Logan: Environmental Planner
Career Pathway Lesson

Balancing Your Pollution Budget

Storm Water Career: Planner

All Careers Full- Course Lesson Plan #:
4 of 15

Next Lesson Plan Title (Full-Course):
Flowing with Curves & Drainage Design

Select Career Short-Course Lesson Plan #:
4 of 6

Next Lesson Plan Title (Short-Course):
Scope Quest: Unravelling Project Possibilities

SUMMARY

In this lesson, students explore balancing a pollution budget, drawing parallels between financial management and water quality management. They will learn about tracking pollutant deposits and charges to manage healthy water ecosystems.

FOCUS & GOALS

In learning the principles of balancing a pollution budget, students will:

- Understand budgets and tracking inputs and outputs
- Describe the role of TMDLs in regulating water quality
- Assess the impacts of actions on local water quality

MATERIALS NEEDED

- Paper cups
- Land Owner Scorecards & BMP Cards
- PBL Track: Computer with internet connection to access PLET online tool (link below) and PLET Student Guide (online)

LEARNING OBJECTIVES

- Demonstrate ability to create and maintain a pollution budget
- Analyze pollutant debits and credits
- Develop strategies to balance a pollution budget
- Evaluate impact of pollution on ecosystems

VOCABULARY

Model/Modeling - The creation and use of representations or simulations of natural systems to understand their behavior, predict outcomes, and inform decision-making.

Nitrogen - Nitrogen is naturally taken up by plants and algae as nitrates and used to build up the bases needed to construct DNA, RNA, and all amino acids, components essential for growth.

Phosphorus - Phosphorus, often in commercial fertilizers, is a vital for all living organisms, including plants and animals. It is often a limited in natural systems, causing rapid plant growth when introduced.

Sediment - Matter that settles to the bottom of a liquid in large quantities, particularly from erosion. It clouds waters, impairs fish and aquatic vegetation, and reduces water depth.

Total Maximum Daily Load - A plan for restoring impaired waters that identifies the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards

Background

In the realm of environmental management, the concept of balancing a pollution budget is vital. Much like personal finance, where one tracks income and expenses to avoid overdrafts or debt, managing water quality requires accounting of pollutant deposits and charges. This lesson explores the metaphorical relationship between financial budgeting and water quality management by examining Total Maximum Daily Loads (TMDLs) and associated Waste Load Allocations (WLAs) as tools for maintaining ecological balance.

As with personal finances, proper tracking helps prevent shortfalls and potentially severe consequences like bankruptcy. In the case of pollution, consequences include degraded water quality, loss of aquatic life, and an overall decline in community health and vitality. Just as accumulating debt can lead to a poor credit rating, failing to manage pollutant loads can result in a diminished ecological quality.

To effectively manage this delicate balance, tracking of both pollutant sources and their impacts is necessary. TMDLs serve as a regulatory framework that establishes the maximum acceptable levels of specific pollutants in bodies of water. They function akin to a budget sheet, where each pollutant source (land owner) is itemized, limits are set (WLAs), and responsibilities are assigned (permits or other regulations).

Once responsibilities are assigned as WLAs or "starting debits" to land owners or managers, different Best Management Practices (BMPs) are considered to reduce pollutant loads or reach "credit targets". BMPs like installing porous pavement or rain gardens have real financial costs that managers must also balance given their own fiscal capacities. Therefore careful consideration is given to the specific capabilities of BMPs to reduce targeted pollutants like sediment and nutrients such as nitrogen and phosphorous, all of which are key components that must be balanced in a healthy ecosystem..

One of the innovative tools employed in this budgeting process is the Pollutant Load Estimation Tool (PLET), which provides a user-friendly interface for managing watershed models. PLET allows users to estimate nutrient loads and sediment delivery based on specific land management practices, effectively acting as a financial calculator for water quality. By quantifying pollutant loads at various scales, stakeholders can make informed decisions about resource allocation and necessary interventions. Moreover, PLET's integrated BMP calculator enables users to assess the effectiveness of multiple strategies for reducing pollutants.

A balanced pollution budget is vital to effective water quality management. Just as individuals track their financial accounts to avoid adverse consequences, communities monitor their pollutant loads to protect the health of their water resources. Tools like TMDLs and PLET provide frameworks for achieving this balance, allowing for responsible decision-making that supports both environmental integrity and community growth. As we continue to face the challenges of pollution and resource management, the lessons learned from financial budgeting can serve as a guiding principle for sustaining our vital water ecosystems.

I. Pollutant Budgeting Activity

1. Ask students how bank accounts function (deposits, withdrawals, overdrafts). Share the *TMDL vs. Personal Budget* infographic to show how watersheds track pollutant load accounts (*Waste Load Allocations / WLAs*).
2. Explain that watersheds can also be viewed as having accounts, specifically pollutant load accounts or "Total Maximum Daily Load" accounts with "Waste Load Allocations" distributed to members, much like an allowance. Instead of dollars and cents, deposits and charges in the allowance accounts (WLA) are quantified using metrics like parts per million or milligrams per liter.
3. Inform students that they will be examining a WLA "allowance account" for the Waikele Stream watershed in Oahu. Their task will involve calculating nutrient and sediment charges to the watershed's WLA account.
4. Divide students into small groups and assign each a Landowner Card (e.g., *Mock Site, State Highways, Public Land Trust, Agriculture Specialists*).
5. Using the information on their card, groups determine their baseline pollution output, or Starting Debits, which is based on acreage and type of land use.
6. Instruct groups to place their initial pollutant output beads, their Starting Debits, into their designated Debit Cup to represent their starting TMDL load.
7. Ask groups to use what they learned in the previous lesson (*Storm Water in the Community*) to identify the land use type relevant to their site and share some potential polluted runoff expected.
8. Conclude by informing them that in the next activity, they will explore how they can reduce pollutant loads from their lands.

II. Managing Accounts to Balance a Budget Activity

1. Explain that land managers reduce pollutant loads by purchasing Best Management Practices (BMPs). Distribute each group's starting budget of BMP Bucks and a set of *BMP Cards*.
2. Based on information on the *Land Owner Scorecard* provide each group with a physical budget of play money, *BMP Bucks*, and a set of *BMP Cards*.
3. Direct groups to review the *BMP Cards*. Point out that each unique BMP costs a specific amount of BMP Bucks and removes a set number of Total Suspended Solids (TSS)/Nitrogen (N) beads. *(Note: Limit groups to 1 purchase per BMP type).*
4. Using their scorecards, groups consider a combination of unique BMPs to meet their credit requirements.
5. Designate an area for a "BMP Marketplace" station in the classroom with an assigned "cashier". Student groups visit the BMP Marketplace station, pay the cashier in BMP Bucks, and get their budget sheet initialed as proof of purchase of their BMPs.
6. Groups then return to their stations and physically move the corresponding number of TSS/Nitrogen beads from their Debit Cup into their Credit Cup for each BMP purchased.
7. The activity is complete when enough debit beads are moved to meet their site's Credit Target.
8. Have each group share how they balanced their pollution budget. Discuss the different approaches as it relates to the different land use types and thoughts on ongoing management of the different lands.
9. Conclude by combining the remaining beads from all groups' Debit Cups into a single container representing the receiving body of water (Pearl Harbor / Waikele Watershed). Lead a class discussion on how collective land management decisions impact overall watershed health.

Adaptations and Resources

Project Based Learning Track:

- Compare storm water modeling tools to financial budgeting software like QuickBooks or TurboTax.
- Discuss how GIS provides key inputs (land use, runoff percentage, rainfall) for the Waikele Stream watershed.
- Use the PLET Student Guide for directions on accessing the tool and creating a custom watershed of their project site and explore reductions from BMPs in order to help choose one to implement for their project. **DOWNLOAD GUIDE:** https://gqr.sh
- Student work on completing the Investigate & Model section of their workbook (https://gqr.sh/B75H).
- **NOTE:** The Pollutant Load Estimation Tool (PLET) model may be accessed at the PLET web site (https://epa.gov/nps/plet).

Activity-Centric Learning Track:

Conduct Activity I and II.

Tips to Truncate Lesson:

- Limit marketplace purchases by restricting choices to a streamlined set of 3-4 core BMPs.
- Replace individual group sharing with a quick hand-raising poll to check which groups met their TMDL Credit Targets. Wrap up with a brief teacher-led summary.

Tips to Extend Lesson:

- Have students consider the mock or real high school campus and evaluate the load reduction, invoice or charges discount or credit, achieved through various BMPs.
- Have students research other available storm water models and share their findings.

Resources:

- U.S. Environmental Protection Agency (EPA), *User's Guide Pollutant Load Estimation Tool (PLET) Version 1.0*, https://www.epa.gov/system/files/documents/2022-04/user-guide-final-04-18-22_508.pdf
- American Planning Association, *School Site Selection*, https://www.planning.org/pas/reports/report175.htm
- California Department of Education, *Guide to School Site Analysis and Development*, https://www.cde.ca.gov/ls/fa/guideschoolsite.asp
- Graphing Parking, *Parking for High Schools*, https://usa.streetsblog.org/2013/05/22/americas-absurdis-parking-policies-visualized
- U.S. Department of Agriculture Agricultural Research Service, *Revised Universal Soil Loss Equation (RUSLE) - Welcome to RUSLE 1 and RUSLE 2*, https://www.ars.usda.gov/southeast-area/oxford-ms/national-sedimentation-laboratory/watershed-physical-processes-research/docs/revised-universal-soil-loss-equation-rusle-welcome-to-rusle-1-and-rusle-2/