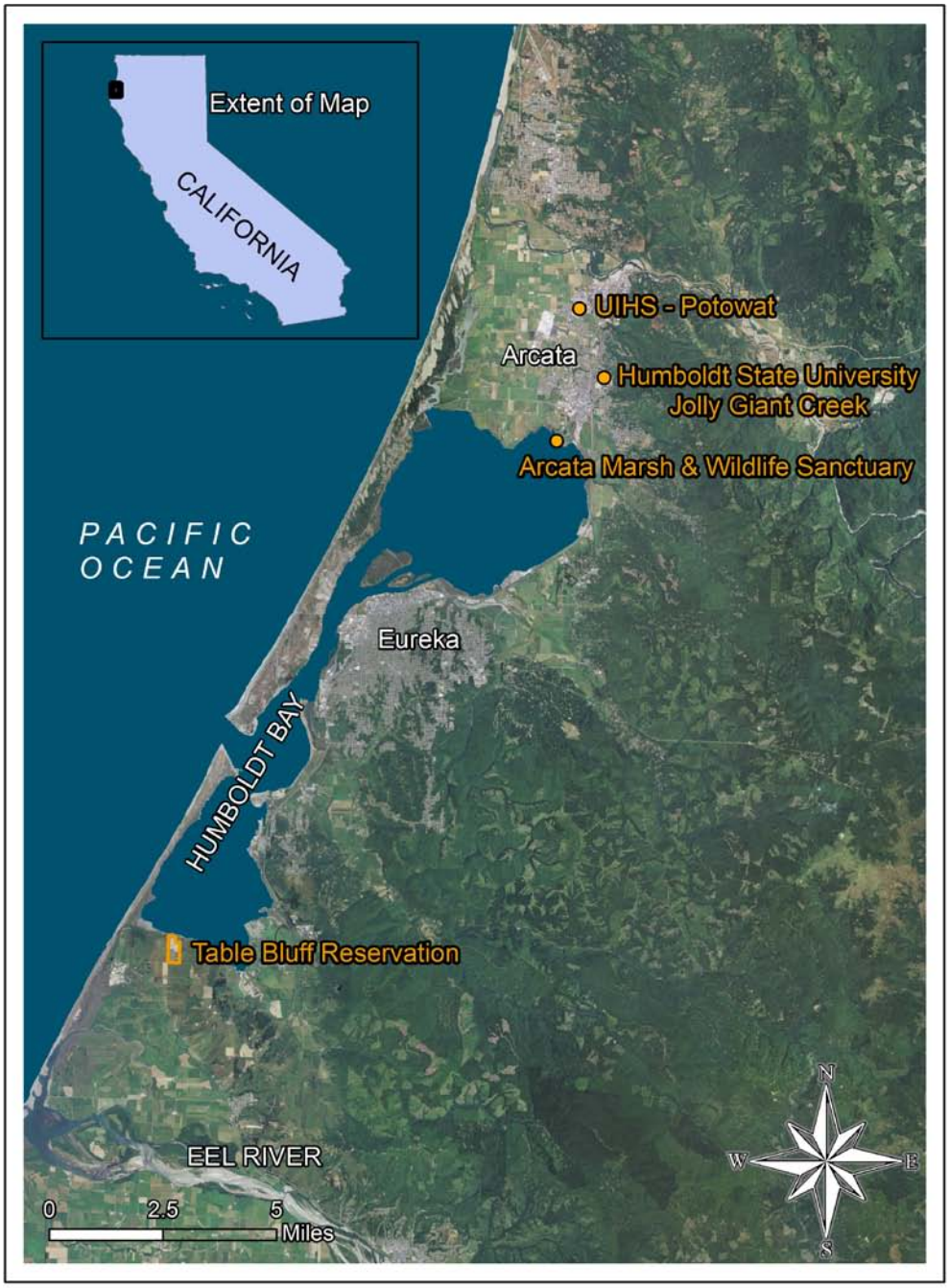
- Magnifying bug boxes (7)

Field Trip:

Table Bluff Reservation Community Garden – The students will visit the Tribe's Community Garden to learn about potential NPS pollution threats such as pesticides, sediment, and nutrients. Other topics to be discussed include photosynthesis, requirements for plant growth, IPM, garden animal life, and the effects of chemicals on human health.

IV. Appendices

Appendix 1. Map of Activity and Field Trip Sites



Appendix 2: Environmental Curriculum Activities

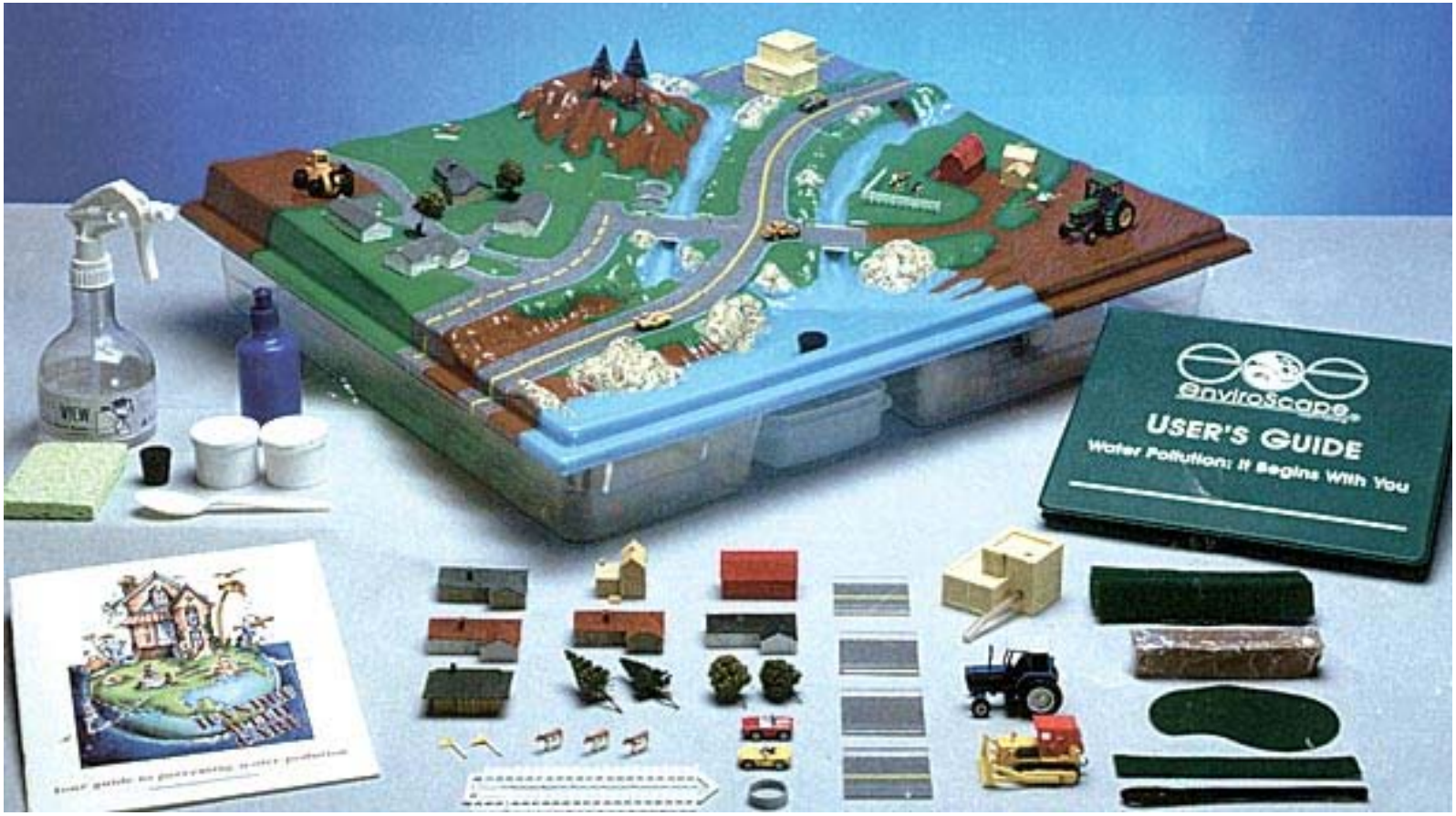


Figure 1. Watershed NPS Pollution Model.* A model designed to demonstrate how NPS pollution travels within a watershed. NPS pollution demonstrated in this model are: soil (cocoa powder), chemicals (colored drink powder), and oils (cocoa powder w/ water). Students will also have the opportunity to learn about BMP's and how we can manage the landscape to naturally capture and/or eliminate NPS pollution thus, preventing the contamination of our waterways.

*Photo taken from Enviroscape® website at: http://www.enviroscapes.com/nonpoint-source.html

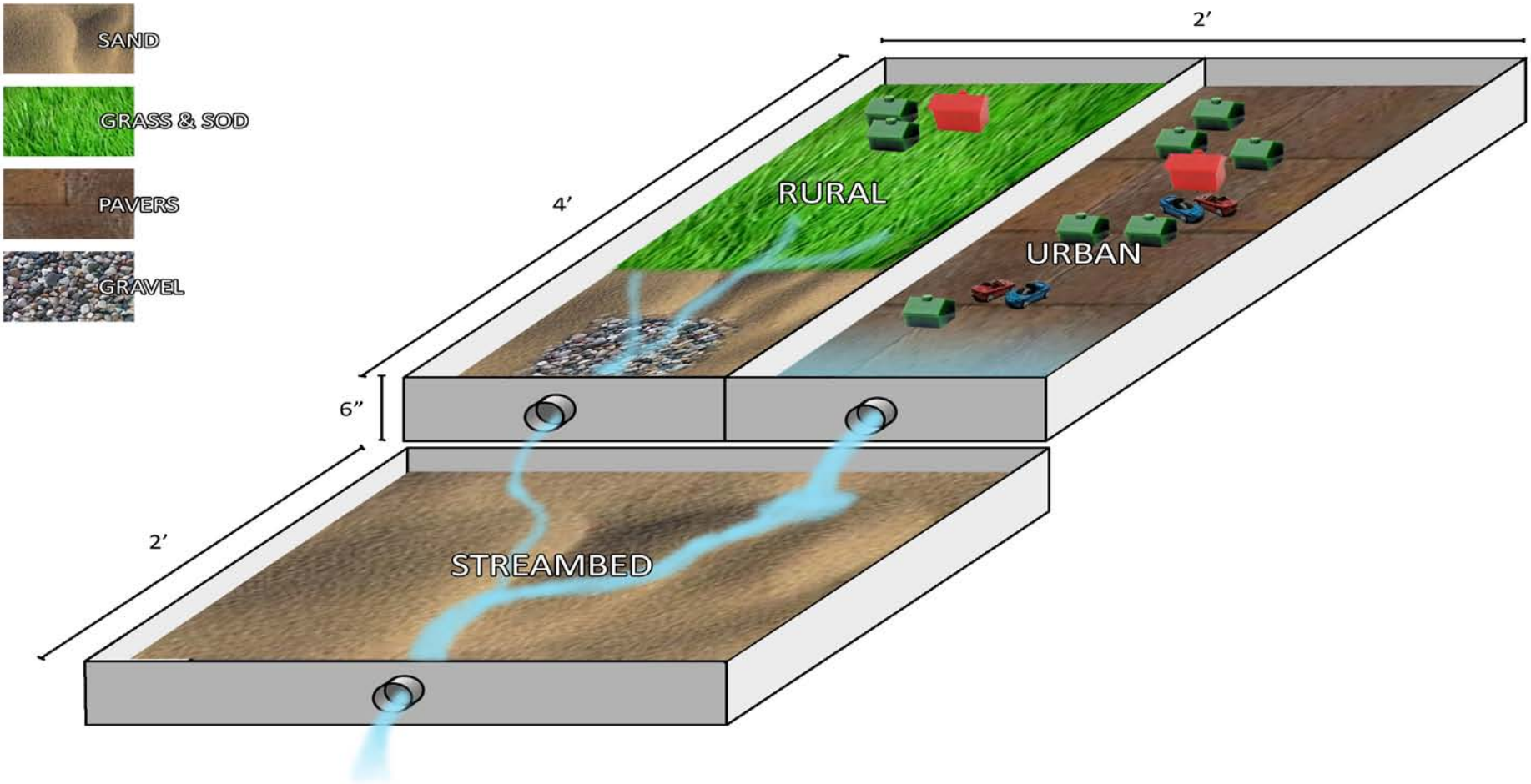


Figure 2. Construction Runoff Table. An activity designed to demonstrate NPS pollution from construction sites in the urban and rural environments. The rural environment will contain permeable surfaces such as carpet (representing grass), sand, and gravel while the urban environment will contain impermeable surfaces such as concrete pavers. NPS pollution is added to the environments using food coloring, colored drink powder, and silt/sand. A second box containing a streambed is placed below the first box in order to show how large water discharges alter the hydrology of a waterway.

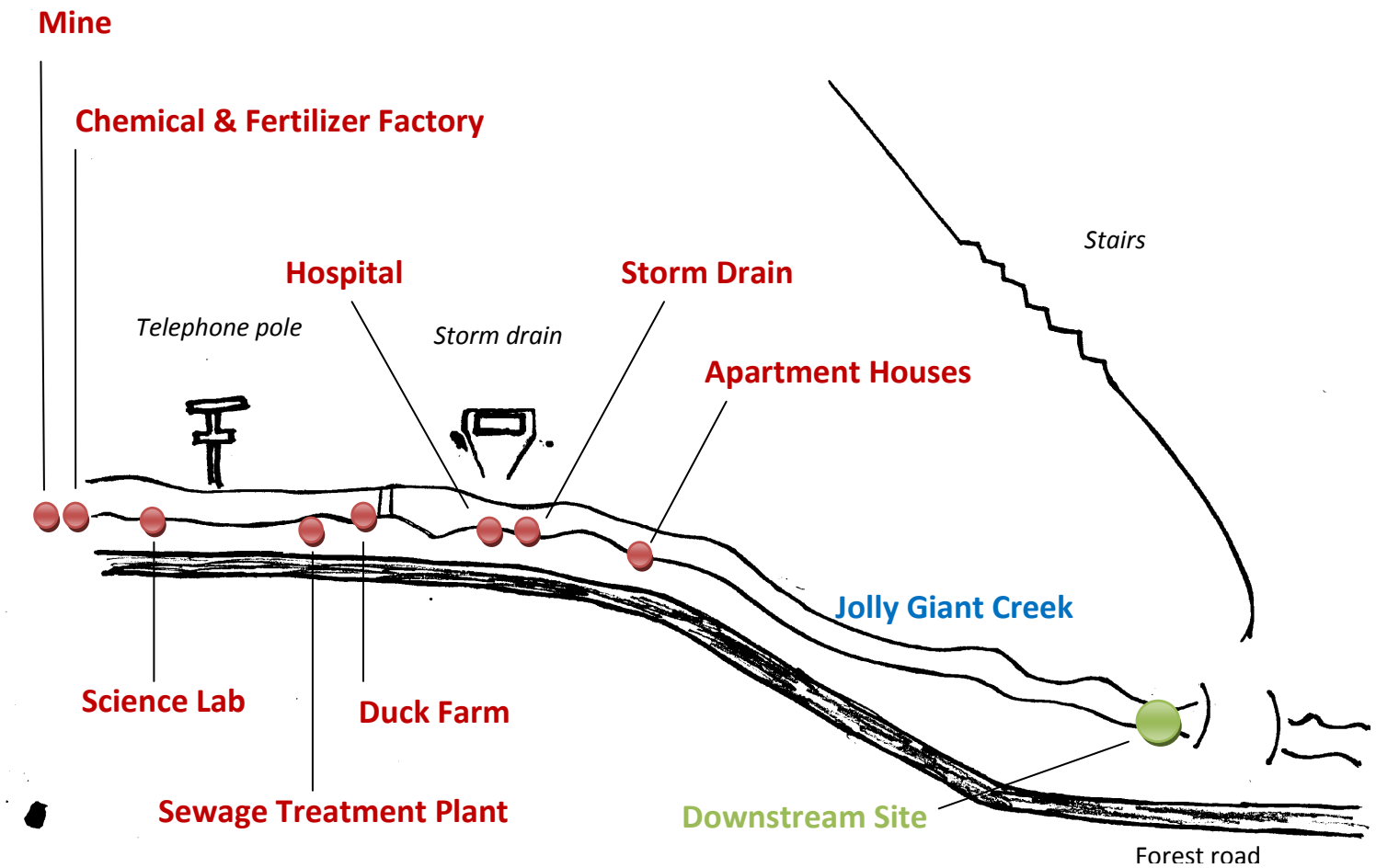


Figure 3. Wiyot Pollution Police Activity*. An activity designed for students to determine who is contributing NPS pollution to the waters of Jolly Giant Creek (in blue). At each site (in red), the students will test vials of water to determine if NPS pollution is present and in what quantity. Later, the downstream site (in green) will be tested to determine if the NPS pollution generated in the higher reaches of Jolly Giant Creek has the potential to reach the lower portions of the watershed (i.e. Humboldt Bay).
*Design from Dr. Matthew Hurst's Pollution Detective activity