Wetlands are working ecosystems

Wetlands have water covering the soil, or saturation at or near the surface, for all or part of the year. Water timing and duration shape their soils, vegetation and animal communities.

1. MANGROVES ARE ONE KIND OF COASTAL WETLAND

Mangroves are salt-tolerant trees and shrubs of tropical and subtropical intertidal environments. Their roots slow tidal water, trap sediment and shelter organisms.
Not all wetlands are mangroves: inland marshes, swamps and other wetlands can be freshwater systems. A wetland that is seasonally dry has not necessarily ceased to be a wetland.

2. STRUCTURE SUPPORTS ECOLOGICAL SERVICES

SLOWER WATER → Sediment can settle; plants and microbes can retain or process some nutrients, improving water quality.

SPACE FOR WATER → Temporary storage and slower release of floodwater can reduce downstream flood peaks.

ROOTS AND VEGETATION → Mangrove roots stabilize sediment and reduce shoreline erosion caused by waves and currents.

FOOD AND SHELTER → Wetlands provide feeding, breeding and nursery habitat for fish, birds and other wildlife.

3. NATURAL PROTECTION HAS LIMITS

Wetlands do not remove every contaminant, and they do not make polluted water automatically safe to drink. Flood and shoreline protection depend on site conditions and available storage; they cannot prevent every flood or storm impact. A wetland is valuable habitat, not a place to dump waste because it can filter water.

Wetland definition and seasonal conditions: US EPA, What Is a Wetland?
Water storage and habitat: US EPA, Why Are Wetlands Important?
Intertidal forests and shoreline functions: NOAA, What Is a Mangrove Forest?

Scope: College Board AP Environmental Science CED, Topic 8.4, p. 161.

Trace the activity to the lost function

A useful explanation links a human activity to a physical or biological change, then to a lost ecosystem service. Impacts can originate within the wetland or elsewhere in its watershed.

1. COMMERCIAL DEVELOPMENT: DRAIN, FILL OR CLEAR

Draining lowers the water table; filling replaces wetland space with soil or built surfaces; clearing removes vegetation. Habitat can shrink or become fragmented, and less space remains for floodwater storage. Removing mangrove root systems also reduces shoreline stabilization. A new road or building can therefore affect both wildlife and nearby communities.

2. DAM CONSTRUCTION: CHANGE THE WATER REGIME

A dam can change the timing and amount of water reaching downstream wetlands and trap sediment that would otherwise move downstream. Changed inundation patterns can alter vegetation and habitat; reduced sediment delivery can hinder maintenance of coastal wetland elevations. The effect depends on dam location and operation, not simply on whether a dam exists.

3. AGRICULTURAL AND INDUSTRIAL POLLUTION

Runoff can deliver nutrients, pesticides and sediment; industrial waste can carry toxic contaminants. Excess nutrients can stimulate algal growth and oxygen depletion, while toxic substances can impair survival or reproduction. Overloading a wetland can degrade the plants and organisms that help maintain its water-quality functions.

4. OVERFISHING: REMOVE ORGANISMS TOO QUICKLY

Harvesting fish or shellfish faster than populations can replenish themselves can reduce their abundance and disrupt food-web relationships. Nursery habitat alone cannot guarantee sustainable fisheries when harvest remains excessive. Protecting the habitat and managing the populations that use it address related but different pressures.

Required human threats: College Board, STB-3.E.3.
Water regime, sediment processes and watershed impacts: US EPA, Restoration Principles.

Scope: College Board AP Environmental Science CED, Topic 8.4, p. 161.

Protect the process, not just the plants

Protection prevents further degradation; restoration aims to return natural functions to a former or damaged wetland. Restoring a site does not remove the need to conserve intact wetlands.

1. MATCH THE RESPONSE TO THE PRESSURE

FILLING OR CLEARING	Avoid new damage and retain intact habitat.
ALTERED WATER FLOW	Restore suitable inundation or tidal connections.
POLLUTED RUNOFF	Reduce the upstream source and intercept runoff.
EXCESSIVE HARVEST	Manage harvest alongside habitat protection.

These are response categories, not a one-size-fits-all engineering plan. Choose actions for the actual site and cause of degradation.

2. RESTORE HYDROLOGY AND CHECK FUNCTION

Correct water levels, flow connections and site elevation are often essential before native vegetation can recover. Monitor whether the desired functions return, not just how many plants were planted. Useful measures include water-level patterns, native plant survival, habitat use and water quality. Adjust the project if results fall short.

3. EXTENSION: ESTIMATE TEMPORARY STORAGE

Illustrative wetland: 2 hectares with an average 0.20 m of available surface-water storage depth.
Area = 2 × 10,000 = 20,000 m²
Storage volume = 20,000 m² × 0.20 m = 4,000 m³
This simplified capacity estimate is not a prediction of flood damage prevented. Actual storage depends on water already present, inflows, outflows and topography.

Protection and restoring functions: US EPA, Wetland Restoration and Protection.
Hydrology, native species and monitoring: US EPA, Principles of Wetland Restoration.
Temporary floodwater storage: US EPA, Why Are Wetlands Important?

Scope: College Board AP Environmental Science CED, Topic 8.4, p. 161.