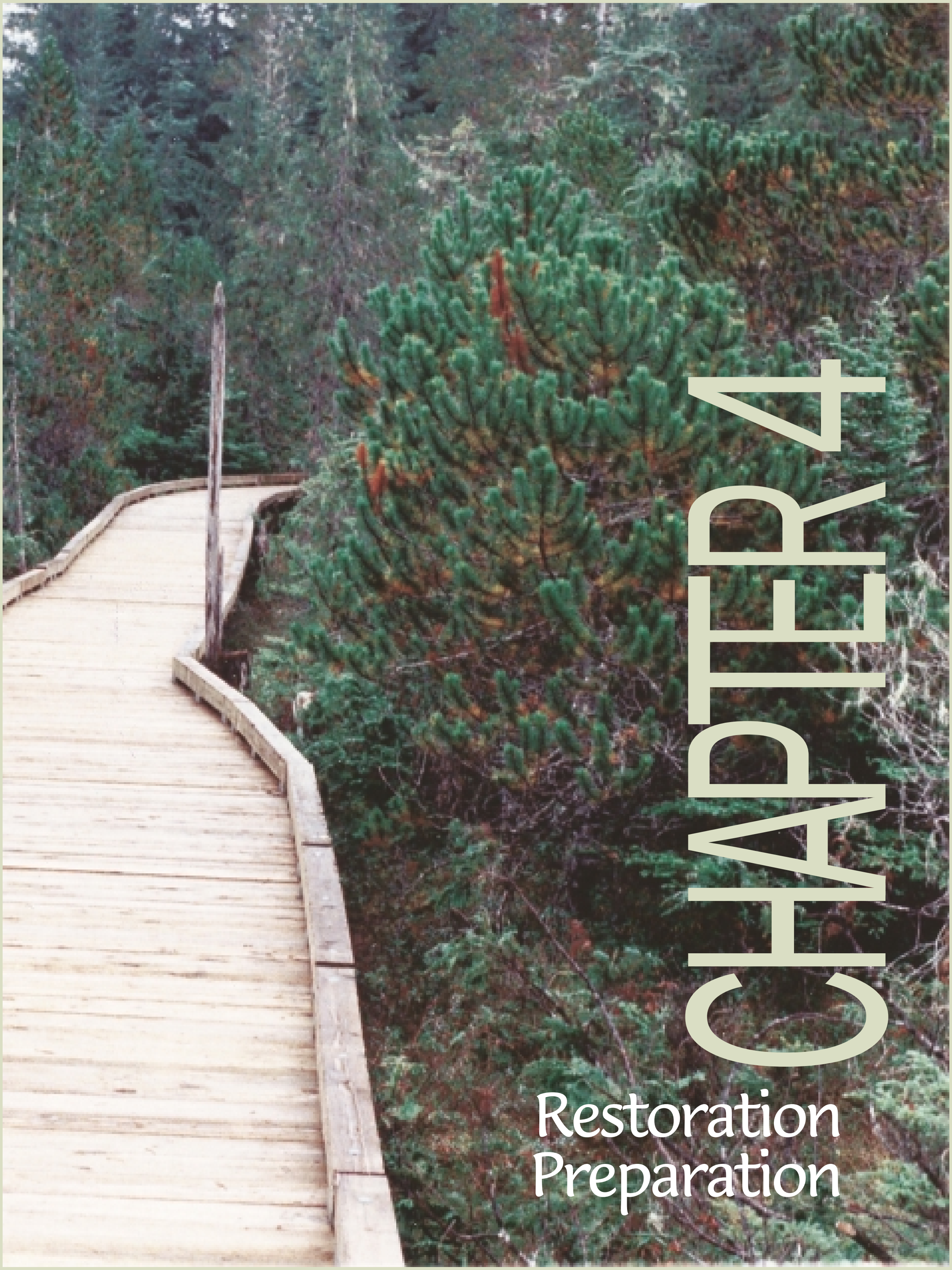


CHAPTER 4

Restoration Preparation

RESTORATION PREPARATION

The goal of riparian restoration is to set in motion a process that enables natural ecological processes to reestablish themselves and to continue. The essence of riparian restoration is working with nature rather than trying to change or control it. To accomplish this goal requires being acutely aware of the area's natural characteristics, its natural functional and structural elements, including but not limited to climate, soils, weather patterns, hydrology, plants and wildlife, and also being aware of socioeconomic use patterns.

Good planning will make or break any project, especially one as complicated as a restoration project. Planning must encompass any aspects, whether grand or minute, that might impact the site.

An interdisciplinary (ID) team is necessary for a riparian restoration project. It is essential to clearly delineate riparian characteristics through science-based field assessments. The team must gain a thorough understanding of the restoration site, its associated problems, and of how these problems are affecting the site and other natural processes in the watershed. The team also needs to know how current and proposed recreational activities might affect the site and surrounding areas.

When assessing the restoration site (sometimes called a site analysis), the ID team should address the assessment holistically, assessing upstream and downstream conditions, lateral and vertical conditions, conditions of areas surrounding lakes and other water bodies, and their connections to the restoration site. The team should conduct initial planning assessment at a broad watershed scale and graduate to collecting information at a project-specific scale. Such assessments will help determine whether a problem is unique to the site or symptomatic of other problems in the watershed. Planners, designers, and other members of the ID team should seek long-term solutions to the problem rather than using a "quick-fix" that treats only symptoms.

Understand Existing Conditions

In the early stages of project planning, a field assessment conducted by a team of specialists can clearly identify the riparian ecosystem and the outside influences that contribute to its health or infirmity. This assessment clearly defines which ecological functions and processes must remain undisturbed during and after any potential construction and/or restoration projects. With this approach, protection of riparian structural and functional characteristics automatically becomes part of the planning, design, and construction processes.

To help understand the structure and function the site may have had, the ID team should use a reference site to compare, in the simplest of terms, a functioning, intact site with the project site. The reference site can be adjacent to the damaged site, a short distance away, in the same watershed, or in a different watershed with similar ecosystems. It needs to have characteristics similar to the project site, such as soil type, aspect, topography, geology, stream patterns and profile, weather patterns on lakes, and climate.

To analyze the reference and restoration sites for differences and commonalities, the ID team should consider the following factors:

1. Historical records
   - Historical written records and photographs to the present for analyzing social and economic trends and use patterns, including indigenous peoples, pioneers, and settlers.
   - Aerial photographs for comparing images from different decades or years.
   - Climate data from Government land office surveys, old journals, dendrochronology (tree-ring analysis), pack rat middens, and palynology (pollen analysis).
   - Topographical maps.
   - Land-use patterns including farming, ranching, housing, and recreation.
   - Proper Functioning Condition reports (DOI 1998).

2. Adjacent communities and activities
    - Adjacent conditions of upland and riparian habitats and how their conditions may be affecting the reference and restoration sites.
    - Hydrologic responses, such as percolation tests and water storage differences between degraded and natural sites.
    - Depth-to-dry-season water table, which may vary during the day, thus requiring readings at the same test sites morning, noon, and evening to determine water depth. (Water table depth profoundly influences the ability to restore riparian structure and function.)
3. Soils
    - Site-specific soil survey to provide site productivity information such as nitrogen, calcium, and phosphorous content; percent of organic matter; and so on; physical properties (for engineering purposes); and water-holding capacities.
    - Soil type variability across the site.
    - Soil moisture variabulity across the site.
4. Hydrology
    - Water quality to determine the presence of toxic chemicals, such as herbicide residues, aquatic macroinvertebrates, and periphytons (communities of microorganisms that are associated with various aquatic substrates).
    - Stream and watershed health (Regional 1995; USDA FS 1989).
    - Annual hydrograph.
    - Flood regime—time-of-year of flooding, length of time of overbank flooding, and frequency of flooding.

5. Vegetation

The ID team should use transects of the reference site to inventory the benthic macroinvertibrates, vegetation species frequency (plant species composition), woody species density, and woody species age classes. The team should use references such as DOI BLM1992; USDA FS 1989; Bonham 1989; and Myers 1989.

- Canopy—coverage and health.
- Root structure.
- Characteristics such as old growth, even age, and so on.
- Dead and downed material.
- Litter.
- Root zone functioning.
- Plant composition—The ID team should note closely the plant variety differences at the water's edge or ecotone where the riparian ecosystem blends with the upland species as compared to the middle of the site and look for the ecotones within the riparian ecosystem. Plant species on terraces, which mark abandoned flood plains, will be different from those on flood plains because soil moisture in the terrace is probably lower than on the flood plains.
- Visibility of species during only part of the year; for example, annuals.
- Identity of all threatened and endangered species.
- Habitat for specific animals—migratory and resident.

6. Wildlife
    - Bird populations.
    - Identity of which birds customarily use the project site during breeding season, as a way to gauge riparian health. If birds are absent, the site may have been altered to an extent that makes it uninhabitable.
    - Identity of all threatened and endangered species and their habitat niches.
    - Identity of migratory and residential use.

In some areas of the country, it may be difficult to find a reference riparian ecosystem that has naturally occurring processes that support riparian structure and function. For instance, the native vegetation may have been removed for farming and then left fallow.

What grew back may not be native riparian vegetation, nor would it necessarily have a riparian structure to support ecosystem functions. Information gleaned from historical accounts, soil analysis, an adjacent watershed, and the flood regime would indicate what the land was capable of supporting. Local botanists and native plant societies can suggest appropriate plant selections to achieve ongoing ecosystem function.

Project Goals and Objectives

The ID team should determine the project site's future condition (FC) based on its analysis. It should set the FC for what the project site is ideally capable of supporting. Forest plans generally have a broad FC, while a site's FC is specific.

To achieve the FC, the team should set project goals and objectives, which at a minimum should support the proper functioning conditions of the riparian and watershed ecosystems (Prichard 1998). A goal is a general broad statement of purpose and direction that supports or is an element of the FC. For example, a goal might be to restore natural riparian ecosystem processes to the site by reestablishing riparian function. Goals, which deal with distant timeframes, can be achieved but cannot be "done." Objectives, which are more immediate, are a series of steps or activities to be done that lead to the accomplishment of goals (Rieger and Traynor 1998). They are measurable.

The drawings in figures 50 and 51 show how to use a site analysis and good design to sustain riparian structure and function. The same principles are also useful in evaluating current conditions and/or restoring an existing site.

Figure 50–Site analysis.

Site Inventory and Analysis

When workers survey a site, they should begin with a topographical map that identifies all natural features and how they work in the landscape. They should observe the following:

Topography
Note contours of slopes and valleys, flat areas, and rock outcrops.

Drainage
Note drainage patterns from upslope to downslope and across flat areas and their connections to the stream/lake/wetlands.

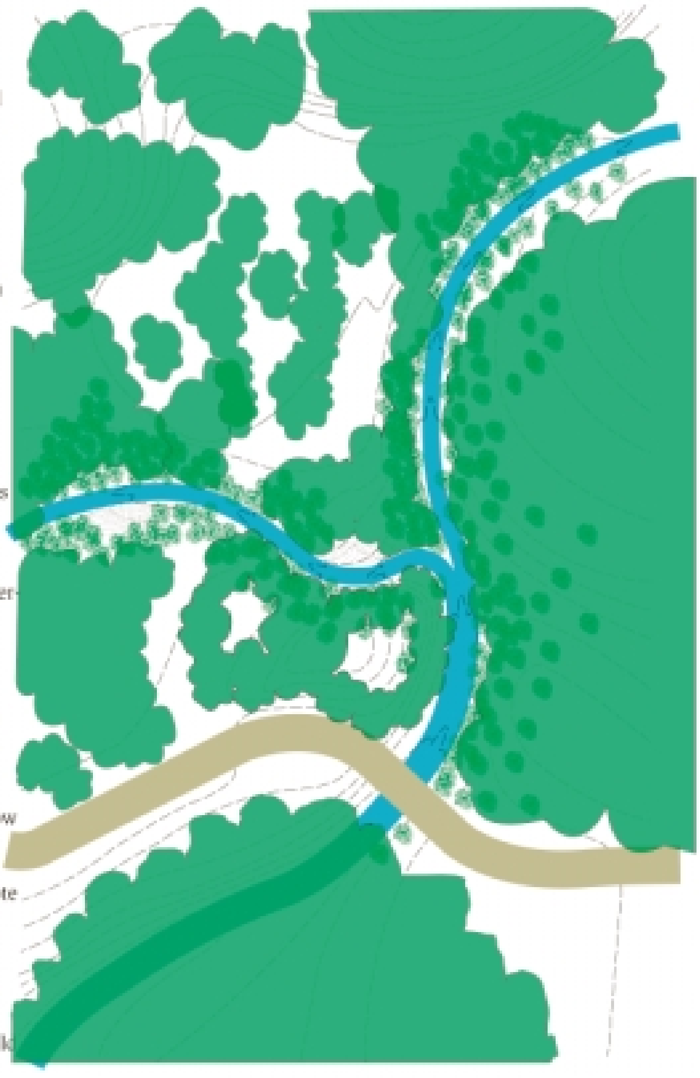
Vegetation
Note upland species, species that make up transition (ecotone) areas, aquatic species, keystone species, and threatened and endangered species.

Note the placement and relationships of trees to shrubs and grass, and their relationships to topography and soil types.

Observe the tree canopy, how the light penetrates it, and where shadows (shade) are cast throughout the day. Note which areas are dense with vegetation, and which are open (microclimates).

Observe the way in which plant species function to hold the soil in place; replenish soil with nutrients; and supply food, shelter, and travel ways for wildlife.

Note offsite influences, such as land-use and man-made features that affect the health of the riparian and aquatic ecosystems.



Weather
Note the prevailing weather patterns, annual rainfall and/or snowfall amounts, number of sunny days, prevailing wind patterns, and solar orientation/sun angles.

Observe where snow drifts from and to.

Hydrology
Check historical records for flood regime. Find the channel bankfull level. Record the water temperature and analyze macroinvertebrate health.

Find out if there is a dam upstream and/or downstream of the site. Note reservoir high- and low-level readings over the life of the installation.

Do a Proper Functioning Condition survey. Note whether banks appear stable or are eroding or aggrading.

Down-and-Dead Material
Note whether the ground is bare of debris or has layers of woody debris, leaf litter, and duff layer. Note any woody debris in the channel or lake.

Soils
Note soil types and whether they are types that compact easily. If soils are disturbed, find the cause. Note erosion due to disturbances.
Note wet soils.

Wildlife
Note keystone and threatened and endangered species. Observe habitat characteristics that attract wildlife to the site. Name the resident and migratory animal species, including birds and fish that use the site.

Figure 51–Design Principles

Project Design

After studying campgrounds, Orr (1971) found that "design is the second most important variable in relation to site deterioration" (Manning 1979). The design is based on the data gathered and on internal and external influences (social factors). Recreation-use planning is an integral part of site design. When a recreation facility is planned, habitat fragments are likely to be created. The ID team must understand the habitat needs of the resident and migratory wildlife and eliminate as many fragments as possible from the design. The team should consider relocating a facility out of the riparian ecosystem and providing planned access routes to the water and other attractions.

While recognizing that each restoration project is unique, the team should adhere to certain design principles:

- Design facilities to balance the benefits of access against the effects they will have on riparian processes; that is, structure and function.
- Use soil-survey information to help site recreation facilities on soils that are likely to be less susceptible to compaction and erosion and more productive and stable (Manning 1979).
- Use good design to substantially reduce and eliminate deterioration of ground cover and other plant life (function) on new or recovered sites. Install barriers and hardened or mulched paths, delineate camp and picnic sites, and install signs to indicate where forest visitors should or should not go and interpretive signs that explain why. See figures 52 and 53.

Figure 52–A hard surface defines this accessible camping unit.

Figure 53–Path is defined by a low fence and is covered in mulch. It is accessible and the mulch protects the soil.

- Leave native vegetation, whether alive or dead and down, on the site.
- Lessen negative impacts to the restoration site by addressing management and restoration of upslope and adjacent areas of influence.
- Consider fencing off a site, which is sometimes the best and most efficient restoration solution. See figure 54. Yosemite averages 90 to 95 percent compliance in keeping visitors out of restoration sites by using fences and informational signs. (See appendix E.) Fence installations encourage compliance. Cutting corners off potential restoration areas so that visitors can see their destination from the path encourages them to stay on the trails. (Fritzke 2001). See figure 55.

Figure 54–The fence blends with the forest, allowing views of the lake while protecting the riparian vegetation.

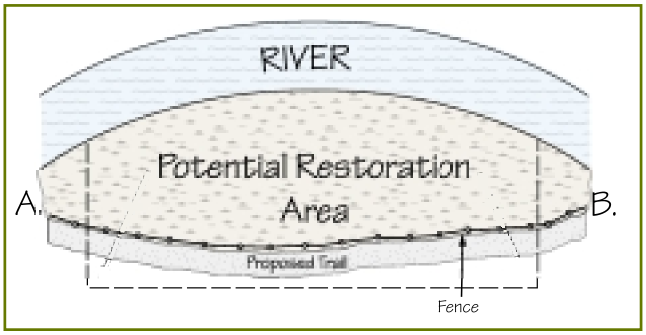


Figure 55–Restoration site with trail.

- Be aware of the hydrologic connections on the site and the effect that grade changes may have on them, and ultimately on the riparian ecosystem. For example, be sure flood plains remain functional. See figures 56 and 57.

Figure 56–Cedars are very sensitive to hydrological changes. The cedars (at right foreground) died because of the road construction and because the subsequent compaction and settling of the roadbed changed the hydrologic regime. The water became impounded around the cedars and they drowned. Their deaths further impacted cedar regeneration because increased deer browsing makes regeneration difficult, if not impossible.

Figure 57–Drainage patterns changed when a road was built across this meadow. The water can drain through only a few culverts, which concentrates the outflow and causes down cutting that has lead to an incised stream.

- Determine whether the channel is stable. If it is not, determine whether it is incising or aggrading. (See appendix H for sources on channel stability.) If it is incising, the water table may be lowered, perhaps beyond the reach of most riparian plant roots. See figure 58.

Figure 58–Incised channel.

- Design functional elements of the riparian ecosystem, including reconnecting the site to its hydrologic regime, restoring the natural topography, and planting site-specific vegetation. See figures 59 and 60.

Figure 59–This boardwalk winds over and through a riparian ecosystem, allowing visitors to experience and yet not disturb its structure and function.

Figure 60–A side view of the boardwalk shows plant growth under the boardwalk.

- Understand the consequences of actions such as cutting and filling; removing vegetation; and placing and constructing facilities, roads, and trails. For instance, because of pollution potential, do not drain parking lots directly into water bodies. See figure 61.

- Understand which activities can be supported in the area and how they mesh with sustaining natural riparian processes. (See appendix A.) Plan for the separation of conflicting types of recreation. Design according to what visitors want to do, while protecting the resources. "For example, … visitors want access to the river but this is inappropriate due to channel location (outside meander bend) so fencing and signs are installed to focus access to more appropriate sites both up and downstream" (Fritzke 2001).

- Plan paths to popular destinations such as restrooms, trash bins, other campsites, beaches, vista points, amphitheaters, trailheads, dispersed fishing and access points, and so on. Control where visitors go by using rustic wood fences (see appendix E); native rock; native thorny shrubs, vines, roses; and hardened paths. "Impacts can also be minimized by controlling the distribution and location of visitor use. Concentrating use and the resultant

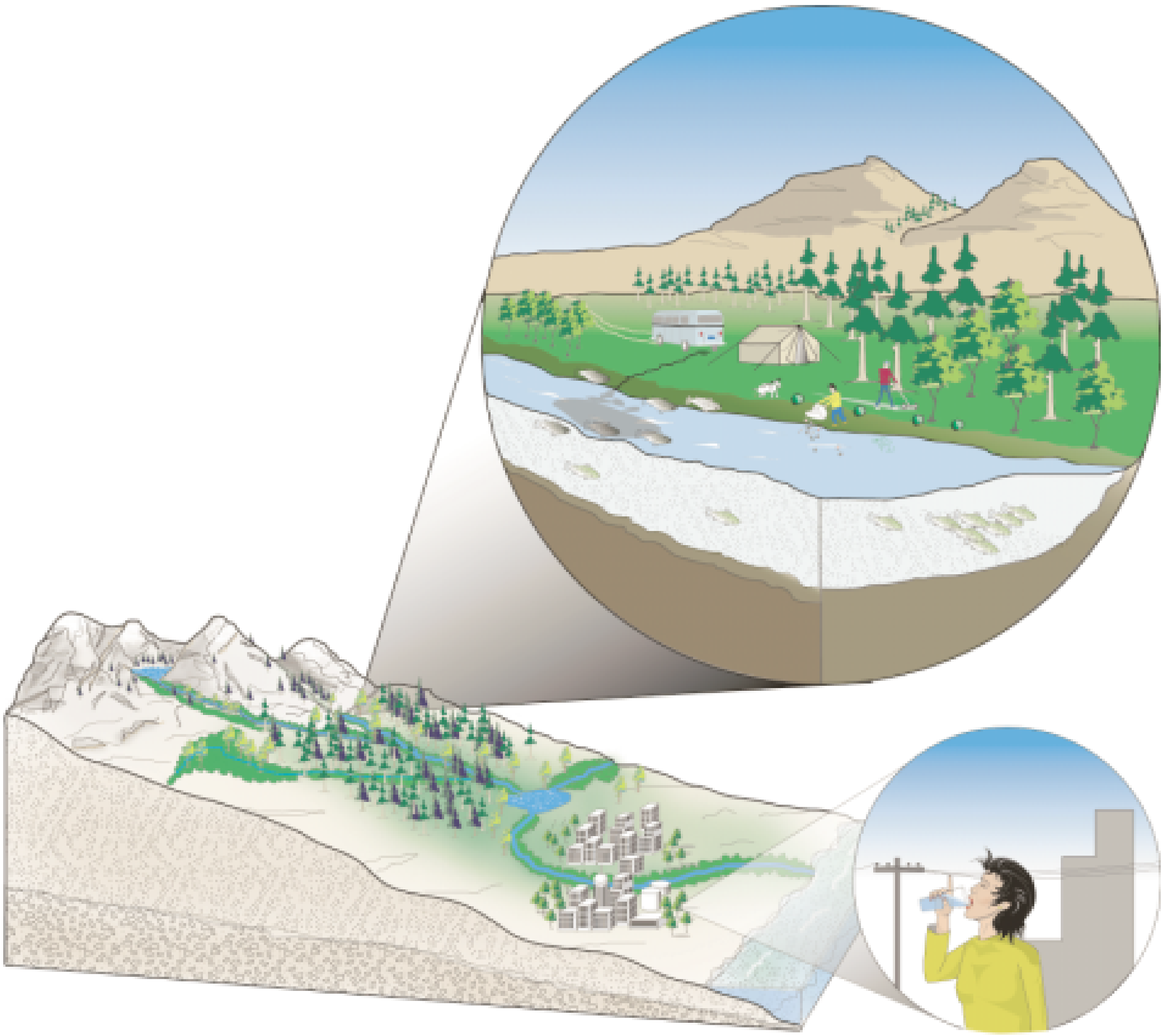


Figure 61–Actions upstream affect water quality downstream.

impacts in a few places will leave most of the area relatively undisturbed" (Cole as quoted in Alexander and Fairbridge 1999). See figures 62, 63, 64, 65, and 66.

Figure 62–A delineated path shows visitors where to go.

Figure 63–This trail allows water to flow through it, preserving the wetland and providing a dry walking surface.

Figure 64–Visitors using this water pump stay on the pavement and off the vegetation.

Figure 65–A fenced and signed path in Florida. The path leads to a beach and keeps visitors off the riparian vegetation.

Figure 66–A fenced path leads to a defined picnic area.

- Ensure that high-use areas, such as campground trails, roads, and campsites, are inherently durable or have hardened surfaces to prevent deterioration (Cole as quoted in Alexander and Fairbridge 1999). See figure 67.

Figure 67–Site cover material is 1/4 inch and less crushed limestone for accessibility. Each campsite area is framed in timber.

Figure 68–An information sign.

- Provide education through talks, signs, brochures, and Forest Service personnel. Such efforts are key to keeping visitors informed and ensuring their cooperation in behaving responsibly. See figure 68.

  River rafters, canoeists, kayakers, innertubers, picnickers, trail users, snowmobilers, and other visitors need to know the consequences of their actions and what they can do to leave the least imprint on the land. Mandatory ranger talks to users before allowing them on the Colorado River in the Grand Canyon and on the Middle Fork of the Salmon have proven to be very successful (Cole 2000b). See figure 69.

Figure 69–Before their float trip, rafters listen to a brief talk about outdoor skills specific to river, riparian ecology, and ethics.

Conceptual Design

This is a sample conceptual design illustrating some of the information covered in this publication. Before work begins, understand the affects of grading on existing vegetation, drainage patterns, and streambank stability. Disturb as little of the land as possible; grading for buildings, roads, spurs, and paths is minimal. Allow natural cycles to occur unimpeded. For example, don't alter a stable bank and don't build on the flood plain.

Restoration and Recreation Planning Objectives

The campground is large enough to be economically feasible without destroying the riparian ecosystem.

Visual quality and natural features, such as rock outcrops and vistas, are inherent in the restoration or new design.

Campground is sited above the flood plain on a plateau.

All visitor-use areas and amenities are designed away from known wildlife-use areas.

Accessible paths lead to the restrooms and to the sandbars so all visitors can experience the site amenities.

Site Design

Campground loop roads are designed/laid out perpendicular to the stream, which is the attraction. Loops perpendicular to the attraction encourage visitors to walk down the roads to get to the stream instead of walking cross country.

An information kiosk and a pay station are located by the restroom at the bottom of the loop. These common interest areas to most visitors are placed here to encourage people to use the road rather than to trample vegetation.

Paths lead to two sandbars. A low fence runs along the streamside of each path to protect the riparian ecosystem by preventing visitors from trampling the vegetation between the path and the stream.

A bridge is used to cross the stream. The abutments are set into the bank so wildlife can cross under the road and fish and other aquatic species can move upstream and downstream unencumbered. The bridge is wide enough to accommodate two-way traffic and a sidewalk, for pedestrian safety. The sidewalk encourages visitors to cross the stream over the bridge instead of trampling the streambanks.

Visitors are directed through a network of hardened paths to access the water via the sandbars.

Sandbars can be used as beaches and offer open spaces and shade. They are also renewable. Sandbars significantly reduce the impacts to vegetation, soil, and wildlife because access to the water is controlled and not occurring indiscriminately along the streambank.

Recreation Management

Trail signs lead visitors to the water and other site amenities, and additional signs explain why it is important to stay on paths.

All roads, spurs, and paths are surfaced with 4 to 6 inches of aggregate or paved. Paths can be surfaced with wood chips to reduce erosion and delineate use areas.

A fence runs along the east boundary of the campground to discourage visitors from going beyond the area. The riparian ecosystem is maintained intact by preventing trampling and compaction and by not disturbing wildlife.

Soil Protection

Construction (restoration or new installation) can cause streambanks to be compacted and left bare. This could lead to destabilization. Soil bioengineering is used to restore vegetation (structure and function) to banks. Hardscape materials such as steel and riprap won't grow and they shift over time. They don't support the riparian ecosystem.

Figure 70–Design Principles

Example of How Principles are Implemented

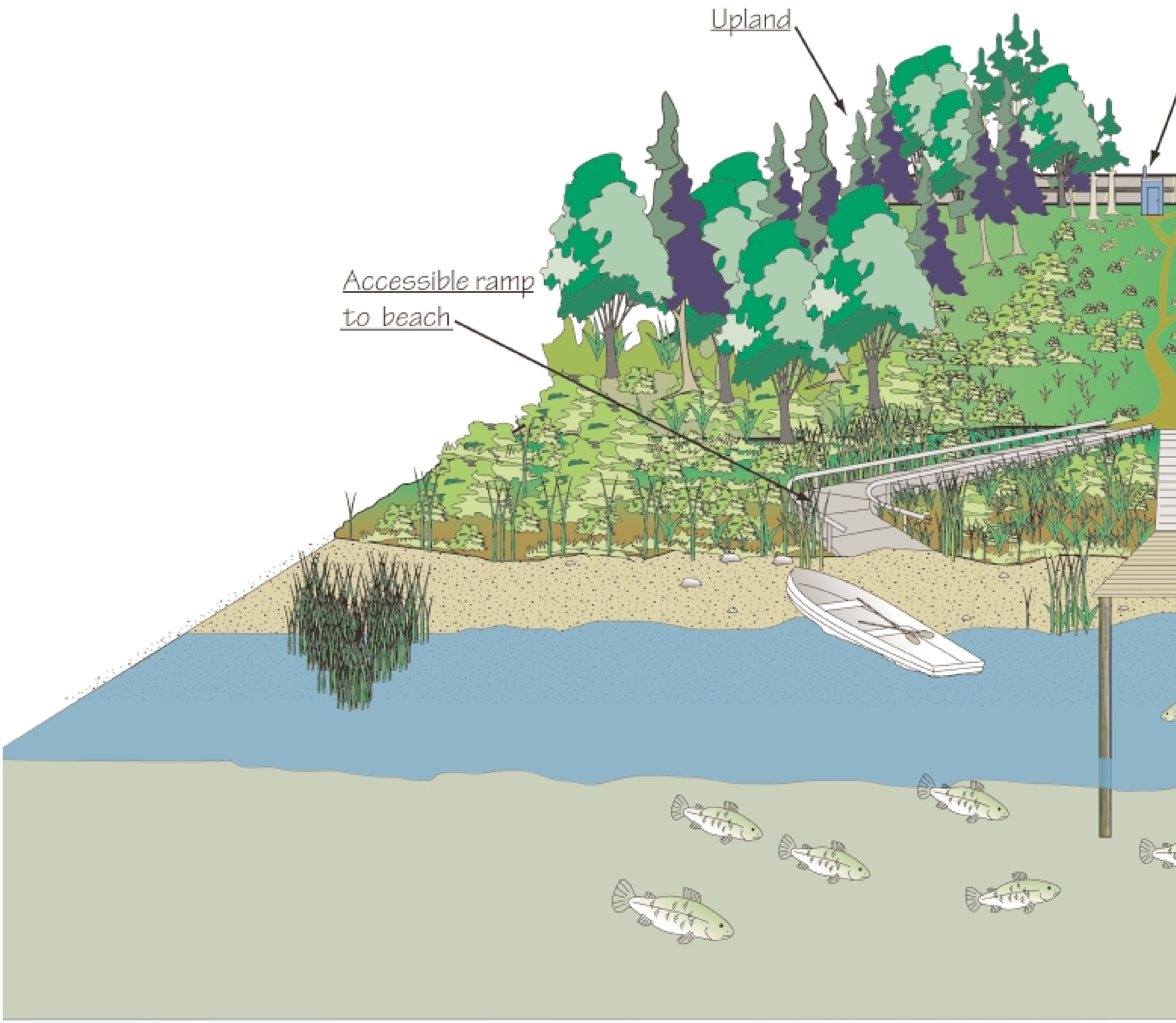
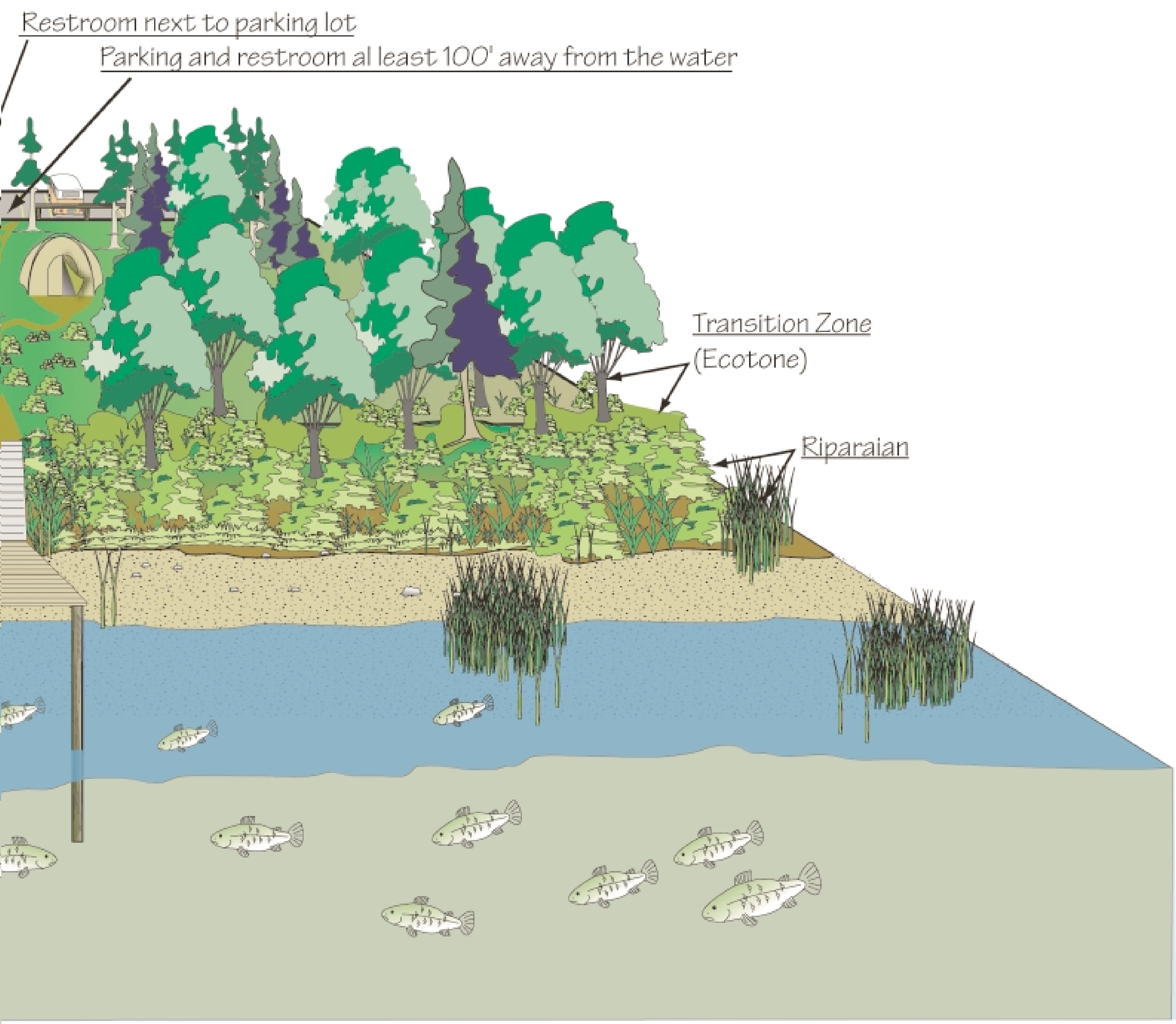


Figure 71–Implemented principles.


Restroom next to parking lot
Parking and restroom al least 100' away from the water
Transition Zone
(Ecotone)
Riparaian