

# Notes on Wetland Ecology

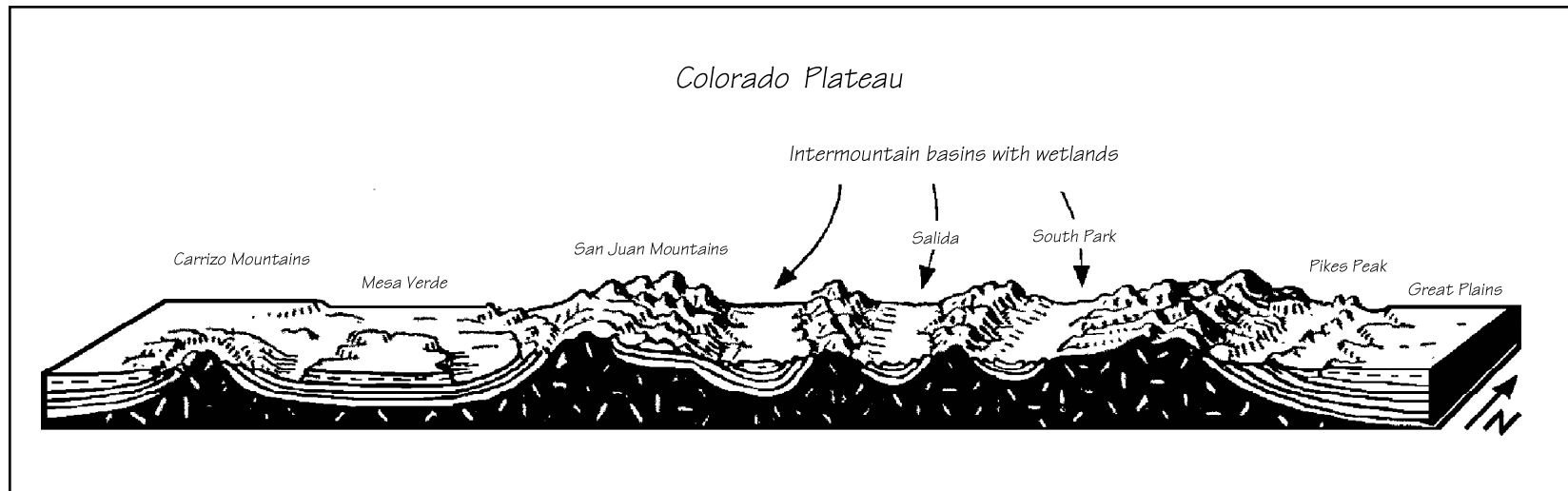
Wetlands are part of a continuous landscape that grades from wet to dry. They are defined as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support—and that under normal circumstances do support—a prevalence of vegetation typically adapted for life in saturated soil conditions (CoQWS [34]), EPA, and Army Corp of Engineers). In some cases, riparian areas and floodplains may be included in wetland designations (EPA 1990).

Three conditions must be satisfied before an area will be regulated as a wetland. The area must exhibit:

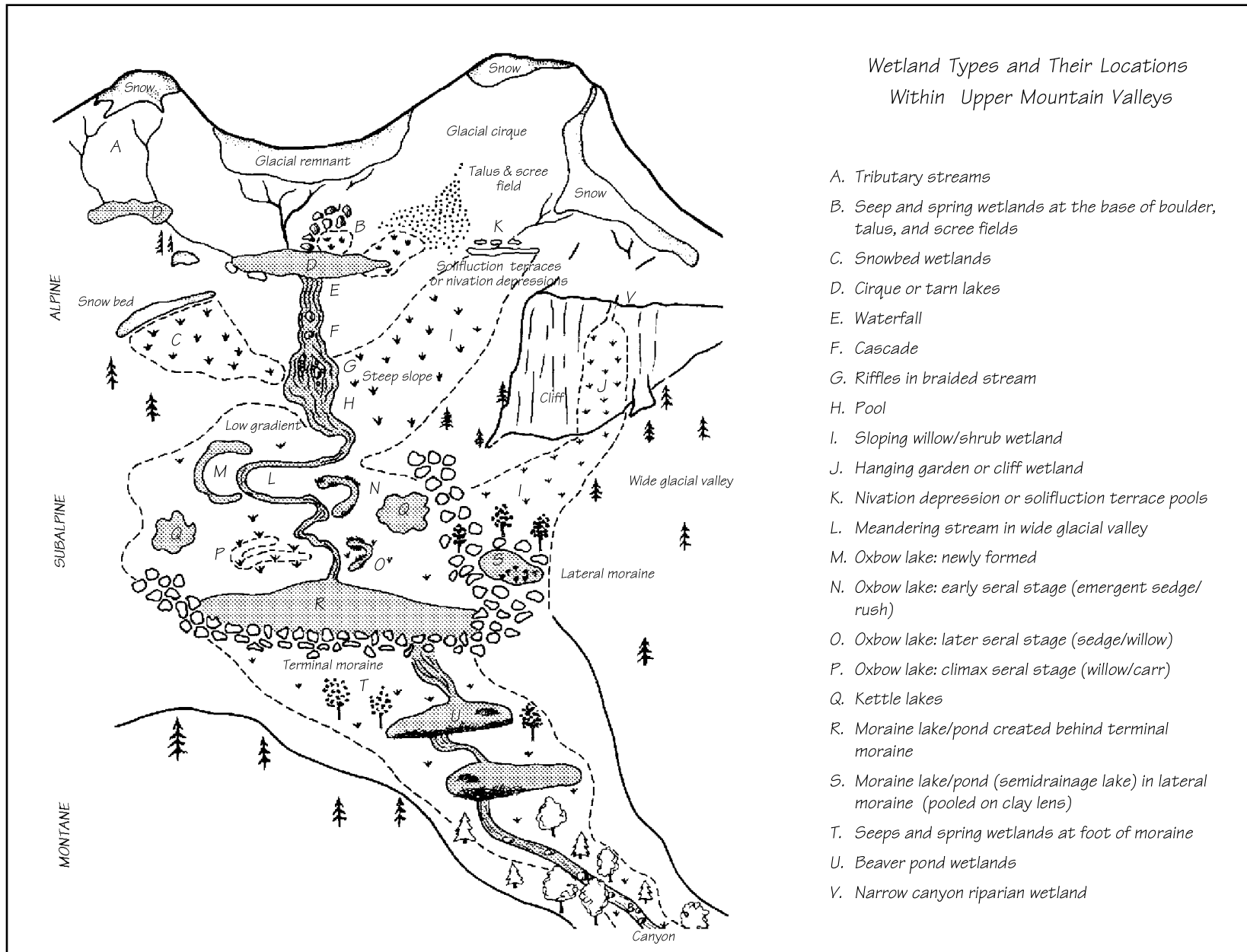
- characteristically wet (hydric) soils, characterized by a low level of oxygen available for biologic purposes within the root zone;
- permanent or periodic inundation or saturation of the soil; and
- a preponderance of plants that can grow under these conditions.

Hydric soils have formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (U.S. Department of Agriculture, Natural Resources [Soil] Conservation Service 1985). Hydric soils exhibit:

- saturation (occurs when enough water is present to limit the diffusion of air into the soil, resulting in accumulation of a layer of decomposing organic matter),
- reduction (occurs when oxygen is not available to soil microbes; microbes then cease to decompose the organic matter or substitute oxygen-containing iron compounds in their respiratory process), and
- redoximorphic features (include grey layers and mottles which occur when iron compounds are reduced by microbes in anaerobic soils and carried away, leaving bare grey mineral soils; the iron tends to be oxidized elsewhere, leaving orange stains, usually at the seasonal high-water table).



*Between Pikes Peak and the great dome of the San Juan Mountains are a series of parallel mountain ranges and lowland basins harboring a variety of wetlands. (Illustration adapted from Atwood 1945)*



(Illustration adapted from S.Q. Foster in U.S. Fish and Wildlife Service 1986)

#### WETLAND FUNCTIONS

Wetland classification is based on function.

Functions that warrant site-specific protection include:

- groundwater recharge or discharge,
- flood-flow alteration,
- sediment stabilization,
- sediment or other pollutant retention,
- nutrient removal or transformation,
- biological diversity or uniqueness,
- wildlife diversity of abundance,
- aquatic life diversity or abundance, and
- recreation.

Where functions are mutually exclusive (*i.e.*, wildlife abundance *vs* recreation), protection is determined on a wetland-by-wetland basis, considering natural wetland characteristics and overall benefit to the watershed (CoWQS 3.1.13 [e][iv]). Classification on a site-specific basis is intended to maintain or restore appropriate wetland characteristics and functions, within the range of natural variation of the affected wetland (CoWQS 3.1.24 A2).

Section 131.10(a) of the federal water quality standards regulation prohibits the use of any waters of the United States for waste transport or waste assimilation.

### Classification of Wetlands

(from Cowardin *et al.* 1979)

<i>System</i>	<i>Subsystem</i>	<i>Class</i>
Marine	Subtidal	(4 classes)
	Intertidal	(4 classes)
Estuarine	Subtidal	(4 classes)
	Intertidal	(8 classes)
Riverine	Tidal	(6 classes)
	Lower Perennial	Rock Bottom
		Unconsolidated Bottom
		Aquatic Bed
		Rocky Shore
		Unconsolidated Shore
		Emergent Wetland
	Upper Perennial	Rock Bottom
		Unconsolidated Bottom
		Aquatic Bed
		Rocky Shore
		Unconsolidated Shore
	Intermittent	Streambed
Lacustrine	Limnetic	Rock Bottom
	Littoral	Unconsolidated Bottom
		Aquatic Bed
		Rock Bottom
		Unconsolidated Bottom
		Aquatic Bed
		Rocky Shore
		Unconsolidated Shore
		Emergent Wetland
Palustrine		Rock Bottom
		Unconsolidated Bottom
		Aquatic Bed
		Unconsolidated Shore
		Moss-Lichen Wetland
		Emergent Wetland
		Scrub-Shrub Wetland
		Forested Wetland

*Features that may help to identify wetlands when standing water is not present:*

- (1) sediment deposits on litter;*
- (2) water-stained boulders or tree trunks;*
- (3) drift lines of debris piled against trunks and fencelines; and*
- (4) surficial root systems.*



## TYPES OF WETLANDS

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### BOGS

Bogs are wetlands that form in depressions where cool climate (generally where the ground freezes in winter) and abundant moisture retard the rate of decomposition and result in:

- nutrient-poor, acidic conditions;
- accumulation of organic matter (predominantly moss/peat);
- restriction of water movement; and
- raising of the water table.

True bogs occur only where peat can be formed and preserved isolated from the groundwater system; they depend upon precipitation for moisture. They are open systems with near normal surface runoff and the capacity to recharge groundwater.

Due to frequent droughts and generally low humidity in most of the Rocky Mountain west, peat can be preserved only where it is in contact with groundwater and surface water systems. Bogs do not occur south of central Idaho and westcentral Montana (Cooper 1988).

### DISCHARGING WETLANDS

A discharging wetland receives water from a groundwater supply. This may be a temporary or cyclic feature of the wetland. (See also "Recharge Wetland")

### FENS

Fens are biologically rich peatlands formed in cases where the groundwater and surface water supply is alkaline (high pH) because it has flowed over limestone, or other rock rich in calcium carbonate and other salts. Fens therefore tend to reflect the chemistry of the underlying geology. (Fens receive both surface and groundwater; bogs receive only precipitation.) A very pronounced flush of very diluted minerotrophic snowmelt water in early Summer is characteristic of these systems and ties them to the snowfall/snowmelt regime of their respective basins. Fens exhibit both surface and subsurface/groundwater outflows, whereas bogs exhibit principally the latter. Because of the surface flows, beaver are known to occupy fens. Fens may grade into bogs. They are rare in Colorado.

### FORESTED WETLANDS

In forested wetlands, trees are the dominant plants. These wetlands may be like neighboring upland stands except for understory vegetation characteristic of wetlands. (See also "Swamps" and "Wooded Wetlands")

### GAINING STREAMS

A stream that receives groundwater is a gaining stream.

#### HEADWATER WETLAND

Headwater wetlands are temporarily to seasonally flooded wetlands located at the origins of streams. They exhibit low water-storage capacity.

#### ISOLATED WETLANDS

Isolated wetlands are not associated with perennial waters and are not tributaries to created wetlands. They are generally associated with the groundwater table; accordingly, they receive protection from the prevailing statewide, regional, and site-specific groundwater-quality standards. Isolated wetlands are subject to narrative standards (CoWQS 3.1.24 A2).

#### LOSING STREAM

A stream that loses water to the groundwater system is a losing stream.

#### LACUSTRINE SYSTEM

Wetlands associated with lakes larger than 20 acres are part of lacustrine systems.

#### MARSHES

Marshes are characterized by influxes of water in the Spring that can create flooded conditions and relatively deep water, followed by dropping water levels during the growing season. They are dominated by herbaceous plants (*e.g.*, sedges, grasses, rushes, cattails, bulrushes). Water and soil may be fresh or saline. Marshes were once common in Colorado at elevations below 8,500'. Marshes:

- serve as vital links in aquatic food chains,
- absorb water-borne pollutants,
- trap sediments, and
- absorb wave energy.

A "low marsh" floods regularly. A "high marsh" floods irregularly.

#### PALUSTRINE SYSTEM

Palustrine systems include freshwater wetlands not associated with stream channels, wetlands associated with lakes under 20 acres, and other wetlands bounded by uplands. Most forested wetlands are palustrine.

*(continued)*

*Colorado has lost over 50% of its wetlands since settlement.*

*The Colorado Natural Heritage Program identifies 29 species of wetland-dependant birds and 11 species of amphibians as "rare and imperiled."*



*Conservation  
of riparian ecosystems  
for vertebrate habitats  
needs to place equal emphasis  
on headwater [as well as lowland]  
riparian sites  
to assure conservation  
of regional diversity.*

*—Knopf 1988*



## TYPES OF WETLANDS (CONTINUED)

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### PEATLANDS

Peatlands are created where a constant flow of groundwater seeps to the surface for most of the growing season. Saturation and anaerobic conditions retard decomposition, and peat accumulates slowly over thousands of years (at an average rate of 8"/1000 years). Peatlands are dominated by sedges and willows. The water supply may be fresh or saline, and may be acidic, basic, or neutral. Peatlands in Colorado are usually nutrient-poor, as the water source has flowed over granite or igneous rock.

Most high-elevation peatlands have basal C<sup>14</sup> dates from 7,000-14,000 years old. Peat-accumulation rates in Rocky Mountain wetlands range from 2,000-5,000 years/meter of peat. Cooper (1988) speculated that peatland ecosystems probably cannot be initiated in today's dry climate. (See also "Fens" and "Bogs")

### PLAYA LAKES

Playa lakes are ponds that are most obvious in spring as a consequence of snowmelt, precipitation, and high water tables. They are not necessarily statutory wetlands. They are free of fish and are, therefore, good habitat for invertebrates and amphibians.

### RECHARGE WETLAND

A wetland from which water flows to groundwater systems is a recharge wetland. This may be a temporary or cyclic feature of the wetland. (See also "Discharging Wetland")

### RIPARIAN WETLANDS

Riparian wetlands occur on the banks and floodplains of streams. Flooding, sediment erosion, and deposition occur frequently. Soils are mineral sediments (little organic matter accumulates). These wetlands are typically dominated by trees.

### SHRUB WETLANDS

Shrub wetlands support low-growing, multi-stemmed, woody plants. These may include forested woodlands that have been cleared and are in the process of regeneration.

### STREAMSIDE WETLANDS

Streamside wetlands are associated with streams with relatively large watersheds. Flooding is closely associated with spring thaw and regional (as contrasted with local) storm events.

#### TRIBUTARY WETLANDS

Tributary wetlands are hydrologically connected to surface waters via either surface or groundwater flows. The hydrologic connection may be intermittent or seasonal, but must normally reoccur annually.

Tributary wetlands do not include:

- constructed wetlands or
- created wetlands.

In general, tributary wetlands receive, as an interim classification, the classification of the wetland to which they are most closely connected. Relevant numeric standards apply; however, an adjoining Drinking Water Supply Classification does not apply except on a case-by-case basis. Ultimately tributary wetlands are assessed and receive a site-specific classification. (See *Glossary* for relevant regulations.)

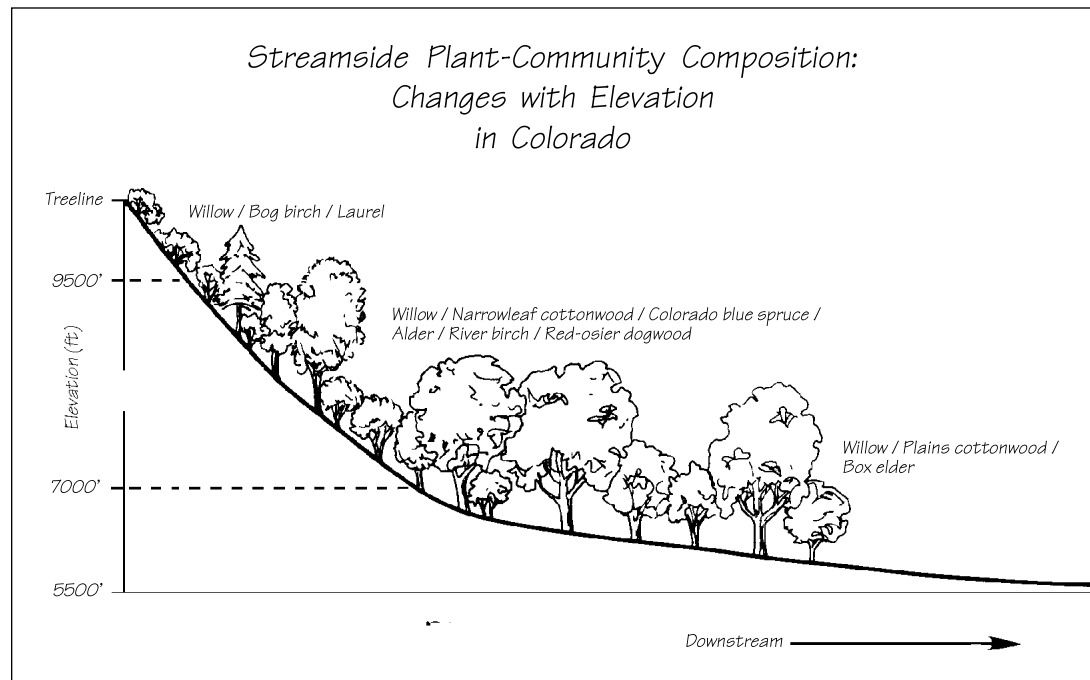
#### WET MEADOWS

Wet meadows exhibit saturated soils for long periods of time during the growing season (water table near the surface), but they do not experience deep flooding (8"). They are dominated by herbaceous plants (e.g., rushes). Water and soil may be fresh or saline.

#### WOODED WETLANDS

In wooded wetlands, trees are the dominant plants.

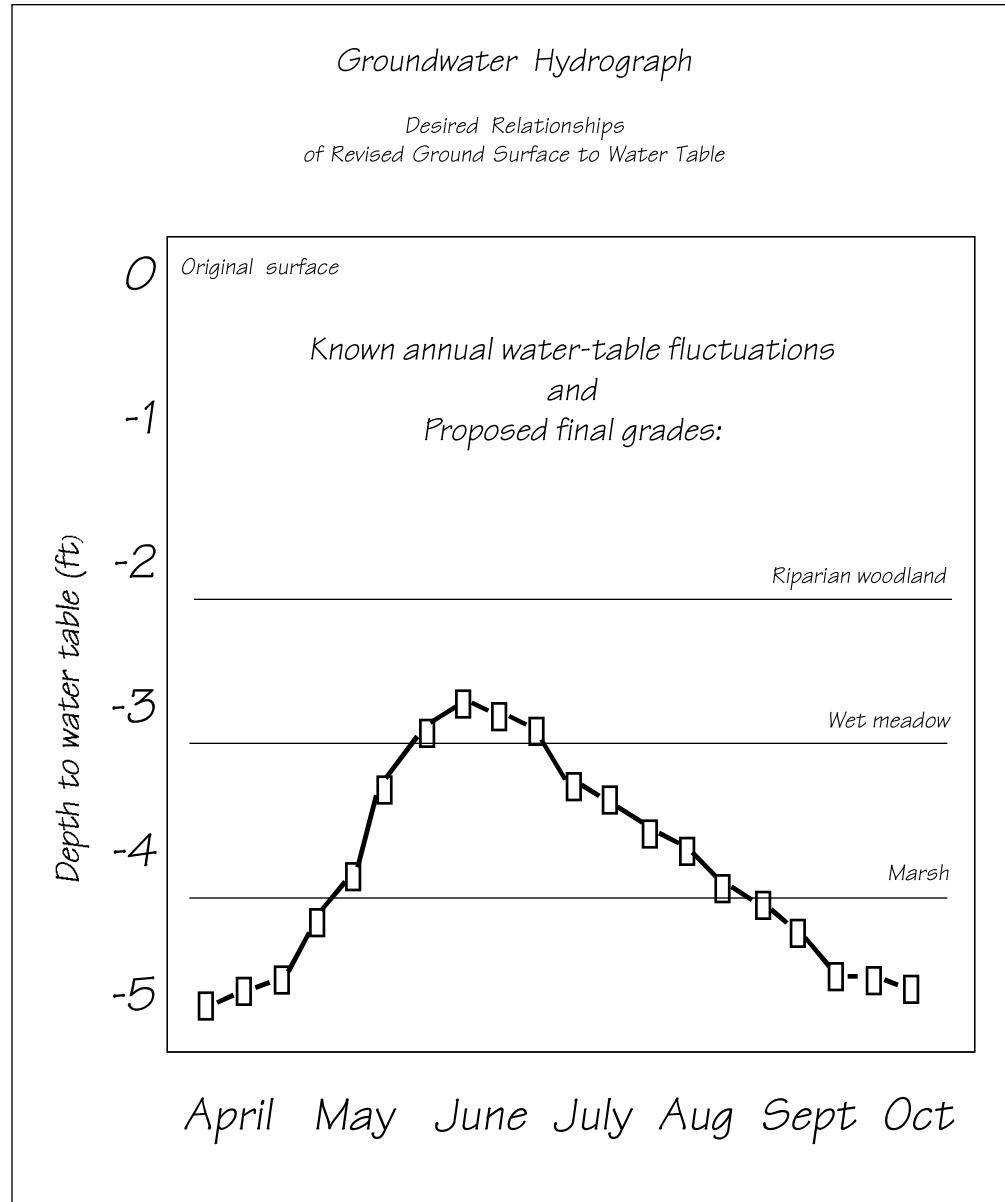
These include broad, bottomland forests in the floodplains of large rivers with very large watersheds. Accordingly, flooding is associated only with spring thaw and prolonged, regional storm events. Silt-laden floodwaters are an important source of nutrients. (See also "Forested Wetlands" and "Swamps")



(Illustration adapted from S.Q. Foster in U.S. Fish & Wildlife Service 1986)

Physical Factors  
to consider in  
riparian ecosystem management  
commonly include  
elements of hydrology related to  
natural (vs. accelerated)  
erosional processes such as:

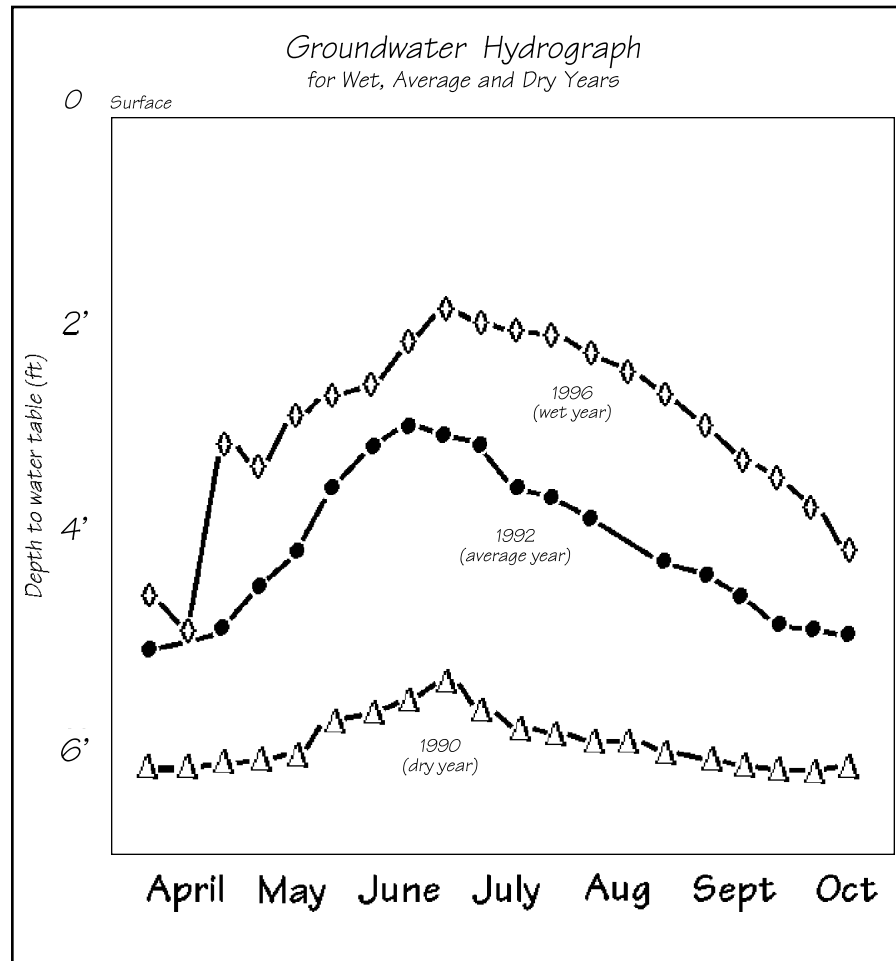
- (1) valley slope vs. channel slope,
- (2) runoff quantity/timing,
- (3) ice flows and aufeis,
- (4) degree of riparian soil compaction and infiltration,
- (5) types of erosion occurring within the watershed and the degree to which they are related to human activity,
- (6) permafrost,
- (7) water quality,
- (8) gully volume determinations to determine past soil losses and present storage capacity,
- (9) flow velocities and potential sites for water spreading to reduce velocities, and
- (10) potential areas of sediment deposition or accumulation and their storage capacities.



(Illustration adapted from P. Anderson-Goguen in EPA 1993)

#### GROUNDWATER HYDROGRAPHS

Groundwater fluctuates throughout the year, and levels vary from year to year. Records of these natural variations are essential baseline data for any vegetation, construction, or recreation plan regarding wetlands and adjacent sites. These two hydrographs illustrate compilations and applications of groundwater data.



(Illustration adapted from P. Anderson-Goguen in EPA 1993)

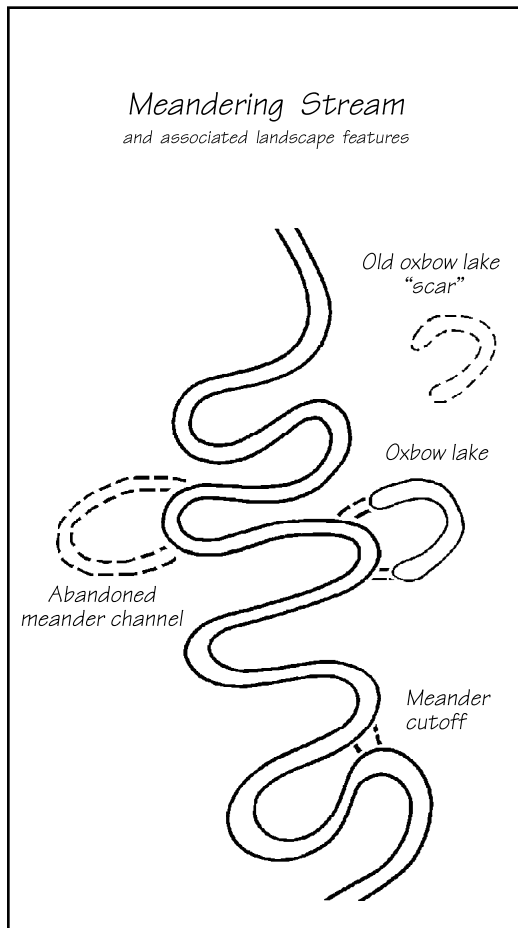
*Biological factors  
affecting the relationship  
of channel to valley slope  
include:*

- (1) native pioneer species  
of vegetation  
(e.g., willow, aspen, alder)  
and*
- (2) beaver.*

*These have moderated  
high-energy runoff and  
associated sediment transport  
through:*

- (a) spreading across floodplains,*
- (b) vegetative entrapment,*
- (c) development of  
sinuous meander patterns,  
and*
- (d) seasonal recharge  
of groundwater aquifers  
and riparian bank storage.*

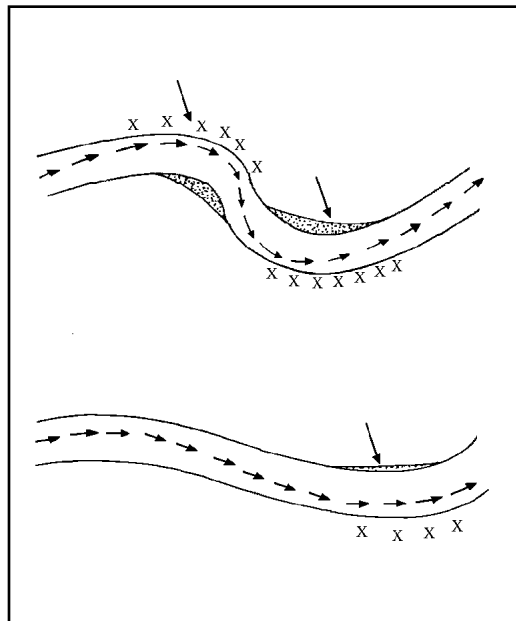




(Illustration adapted from S.Q. Foster in U.S. Fish and Wildlife Service 1986)

#### NATURAL MEANDERING OF A STREAM

A stream that is carrying a heavy load of sediment will often meander, cutting into outside banks and building point bars on inside bends (depositing some of its sediment load where water velocities are low). Because this is a natural process in many cases, managers of riparian systems must not assume that the changes observed are the result of human-induced disturbance.



Sharply and gradually curved bends under normal flow conditions; short arrows indicate the path of maximum stream velocity. During floodflow, this path broadens to include (erosion of) the point bar on the inside of the bends.

Look for indications that the stream has meandered historically. For instance, such a stream occasionally cuts off an increasingly exaggerated bend and abandons its channel, leaving an "oxbow" lake or an oxbow scar that may be sunken and/or vegetated by "wetter" plant communities than are characteristic of adjacent areas.

Other vegetation patterns associated with meandering streams include orderly stages of primary succession on what would have been an old point bar (inside bend) and abrupt boundaries against late-succession plant communities on what would have been an outer cutbank.

Headcutting (incision of a streambed) upstream, associated for instance with increased runoff or elimination of beavers and their dams, is likely to induce the cutting of banks downstream because of increased water velocities and abrasive sediment loads. A case-by-case decision must be made to (1) address the dynamics at their sources, (2) allow the changes to take their course, or (3) deflect the forces (the erosive current and sediment load) so that the impacts register further downstream in the system.