

The Council Packet: Protect the Ecosystem or Pay to Replace It?

Investigation question: For three ecosystem services a fictional California town depends on, which mix of protecting, restoring or replacing best keeps the services and the biodiversity behind them, within a 30-year budget and with fair treatment of the people affected?

Data-driven decision

Groups of 4

2 sessions

Setup 5 · Activity 80 · Cleanup 2 min

MS-LS2-5 · assesses

MS-ETS1-2 · assesses

MS-ETS1-1 · practice

MS-ESS3-3 · supports

Name _____

Group _____

Date _____

Your role today

- ☐ **Water engineer:** Leads Decision 1: computes the costs for 1A and 1B, explains how the forest cleans the water, and reads the water district engineer's and housing advocate's statements.
- ☐ **Coastal scientist:** Leads Decision 2: computes the costs and cost per home for 2A, 2B and 2C, and reads the homeowner's and biologist's statements.
- ☐ **Farm advisor:** Leads Decision 3: computes the costs for 3A and 3B, tracks who pays and who gains, and reads the farmer's and company's statements.
- ☐ **Budget chair:** Checks every calculation, lists the packages that fit the budget, runs the decision matrix, keeps time and presents at the hearing.

Safety

- Paper and calculators only; no physical hazards.
- Marisol Bay, its people and its numbers are fictional. If students connect the lab to a real local decision, keep the discussion respectful of people who disagree and check facts before stating them.

Procedure

1. Session 1. Read the packet introduction, the option sheet and the stakeholder statements aloud; each role reads the statements for its decision.
2. Calculate the 30-year total for every option in the cost table (q1). Each role computes its own decision, and the Budget chair checks all seven.
3. Answer q2 (cost per home protected) and q3 (the replacement cost of the forest's water-cleaning service).
4. List the packages of one option per decision that fit the town's \$80 million budget (q4).
5. As a group, choose a weight from 1 to 3 for each of the four criteria and write the weights in the matrix headings before scoring anything. Then score every option from 1 to 3 on each criterion and compute the weighted totals.

6. Decide one option for each decision; you may propose a hybrid if you give its cost and show it fits the budget. Write the group's recommendation in the claim-evidence-reasoning box.
7. Session 2. Council hearing: each group presents its package, its strongest piece of evidence and one stakeholder concern it answers, in two minutes. The class records every group's choices on the board and votes on each decision with sticky notes.
8. Answer q5-q10 individually, in class or for homework.

Record your observations

Lab 3 council packet: Marisol Bay decides

Marisol Bay is a **fictional** coastal California town of 38,000 people, and every number in this packet is a **teaching dataset**; real costs depend on place and year. The town gets three ecosystem services without paying for them. A forest of 2,500 acres above Alder Creek reservoir keeps the drinking water clear, so the town only disinfects it. Dunes and a salt marsh at Shell Point shield 350 homes in the Lowlands neighborhood from storm waves, but a parking lot and foot traffic have damaged them. An oak woodland of 1,200 acres in Arroyo Valley houses wild bees that help pollinate 4,000 acres of almond and apple orchards. Three proposals now threaten or depend on these ecosystems, and the council must choose a 30-year plan.

Option sheet (costs in millions of dollars)

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

Option	What the town would do	Up-front cost (\$ million)	Yearly cost (\$ million)	Who pays	Other information
1A	Approve 600 homes in the upper watershed and build a filtration plant	60	2.5	Town water customers	Very reliable once built (about 3 years); uses electricity and treatment chemicals; homes built where the developer prefers
1B	Buy conservation easements on 2,500 acres of forest; steer the 600 homes to an infill site downtown	18	0.6	Town water customers	Yearly cost covers wildfire-fuel work, trail upkeep and water testing; forest stays as habitat; a severe wildfire could still muddy the water for a few years; downtown neighbors worry about traffic
2A	Build a 1.5 km concrete seawall at Shell Point	28	0.4	Town	Full protection once finished (about 2 years); the beach in front is expected to narrow; little habitat
2B	Remove the beach parking lot, rebuild and replant the dunes, reconnect 60 acres of marsh	9	0.5	Town	Full protection in about 5 years, with about \$1.5 million of flood damage expected in total while plants establish (add it as a one-time cost); shorebird nesting habitat; a new trail
2C	Do nothing at Shell Point	0	0 to the town; about 1.8 a year in expected flood damage	Homeowners, insurers, disaster aid	350 homes at risk; damage likely to rise as sea level rises
3A	Approve clearing 400 acres of oak woodland for a warehouse park; farmers rent 1,500 extra honey bee hives a year	0	0.3	Valley farmers	300 jobs and about \$0.4 million a year in taxes for the town; hive supply and price can change; fewer wild bees

Option	What the town would do	Up-front cost (\$ million)	Yearly cost (\$ million)	Who pays	Other information
3B	Protect the woodland and plant 15 miles of flowering hedgerows along farm edges	0.9	0.1	Town	The company may build in another town; woodland keeps wild bees, birds and trails; hedgerows take about 3 years to flower well

Simulated values for a fictional town, built so that each decision has a real kind of trade-off. Up-front means paid once at the start; yearly costs repeat every year for 30 years.

Budget constraint: the town may spend at most **\$80 million over 30 years** on these three decisions combined. Costs paid by town water customers (1A, 1B) come through the town's water bills and count toward the budget. Costs paid by farmers, homeowners or insurers do not come out of the town budget, but the council must still weigh them. **30-year total** = up-front cost + (yearly cost x 30) + any other one-time cost.

30-year cost calculations

Option	Calculation	30-year total (\$ million)	Who pays
1A			
1B			
2A			
2B			
2C			
3A			
3B			

- Complete the cost table. Show the full calculation for 1A and for 2B here.

- Shell Point protects 350 homes. Find the 30-year cost per home for 2A and for 2B, and the expected flood damage per home over 30 years for 2C.

3. Using option 1A, what is the replacement cost of the forest's water-cleaning service over 30 years? Give one reason this number is only an estimate of what the forest is worth.

4. List at least three packages (one option from each decision) that fit the \$80 million town budget, with their totals. Which option can never fit, and why?

Stakeholder statements heard by the council

Speaker	What they told the council
Water district engineer	A filtration plant would give us very reliable water, but customers would pay for it on every bill for decades.
Housing advocate	Marisol Bay is short of homes. If the 600 homes are not built upstream, where will they go, and how soon?
Lowlands homeowner	My street flooded twice in ten years. I need protection now, not in five years.
Shorebird biologist	The Shell Point dunes are one of the few places on this stretch of coast where shorebirds such as the western snowy plover nest.
Valley farmer	Hive rent goes up almost every year. The wild bees from the oak woodland cost me nothing, as long as the oaks are there.
Warehouse company	We offer 300 jobs. If the council says no, we will build in the next town.

How to score the options — First choose a **weight** for each criterion: 1 = matters some, 2 = matters a lot, 3 = matters most. Write the weights in the matrix headings before you score. Then give each option a **score** on each criterion: 1 = poor, 2 = fair, 3 = good. **Cost:** 30-year cost to the whole community, including what residents and farmers pay. **Reliability:** how surely the service will be delivered, and how soon. **Biodiversity and other services:** effects on habitat, wildlife and services such as recreation. **Fairness:** how well the option treats the people affected. Weighted total = (cost score x weight) + (reliability score x weight) + (biodiversity score x weight) + (fairness score x weight).

Decision matrix

Option	Cost (weight __)	Reliability (weight __)	Biodiversity and other services (weight __)	Fairness (weight __)	Weighted total
1A					
1B					
2A					
2B					
2C					
3A					
3B					

CLAIM

Our council recommends (one option, or a costed hybrid, for each decision):

EVIDENCE

Evidence: the 30-year costs, the cost per home, the budget total for our package, our matrix totals, and facts from the option sheet.

REASONING

Reasoning: explain why this package best keeps the three services and the biodiversity behind them within the budget, and how it answers at least one stakeholder concern.

Analysis questions

5. Decision 3 is the one where the replace option might look better to the town treasury. Over 30 years, who pays and who gains under 3A and under 3B? Use numbers (hive rent paid by farmers, taxes gained by the town).

6. Name two benefits of the forest, the dunes or the woodland that appear nowhere in the cost columns. Why do replacement costs leave them out?

7. Option 2B is cheaper than the seawall but takes about five years to reach full strength. Describe a hybrid plan for Shell Point, estimate whether it fits your budget, and say what the council would need to know to judge it.

8. Choose one option your group recommended. Write a monitoring plan: what to measure, how often, and what result would make the town take action.

- 9.** Science can tell the council what each option is likely to do and cost, but it cannot make the decision. Explain this using one place where your group disagreed or where two stakeholders wanted different things.

- 10.** New York City faced a choice like Decision 1. What did it choose, and which number in your packet plays the role of New York's estimated filtration-plant cost?
