PROTECT
OUR WATER
— MĀLAMA I KA WAI —
HAWAI'I DEPARTMENT OF TRANSPORTATION

HAWAIʻI STORM PATROL
PROJECT WORKBOOK

Young Professionals Program
Project-Based Learning

STORM PATROL PROJECT WORKBOOK

Outline

Section 1: Induction & Community Connection

Part 1: Community Connection

Task: Identify a specific storm water issue (flooding, erosion, or pollution) affecting your team's chosen community.

Describe the issue:
What is happening? Why do you think it's a problem?

Where does it occur?
Include locations, landmarks, or known hotspots.

Visual Evidence:
Attach a sketch, photo, or drawing. Use your devices to capture images if possible.

🔗 **Suggested Resources:**

- EPA Storm Water Basics - https://www.epa.gov/npdes/npdes-stormwater-program
- Storm Water Hawai'i - https://www.stormwaterhawaii.com/

Part 2: Causes & Context

Task: Investigate three potential causes and explore how other regions solve similar challenges.

List at least 3 potential causes:

1.

2.

3.

🔗 **Suggested Resources:**

- Water Education Foundation - https://www.watereducation.org/topic-stormwater
- Nat Geo: Urban Storm Water - https://education.nationalgeographic.org/search/resources/?q=Urban%20storm%20water&page[number]=1&page[size]=2

Part 3: Existing Solutions

Task: Investigate proposed or implemented solutions.

List 2–3 existing solutions from your area or other communities:

1. _____

2. _____

3. _____

🔗 **Suggested Resources:**

- Green Infrastructure Toolkit - https://www.epa.gov/green-infrastructure
- TNC Urban Water Projects - https://www.nature.org/en-us/search/?q=urban%20water%20projects

Part 4: Meet the Experts

Task: Choose a Storm Patrol professional (Planner, Scientist, Engineer, or Architect) and explore their expertise in addressing the specific site issues.

Chosen professional: _____

Roles	Responsibilities	Skills

🔗 **Suggested Resources:**

- Environmental Careers Guide (BLS) - https://www.bls.gov/ooh/life-physical-and-social-science/environmental-scientists-and-specialists.htm
- Types of Engineering (TeachEngineering) - https://www.teachengineering.org/k12engineering/types-of-engineering

Section 2: Map & Observe

Part 1. Project Site SWPP Assessment

Task: Conduct a site assessment of your Project Site using the SWPPP Site Assessment worksheet.

What observations did you make during the site walkthrough?
(Any signs of flooding, erosion, pollution, or poor drainage?)

Task: Create a custom Project Site SWPPP Map using the gridded Project Site Assessment: Making a SWPPP Map and Project Site SWPPP Map Checklist worksheet.

- Observations: Note exactly where water travels, where it permeates, and locations of potential pollutants (trash bins, oily runoff, etc.) on your specific site.
- Deliverable: A finalized site map showing flow paths, discharge points, and existing infrastructure

Based on your map, are there issues on your project site similar to those identified in Section 1, Part 1 ?

☐ Yes ☐ No ☐ Not Sure

Explain: _____

Part 2. Issue Selection & Team Discussion

Task: As a team, decide on one issue to tackle in your project.
What issue did you select, and why?

Section 3: Investigate & Model

Part 1. Find Your Watershed

Task: Using the Oʻahu Watersheds Map, (https://gqr.sh/LgG7) identify your project's location.

- Watershed Name: _____
- Describe any visible features of your watershed:

_____

_____

Part 2. Discuss Site-Level Runoff Concerns

Task: Think about the storm water runoff and pollution issues on your site:

- What issues are present on your site?
  (Erosion, litter, oils, blocked drainage, etc.)

_____

- How might these issues affect your broader watershed?

_____

Part 3. Land Use Analysis with ArcGIS Online

Task: Use the ArcGIS Online Oʻahu Watersheds Map, following the *Exploring Runoff* activity worksheet from Storm Water in the Community lesson (#3) .

- What land uses dominate your watershed?
  (Residential, commercial, forest, agriculture, etc.)

_____

- Use the runoff calculator to estimate:
  - Storm water volume: _____ cubic feet
  - Runoff volume: _____ cubic feet

Part 4. Design Strategic Land Use Changes

Task: Given your findings, brainstorm improvements.

- What land cover or land use changes could help reduce runoff?

_____

- Which areas of your site could be modified?

_____

Part 5. Explore BMPs for Your Site

Task: Use the PLET Student Guide (https://gqr.sh/HDWw) to:

- Create a **custom watershed** for your site
- Explore **BMPs (Best Management Practices)** to reduce runoff

Which BMPs could work best at your site?
(Examples: rain gardens, permeable pavement, vegetated swales)

_____

- What is one BMP your team will propose to implement? Why?

_____

Part 6. Reflection & Next Steps

- What was the most surprising thing you learned about your watershed?

_____

- What is your team's next step in this project?

_____

Section 4: Analyze & Engineer

Part 1. Site Reflection & Map Analysis

Task: Reflect on your site walkthrough and mapping activity.

- What drainage, erosion, or trash issues did you observe?

  _____

- Does your site contribute to stormwater problems in the area (select with x)?

  ☐ Yes ☐ No ☐ Not Sure

  Explain your selection: _____

- Use your original site map or update it with new observations.

🔗 ***Helpful Tool:*** Try Google My Maps or print and annotate satellite imagery from Google Earth for enhanced mapping. (https://earth.google.com)

Part 2. Issue Selection & Team Discussion

Task: Choose one issue to tackle as a team.

- Selected issue to address:

  _____

- Why is this issue important to solve at your site?

  _____

Part 3. Role-Based Research Exploration

Task: Use your patrol role to explore how professionals solve this issue.

- How do experts in your role approach drainage or erosion problems?
  (What tools, processes, or strategies are used?)

  _____

🔗 **Suggested Resources:**

- Science Buddies Engineering Design Guide - https://www.sciencebuddies.org/science-engineering-careers/engineering
- NOAA Weather & Water Resources - https://www.noaa.gov/education

Part 4. Sketch & Refine Your Prototype

Task: Create a sketch of your proposed storm water solution device.

- Use pencil, markers, or a digital drawing app.
- Include dimensions, key parts, and how it will work.

📌 Reminder: Choose one method below to prototype your idea.

Part 5. Build Your Prototype

Task: Choose one of the two formats to develop your prototype.

Format	Description	Suggested Tools
Physical	Use recyclables, classroom materials, or common household items to build a model.	Scissors, tape, bottles, cardboard, water basin, modeling clay, building blocks
💻 Digital	Use design software to visualize your idea.	Tinkercad, PowerPoint, SketchUp https://www.tinkercad.com https://www.microsoft.com/en-us/microsoft-365/powerpoint https://www.sketchup.com

Refined Sketch Completed?
☐ Yes ☐ In Progress ☐ Need Help

Part 6. Prototype Testing & Redesign

Only for physical prototypes:

- Test your device's ability to capture the target pollutant using simulated items in water.
    - Trash: Use small bits of paper, foam, or plastic in a water bin.
    - Erosion: Use layers of sand, gravel, and/or soil shaped in relevantly sloped mounds to mimic their site's conditions.
    - Drainage: Use spray bottles or watering cans to simulate rain events.
    - Chemicals/Nutrients: Use food coloring or ground spices to mimic dissolved or suspended particles to be contained and/or filtered.

Testing Results

Adjustments Made (if needed):

Record performance after each test. Consider using a table or graph!

Part 7. Maintenance Plan Creation

Every solution needs upkeep!

- Who will maintain it? _____
- How often? _____
- Tools or supplies needed? _____
- Safety measures to consider (i.e. lane closures) _____

Part 8. Final Design Showcase Prep

Your prototype will be part of your final presentation!

- Consider displaying your sketch, test results, and maintenance plan.
- Be ready to explain how your solution reduces runoff or erosion.

📣 *Presentation Tip:* Include visuals like time-lapse photos, build process stages, or simulation GIFs if using digital design.

Section 5: Measure & Monitor

Part 1. Reflection: Your Watershed & Site Impact

Task: Revisit the watershed you identified in Lesson 3.

- Watershed Name: _____
- Location of your site within this watershed:

  _____
- Storm water runoff or pollution concerns observed at your site:
  (Litter, oil residue, sediment buildup, etc.)

  _____
- How might these concerns impact the larger watershed?

  _____

Part 2. Compare to Watershed Data

Task: Research your watershed's current impairments and water quality issues.

- Documented impairments in your watershed:

  _____
- Does your site contribute to any of these issues? How?

  _____

🔗 **Suggested Resources:**
- Hawai'i Department of Health Clean Water Branch - https://health.hawaii.gov/cwb/
- EPA Water Quality Reports - https://www.epa.gov/waterdata

Part 3. Create a Sampling Study Design

Task: Your team will now design a study to better understand storm water pollution at your site.

Goals of the Study
What does your team want to learn or prove?

_____

What Will Be Monitored?
Examples: water clarity, trash quantity, chemical levels, temperature, sediment flow

_____

Where Will Monitoring Occur?

Identify specific locations on or near your site. Mark these on your Project Site SWPPP Map.

When & How Often Will Monitoring Occur?

Examples: before/after rain events, once a week for 4 weeks

Sampling Procedures & Equipment

How will you take measurements? What tools are needed to ensure accurate results?

🔗 **Suggested Tools:**

- Water sampling kits
- Turbidity tubes
- PH test strips
- GPS or mapping software

Part 4. Study Summary & Planning

Task: Summarize your full sampling plan below, including any precautions to ensure safety, reliability, and fairness of results.

Use this table to assign team members to carry out each part of the plan:

STORM WATER MONITORING TASK	**FREQUENCY**	**ASSIGNED TO**
Example: Prepare for sampling (have materials ready & monitor weather)	*Ongoing*	*Environmental Scientist*

Part 5. Calculating Storm Water Flow Rates

Task: Use field measurements or provided data to calculate storm water flow at your site.

Record the following:

- Flow Channel width (ft or m):
- Average water depth during flow (ft or m):
- Flow Channel shape (rectangular, trapezoidal, natural/irregular):

Measure or Estimate Water Velocity

Choose one:

- Float method (time a floating object travels a known distance)
- Velocity probe (if available)
- Simulation data

Velocity (ft/s or m/s):

Calculate Flow Rate. Use the formula: Flow (Q) = Velocity × Cross-Sectional Area

Your calculation:

- Cross-sectional area:
- Flow rate (Q):
- What does this flow rate tell you about storm water movement at your site?

Evaluate Channel Performance. Does the channel appear to:

- Handle expected storm flows?
- Overflow or back up during heavy rain?
- Move water too quickly, causing erosion?

Explain your reasoning using your flow calculations.

Part 6. Water Quality Indicators: Testing & Simulation

Task: Investigate the quality of storm water using biological, chemical, and physical indicators.

Indicators to Test or Simulate

Record your results or simulated values for each:

Indicator	Why It Matters	Your Result	Interpretation
Turbidity	Measures clarity; high turbidity = more sediment		
pH	Indicates acidity; affects aquatic life		

Temperature	Influences oxygen levels & species survival		
Dissolved Oxygen (DO)	Needed for aquatic organisms		
Nutrients (N, P)	High levels can cause algal blooms		
Biological Indicators	Presence/absence of macroinvertebrates		

Conduct Tests

Use:

- Turbidity tubes
- pH strips
- Temperature probes
- DO kits (if available)
- Teacher-provided simulated data for nutrients or biological indicators

Analyze Results

Answer:

- Which indicators suggest good water quality?
- Which indicators suggest pollution or runoff impacts?
- How might rainfall events change these values?

Apply Findings to Monitoring Design

Based on your results:

- Should sampling frequency increase after storms?
- Do certain locations need more attention?
- Which indicators should be prioritized in future monitoring?

Section 6: Design & Innovate

Part 1. Evaluate Site Characteristics

Task: Analyze your project site's physical characteristics to determine the best landscaping and engineering approach for your GSI (Green Storm Water Infrastructure).

- Topography/Slope: *(Is the area flat, gently sloped, or steep? Where does water naturally pool?)*
- Soil Type & Infiltration: *(What is the ground like? Does water soak in quickly, or does it sit on the surface?)*
- Space & Sun Exposure: *(How much room do you have to build? Is the area shaded or in direct sunlight?)*

Part 2. Select Your GSI & Filtration Media

Task: Based on your site evaluation and the pollutants you identified earlier, select the most appropriate GSI and filtration media (e.g., sand, soil, compost, gravel) to maximize biofiltration.

- Chosen GSI Type: *(e.g., Rain Garden, Bioswale, Permeable Pavement, Planter Box)*
- Selected Filtration Media: *(What layers of materials will you use to capture and filter pollutants?)*

Part 3. Draft Your Landscape Design Plan

Task: Create a preliminary landscaping design plan that transforms your site into a functional, storm water-friendly outdoor space.

- Sketch Your Layout: Draw a top-down view of your proposed GSI.
- Map the Flow: Use arrows to show the direction storm water will flow *into* your infrastructure, how it will move through the media, and where any overflow will safely exit.
- Material List: List the plants, media, and construction materials needed to bring your design to life.

Part 4. Introduction to the GSI Impact Calculator

Task: Explore how GSI designs (like rain gardens, green roofs, permeable pavement) reduce storm water pollution and benefit communities.

🔗 Launch the tool here: GSI Impact Calculator (https://gsiimpacthub.org/calculator/)

What is one thing you hope to learn from using the calculator?

Part 5. Practice Using the Tool

Task: Work through the **Determining GSI Design Impacts** worksheet from the Backyard Investigation lesson (#10) as practice.

- Use the online calculator here: GSI Impact Calculator (https://gsiimpacthub.org/calculator/)
- Utilize the mock site result for guidance: Mock Site GSI Design Results (https://gqr.sh/y9fA)

What benefits were calculated for the mock site design?
(Examples: volume reduced, pollutants removed, cost savings, social value)

Part 6. Enter Your Project Design Data

Task: Input your site's GSI features into the calculator using your real design:

- Which features are you including?
  (e.g., rain garden, permeable pavement, bioswale)

- Data entered into the calculator:
  (square footage, location, design type, etc.)

Part 7. Review Your Calculated Impact

Task: List key results provided by the calculator:

Impact Category	Your Project Results
Storm water Volume Reduced	

Pollutants Removed	
Annual Cost Savings	
Social Benefits Score	

Part 8. Prepare Your Capstone Presentation (Phase 1 & 2)

Task: You'll present your final design and its benefits to the class.

- Review the Design Presentation Assignment
  Use the Presentation Template to guide your structure
- Complete Phase 1 & Phase 2 by next class.
  (Ask your teacher for printed copies or digital access.)

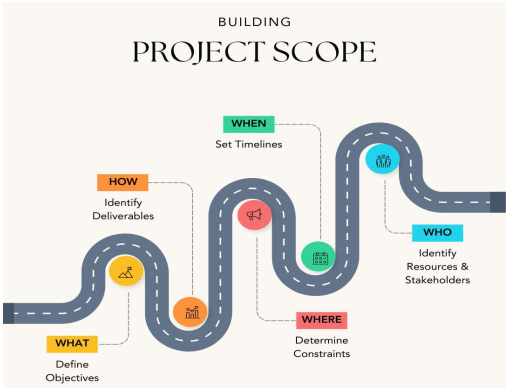
How will the GSI Impact Calculator results strengthen your presentation?

What will your team highlight in your final presentation?

Part 9. Next Steps

- Finalize your visuals (sketches, prototypes, maps)
- Use the summary of benefits from the calculator
- Rehearse explaining your project's impact to others

Section 7: Plan & Prepare



Part 1: Define Project Objectives

An objective is the aim or purpose of a project.

Task: Using the SMART criteria (Specific, Measurable, Achievable, Relevant, Time-bound), define the objectives for your storm water quality project.

	Specific	Measurable	Achievable	Relevant	Time-bound
Directions	Write a specific objective for your project.	What metrics will you use to measure success?	What resources (people, budget, technology) will be needed to achieve this objective?	How does this project align with broader environmental goals or community needs?	Establish a timeline for the project completion.
Example	*Survey 50 stakeholders on trash strategies*	*Achieve 75% response rate & identify three strategies*	*Host a focus group with 5-10 stakeholders*	*Present final report and recommendations to administration*	*Complete feedback collection and reporting within four weeks*

Example Project Objective:
By the end of the school year, we will survey 50 stakeholders on trash strategies, aiming for a 75% response rate to identify three effective strategies; we'll host a focus group with 5-10 stakeholders in two weeks and present the final report and recommendations to administration within four weeks.

	Specific	Measurable	Achievable	Relevant	Time-bound
For Your Project					

Project Objective:

Part 2: Identify Deliverables

A deliverable are the things to be provided within the scope of a project.

Task: List the specific deliverables you expect from this project.

- _____
- _____
- _____

Part 3: Determine Constraints

Constraints are limitations or restrictions. These shape the boundaries of a project's scope.

Task: Identify the constraints that may impact your project. Consider aspects such as budget, time, and legal restrictions such as normal working hours, right of entry, or liability and insurance limitations.

Budget Constraints	Time Constraints	Legal/Administrative Constraints

Part 4: Set Timelines

Timelines often include milestones, key target deadlines or stages of development.

Task: Outline a timeline for the key tasks in your project. Use the table below:

Task	Description	Start Date	End Date

Part 5: Identify Resources & Stakeholders

A resource is the thing to acquire or utilize within a project.

Task: List all resources required for the project.

Personnel	Equipment	Materials

A stakeholder is a person with an interest or concern in the project.

Task: Identify key stakeholders in your project. Describe their potential influence and involvement.

Stakeholder Name	Influence

Part 6: Communication

Task: Determine communication channels (e.g. email, meetings) and frequency for personnel and stakeholders.

Channel	Frequency	Participants	Topics
Example: Stand-up meetings	*Daily*	*Project Team*	*Task Updates*

Part 7: Review and Get Stakeholder Approval

Task: Draft a brief statement about how you will present this project scope document to your stakeholders.

Reflection Questions

1. What challenges do you foresee in defining the project scope for storm water quality?

2. How does documentation play a role in project management?

3. Why is stakeholder involvement crucial in project scope definition?

Section 8: Build & Execute (Final Project Proposal)

Your team will summarize and present the complete project design, including research, analysis, design work, and impact estimates.

Task: Use this checklist to help guide your presentation:

Section	Guiding Questions	Tips & Resources
🔍 LP 1–2: Issue Summary	What drainage/erosion issues did your team choose? Why?	Include photos or annotated maps from your site walkthrough.
🗺️ LP 3: Land Use Baseline	What land covers dominate your site/watershed?	Use maps from ArcGIS or overlays from Google Earth.
📉 LP 4: PLET Results	What runoff volumes and pollution estimates did you calculate?	Screenshot charts or create bar graphs using Excel or Canva.
📐 LP 5–6: Prototype Designs	What physical/digital prototypes did your team create?	Include test results, sketches, or 3D render screenshots.
🎨 LP 9-10: Studio Design Assignment	How do your prototypes fit into a unified site design?	Use your design diagram or landscape layout here.
💰 LP 11–13: Cost & Timeline	What is the estimated budget and schedule?	Present data using a table or timeline graphic.
📊 GSI Impact & Costs	What benefits were calculated using the GSI Impact Calculator? https://gsiimpacthub.org/calculator/	Include volume reduction, cost savings, and social score results. Reference Mock Site Results if needed. https://gqr.sh/y9fA
📈 LP 7–8: Effectiveness Monitoring	How will your project be monitored and maintained?	Identify metrics, timelines, and stakeholder responsibilities.

Capstone Presentation Tips

- **Use visuals** to enhance key points: maps, charts, diagrams, prototype photos.
- **Practice storytelling:** Focus on your site's challenges and how your design solves them.
- **Assign roles:** Each teammate should present one or more sections.
- **Stay organized:** Follow the sequence above or modify with teacher approval.
- **Use the template & criteria sheet** for formatting and guidance.