



# GREENING UP THE GREENWAY

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## FIELD STUDY TRIP

### **ESSENTIAL QUESTION:**

*What is the most economical and environmentally sound fertilizer to use on Northwest forests?*

### **OUTCOMES:**

1. Increase student appreciation for the value of conserving and sustaining forests.
2. Increase understanding of biosolids and forest fertilization.
3. Increase understanding of how scientists make decisions about where to apply biosolids.

**GRADE LEVEL:** 5th–12th

**Time:** 3.5 hours

**LOCATION:** Tiger Mountain State Forest  
High Point

### **Materials:**

ITEMS PROVIDED BY THE GREENWAY  
EDUCATION PROGRAM:

- 4 backpacks which include: clipboards, Forest Exploration Worksheet, Plant ID cards, Invasive Species sheets, Forest Transect Worksheet (different for each clipboard), soil auger, transect rope, pencils, map, jeweler's loupe

### **INTRODUCTION**

Welcome students on the bus and ask them to use the restroom and then meet in the pavilion. At the pavilion, give an overview of the day. Review trail etiquette. Define what a Greenway is. Review in-class material and essential question. Explain how the Forest Exploration Worksheet should be used.

Divide students and chaperones into four groups. Stagger each groups' start time on the trail by 5 minutes. Tell groups who are waiting to go over the information on the Biosolids Reference Guide. Give chaperones directions on how to support their group. (see directions for chaperones next page)

## **AT TRAIL'S END**

After lunch have students share one thing they observed on the hike. Introduce the rest of the day with the following explanation. When scientists want to learn where to apply or not apply biosolids to forestlands, they study small pieces of the forest that represent larger areas. We are going to look more carefully at the soil, plants, wildlife in order to answer the question: Should biosolids be spread on this forest area? Why or why not?

Disperse the groups throughout the area. Encourage them to follow the directions on the worksheet and collect information. They can take about 20 minutes to study their area and fill out their worksheet. After completing the transect worksheet each student (or student-pair) should answer the thinking questions and fill out the advantages/disadvantages chart. The group should spend time talking about whether biosolids should be spread on the area.

Once each small group is finished with their work everyone reconvenes in the lunch spot and presents their results.

## **CONCLUSION**

Show big map of Tiger Mountain. Point out where Tradition Plateau, Natural Resource Conservation Area is located. Explain different land use goals for different parts of Tiger Mountain and show where biosolids are applied.

Emphasize in the conclusion that one of the advantages of recycling biosolids is to help tree farm trees grow faster so they can be cut down sooner. This helps provide trees for paper products and construction so that beautiful areas, such as Tiger Mountain, do not have to be harvested.

## **WALK BACK TO BUS**

Directions for chaperone:

- 1) Help students be responsible learners by letting them carry the clipboards and pencils.
- 2) Help students focus on the activity by reading the Forest Exploration Walk and then observing the forest for answers.
- 3) Help students learn by reviewing the biosolids reference guide when there is a question AND at the beginning of the hike while you are waiting to start down the trail.
- 4) Help your small group come together after they have completed their transect study. Insist that they share their information with each other and then have them as a group develop a response to the essential question: Is this forest a good place to spread biosolids? Why or why not?
- 5) Pay attention to the advantages and disadvantages of using biosolids.

## **ADVANTAGES OF BIOSOLIDS APPLICATION**

- 1) Adds nutrients (N) to the soil which helps trees/plants grow
- 2) Improves health of soil by helping soil retain water which prevents erosion and floods, and allows trees time to absorb nutrients
- 3) Recycles a waste product
- 4) Renewable resource
- 5) Easily accessible fertilizer

## **DISADVANTAGES OF BIOSOLIDS APPLICATION**

- 1) Concerns about pathogens
- 2) EDC's Endocrine Disrupting chemicals
- 3) Keep it out of the water
- 4) Smell
- 5) Heavy metals

# BIOSOLIDS

This is a reference guide to refresh your memory about biosolids and GroCo.

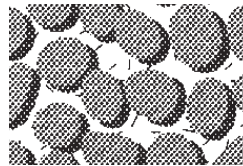
Read it before you start hiking and refer to it while answering questions on your clipboard.

## Where should biosolids be applied on forestland?

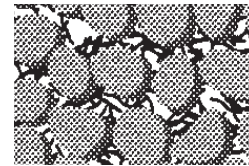
◆ Tree farms in Western Washington benefit from the addition of biosolids. Douglas Fir trees and other evergreens are harvested after they reach 40 to 60 years of age. If their growth is accelerated they can be harvested in a shorter amount of time, thus providing more paper products and preventing other trees from being cut down.

◆ Farmers in Eastern Washington use biosolids on orchards, canola (for biodiesel production) wheat and hop fields. This improves plant growth and crop yields. Less frequently biosolids are used on grapes and corn.

◆ Biosolids can be applied on poor soil that is low in nutrients and organic matter. Biosolids are high in organic matter and nutrients. Plants and trees need nutrients in order to grow and so biosolids improves the health of the soil and the health of whatever is growing on the soil.



Nutrient Poor Soil

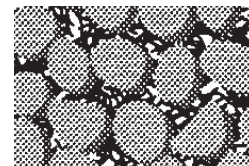


Nutrient Rich Soil

◆ Sandy soil has large air spaces between each particles. These air spaces allow water to rush through, thus very little water is retained in the sand. Farmers want their soil to hold onto water so that it can nourish plants and trees. When water rushes through the soil, it doesn't give the trees a chance to absorb the water and nutrients in the water and so the trees don't grow as well, if at all on sandy soil. When biosolids are mixed with sandy soil, the air spaces get smaller and the biosolids and organic matter hold onto the water similar to how a sponge holds onto water. As the water lingers in the soil it gives the trees and plants a chance to absorb it. This allows nutrients in the soil to enter the water and as the trees absorb the water they also absorb the nutrients.



Sandy Soil



Soil with Biosolids

## What is GroCo?

◆ Gro Co is a mixture of biosolids (1 part) and sawdust (3 parts) composted for a year. It can be used on city gardens and by commercial landscapers. Gro Co restores soil health by adding nutrients and increasing the soil's ability to retain water. Remember, that is a good thing.

(SEE OTHER SIDE)

## Where should Biosolids not be applied?

◆ Biosolids or any fertilizer should be kept away from water sources. Lakes, streams or wetlands are called sensitive areas and may become polluted by too much nitrogen from fertilizer. Large amounts of nitrogen in water can cause algae blooms and/or heavy plant growth. When the plants die, as they decompose, they remove oxygen from the water which then reduces the amount of oxygen available for fish.



◆ Trails used frequently by people are another example of a sensitive area where biosolids should not be spread. The smell of biosolids can be strong for the first couple of weeks after applied and a **SMALL** amount of pathogens may still live in biosolids for the first day. Most of the pathogens die within 24 hours of being exposed to sunlight and air. Signs are posted to discourage people from entering applied areas for 30 days.

- ◆ On steep slopes where the water and biosolids could run down to a water source.
- ◆ On soil where the nutrient level is adequate.
- ◆ On trees that are over 10 feet tall.

### Vocabulary:

Pathogen – Germs! Bacteria or virus which cause disease

Nutrients – A substance which nourishes living things allowing growth to happen

Organic Matter – Material that was alive once and is now dead: leaves, plants etc.

Biosolids – Solid organic material recycled from a wastewater treatment plant

Absorb – To soak up

Compost – mixture of decayed organic material

# FOREST EXPLORATION WALK

## TRADITION LAKE TRAIL BIOSOLIDS CHECKLIST

Please stop at the following points of interest along the trail with your group. Carefully observe the forest and then discuss the questions listed for each stop. The question you are to answer today: Is this forest a good place to spread biosolids? Why or why not?

### STOP 1

Are the trees the right size to spread biosolids in? Are they a good size to harvest? What kind are they?

*Interpretive  
Sign*



Between stops, be aware of and note the following (you can stop and answer these questions if you are waiting for another group in front of you to leave a stop):

- ◆ What do you hear?
- ◆ What do you see?
- ◆ What signs can you find that tell you what animals live in this forest?
- ◆ What signs tell you how people use this forest?

### STOP 2

Is it a problem to spread biosolids next to water? Why? Record guidelines for using biosolids next to water.

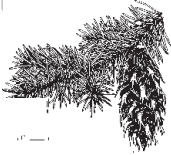
*Bridge*



(SEE OTHER SIDE)

### STOP 3

*Track Box*



What signs of animals do you see? What kind of animals do you think live here? How would they be affected by the spread of biosolids?

### STOP 4

Take two samples at different locations and examine them. Describe the soil in terms of color and texture.

◆ How would biosolids improve the health of the soil?

### STOP 5

*Water Overlook*



How does the public use this land? Does it receive high, medium or low use?

### STOP 6

*Huge Cedar Tree  
with Hollowed  
Trunk*



Are there good enough roads to drive on to spread biosolids?

**Meet the rest of the group in the rest/picnic area located beside the lake. Look for the large cedar trees and benches to identify this spot. If you get to the powerline road you've gone too far!**

# FOREST EXPLORATION WALK

## BUS TRAIL, TIGER MOUNTAIN

### BIOSOLIDS CHECKLIST

Please stop at the following points of interest along the trail with your group. Carefully observe the forest and then discuss the questions listed for each stop. The question you are to answer today: Is this forest a good place to spread biosolids? Why or why not?

**Walking directions:** Turn left at first intersection and walk about ¼ miles until you reach the intersection of the Bus Trail/Tiger 3 Summit Trail. Turn right on the Bus Trail.

#### STOP 1

*Stream*



- ◆ Stand on the bridge and notice the sides of the streambed. What caused it to wash away? What could prevent this?

- ◆ Why is it a problem to spread biosolids next to water?

#### STOP 2

*HUGE upright nurse stump on left side of trail*



- ◆ Are the trees you are looking at the right height to spread biosolids on?

- ◆ Name two trees you are looking at:

#### STOP 3

*Bus skeleton*

- ◆ Look at the forest around the bus. Has it been logged? If so, how long ago?

- ◆ If you were in charge of this forest and decided to log the trees right here, what impact would that have on the ecosystem? Describe the changes you would have to make to this forest.

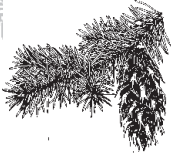
Go straight on the Bus Trail; do not turn right.



#### STOP 4

Walk two minutes and stop in the forest.

- ◆ Remember that you are to decide whether this forest is a good place to spread biosolids.
- ◆ What animals do you think live here:
- ◆ How would the animals be affected by biosolids? Answer:



#### STOP 5

Find a tree alongside the trail that has been cut

- ◆ How old was the tree when it was cut down? Figure this out by counting the growth rings. One light and one dark colored ring equals one year of growth.
- ◆ At what age are trees generally harvested here in the Northwest?

#### STOP 6

*Soil Samples*

- ◆ Take two samples of soil at different locations using the auger. Use the Soil Guide sheet if you need help to answer the following questions.
- ◆ Describe the texture and color of your samples.
- ◆ How would biosolids improve the health of the soil?

#### STOP 7

*Public use*

- ◆ How do people use this land?
- ◆ Does it receive high, medium or low use? Circle your answer.
- ◆ How is this forest different from a park in a city?

**Meet the rest of your group in the meadow. This is where we will have lunch and complete the remaining educational activities. Be on the look out for deer as they browse in this area.**

The background of the worksheet is a detailed black and white illustration of a forest. It features several large trees with thick trunks and dense, needle-covered branches. The trees are arranged to frame the central text area. At the bottom of the page, there are smaller plants and what appears to be a forest floor with fallen leaves or pine needles.

# FOREST TRANSECT WORKSHEET

Names: \_\_\_\_\_ Date: \_\_\_\_\_

## NUTRIENT

Nutrients provide necessary chemicals that plants need to grow. Three essential nutrients for trees are obtained from the air. They are carbon (C), oxygen (O) and hydrogen (H). The remaining 13 mineral nutrients are in the soil and are necessary to help trees grow. First the mineral nutrients dissolve in water that is in the soil. Then the roots absorb the water and the tree receives the mineral nutrients from the water. Three of the most important mineral nutrients are nitrogen (N), phosphorus (P) and potassium (K). If you know the amount of nutrients in the soil you can figure out if trees are getting enough nutrients.

By adding fertilizer to the soil, the amount of mineral nutrients are increased. Farmers and scientists calculate how much fertilizer to add depending on which plants or trees will be grown. Biosolids (treated and recycled solids from the wastewater treatment plant) is one type of fertilizer used in the Pacific Northwest to add nutrients to the soil. Biosolids also improves the texture of the soil. Nitrogen is also added to the soil by decomposing plants and animals. Nitrogen is quickly absorbed by trees and plants, washed away by water flowing through the soil or released as a gas. These factors may affect your results when you measure the level of Nitrogen in the soil or in biosolids.

- What is a nutrient?
  
  
  
  
  
  
  
  
  
  
- How do trees absorb nutrients?

(TURN OVER)

- 
- What are biosolids?

- What were the results of your Nitrogen testing on the forest soil sample?

High                      Medium                      Low                      None

- What were the results of your Nitrogen testing on the garden/biosolids soil sample?

High                      Medium                      Low                      None

- What was the pH of your soil sample?

- Do you think it is a good idea to spread biosolids in this forest? Why or why not?

When you are done with the Nitrogen testing and have answered these questions report back to your group. Help fill out the Final Transect Sheet. Be prepared to explain what Nitrogen is and how it gets into the soil.

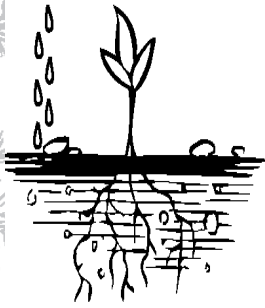
# FOREST TRANSECT WORKSHEET

Names: \_\_\_\_\_ Date: \_\_\_\_\_

## SOIL

TASK/QUESTION	ANSWER
<ul style="list-style-type: none"><li>◆ Take two soil samples along your transect. Take one from the surface soil and one from as deep as you can. To get a good sample make sure you do NOT take it from the trail or a rotting log. Refer to the soil guide sheet for more information on soil.</li> <li>◆ Is the upper sample (#1) light or dark? Why?</li> <li>◆ Is the lower sample (#2) light or dark? Why?</li> <li>◆ Feel the samples. Are they wet or dry? What would cause this?</li></ul> <p><i>Look at the information on the soil guide sheet before answering the next questions.</i></p> <ul style="list-style-type: none"><li>◆ Pinch the soil between your thumb and forefinger and rub it around. Does it stick together when you press it? (Clay) Does it feel gritty? (Sand) Is it smooth? (Silt)</li> <li>◆ Is there any organic material in the soil? How can you tell? What is organic material?</li> <li>◆ Do you think your soil is mostly clay, silt or sand? Or is it a combination with organic material added? (Loam)</li></ul>	

# SOIL GUIDE



Knowing how much sand, silt, clay and organic material are in the soil helps determine how water moves through the soil. When water is held in the soil, rather than rushing straight through, it allows time for roots of trees to absorb the water. This is good, because then trees get water AND they get the nutrients that have been dissolved in the water.



## SOIL TEXTURES

**Clay** – smallest size particles that feel slippery and cannot be seen with unaided eye. There is very little space between the particles. Clay allows water and air to enter and exit very slowly. It holds the most nutrients and can make slippery mud.

**Silt** – medium size particles that feel like flour when dry or a little bit gritty. Silt allows water to pass through slowly and is one texture that makes mud. This texture makes good farm land, but erodes easily.

**Sand** – largest size particles that feel gritty and can be seen by the unaided eye. There are large air spaces between particles so sand doesn't hold water or nutrients. Plant and tree roots can't hold onto this soil texture, but some plants send roots deep through the sandy topsoil to the subsoil.

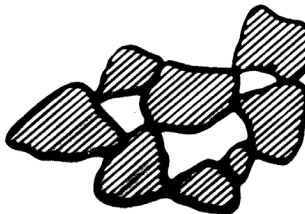
**Loam** – healthy combination of sand, silt, with a little bit of clay and organic material. This texture has enough large and small air spaces between the particles for air and water to flow in. Plant roots can easily grow through these spaces. Loam is the best for growing plants/trees as it holds water just long enough for trees to absorb nutrients.

### Clay

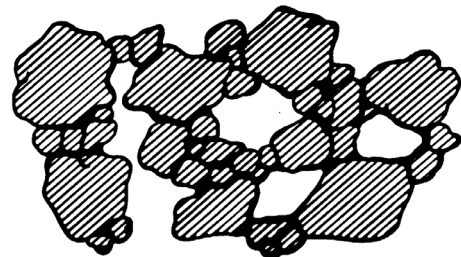
Clay particles –  
12,000 particles  
in a line = 1 inch



### Silt



### Sand



### Loam

Which soil holds water the best? Worst? What could you add to the soil to improve the texture and increase the fertility?

# FOREST TRANSECT WORKSHEET

Names: \_\_\_\_\_ Date: \_\_\_\_\_

## PLANTS

TASK/QUESTION	ANSWER
<p><u>PLANTS: FOREST FLOOR</u></p> <ul style="list-style-type: none"><li>◆ Look on the forest floor and identify at least 3 different plant species along your transect line. Draw one on the back of this sheet.</li></ul>	
<p><u>PLANTS: UNDERSTORY</u></p> <ul style="list-style-type: none"><li>◆ Look at the plants and bushes growing in the area called the understory. It is between the forest floor and the tops of the trees. Identify at least 3. Identify both natives and invasives. Draw one on the back of this sheet.</li></ul>	
<p><u>PLANTS: CANOPY (TALLEST TREES)</u></p> <ul style="list-style-type: none"><li>◆ Identify the dominant (most common) tree species around your transect. Draw one on the back of this sheet.</li> <li>◆ Are the trees around your transect primarily evergreen (keep their leaves all year) or deciduous (lose their leaves in the fall) trees or a mix of both?</li></ul>	

# FOREST TRANSECT WORKSHEET

Names: \_\_\_\_\_ Date: \_\_\_\_\_

## WILDLIFE

- ◆ Explore along your transect line and look at the surrounding area for evidence of animals (birds, insects, reptiles, mammals). Record what evidence you find of any animals living in the area. List animals you think might live here – make sure that the habitat and diet needs for these animals listed on the wildlife ID cards are met by this forest! Write your list here:
  
- ◆ Compare your list of animals to the Animal ID Cards found in the backpack. Fill in the chart below.

<b>List 3 animals you are curious about from the Animal ID Cards.</b>	<b>Read the information on the cards of the animals that interest you. Look at the habitat and determine if this animal would survive here. Why or why not?</b>
1.	
2.	
3.	





6) If you did spread biosolids here, what would be the:

ADVANTAGES	DISADVANTAGES