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How to Manipulate Water in a New, Restored, or Enhanced Wetland to Encourage Wetland Plant Establishment

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Factors affecting plant species distribution

Wetlands are dynamic ecosystems which are highly dependent upon disturbance and changing conditions. Hydrology is perhaps the most important factor in determining wetland type and quality, and it is usually the "easiest" to manage or manipulate. Changes in water levels influence species composition, structure, and distribution of plant communities. Wetland vegetation is primarily limited by hydrology. Water limits the diffusion of oxygen to buried seeds and root zones, which restricts germination and growth of most species. Wetland plants differ from terrestrial plants by having vigorous morphological and physiological mechanisms that enable them to tolerate inundation of their roots. Different species tolerate longer inundation than others. Too much water, especially during the growing season, will stress the plants which will limit growth and establishment. Complete inundation of most plant species, even wetland plant species, can be lethal. Therefore, it is very important to be able to ensure that the site will have enough water in the right place at the right time of year to support the plant species targeted for the planting area.

It should be noted that young plants that are just developing from seeds or plant fragments do not have the same flood-tolerance as mature plants of the same species. Young plants are very susceptible to complete inundation, particularly during the growing season. Establishment success of herbaceous emergents, shrubs and trees is often increased if water levels are controlled the first one or two years to allow only short flooding periods and saturated substrates.

The plant species themselves are good indicators of conditions on the site. They can help you determine the frequency and duration of inundation and help you determine soil conditions and potential planting plans by mapping or reading the plant distribution. It is important to note that the different growth forms of the pants indicate conditions over time. As one would assume, tree life spans are longer than herbaceous species. Often conditions under which a tree species was established may have changed over time, where as short-lived species are more likely to reflect recent conditions. If there is a difference between the environmental tolerance ranges between herbaceous species and tree species, this could indicate a change has occurred at the project site.

Water quality is another factor that determines where different wetland plant species will establish. Water quality factors, such as nutrients, pH, alkalinity, turbidity, salinity, and toxins are important to consider when developing your planting plan. Since most wetland plants acquire their nutrients from the soil, water quality is more important when considering floating leafed wetland species which acquire nutrients from the water column itself.

Understanding the soils in a wetland site is crucial to the success of a planting project. Look at whether there is a stable rooting layer to an adequate depth for the target plant species. Soil texture interacts with the hydrology and ground surface slope to determine the drainage capacities of the site. This will affect the period of inundation. The soils also provide the nutrients necessary for growth and maintenance.

The root penetration depth can be used to determine where to plant different plant species. Identify if an impenetrable layer (i.e. clay, calcic, gravel, or rock) is located on the project site. Remember, rooting depths differ by plant species. Generally, most fine roots that absorb nutrients are in the top foot of soil. It the layer is deeper than one ft, rooting depth is not a problem for herbaceous species and shrubs. Trees, however, will require soils that are much deeper for increased stability against wind and currents.

Besides determining what species will grow on a site based on rooting depth, the impenetrable layer will also affect drainage on the site. It can help in some cases because it will maintain the wetland conditions. If, however, the layer can create undesirable standing water conditions, the layer will need to be broken up or the planting moved to a more appropriate location.

Water management is absolutely critical during plant establishment, and remains crucial throughout the life of the wetland for proper community management. When designing a wetland project, make sure that the design engineers thoroughly understand the importance of water control to the establishment, management, and overall function of the vegetation in the wetland system. If hydrologic control is not built into the system from the start, plant establishment may be severely inhibited, and opportunities for future plant community management will be handicapped. Ideally, you should be able to control the amount of water coming in and going out of the system.

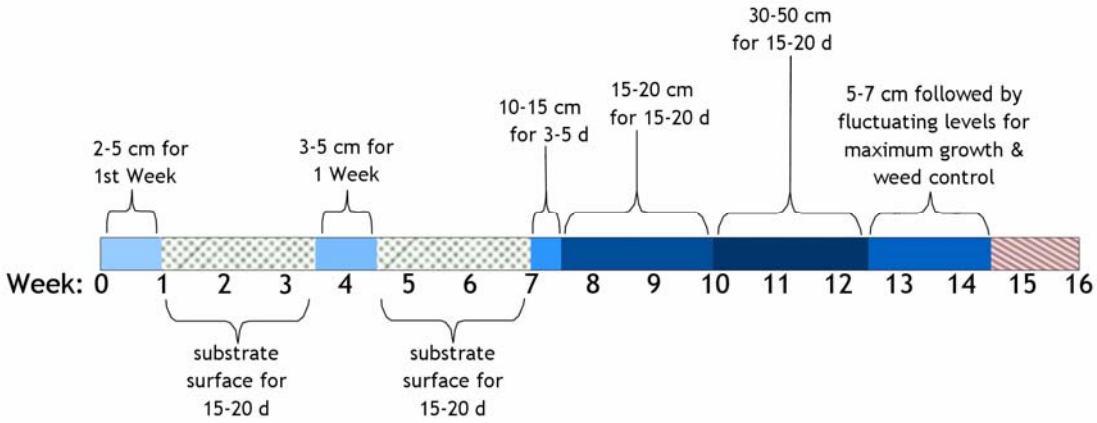
Here is a simple chart to help determine what water depths common wetland plant species need:

Plant Growth Form	Average Water Depth (in.)
Submergents (e.g. pondweeds, elodea, milfoil, etc.)	**>36**
Floating Leaved (e.g. lotus, water lily, spatterdock)	**18-120**
Herbaceous emergents (e.g. bulrush, spikerushes, cattails, etc)	**0-36**
Shrubs (e.g. willows, dogwood, buttonbush, etc) Note: water should be around the shrubs no longer than 3-4 months MAX	**0-8**
Trees (e.g. willows, cottonwood, sycamore, etc) Note: water should be around the shrubs no longer than 3-4 months MAX	**0-8**

Water manipulation schedule

After the initial planting of emergent vegetation, be careful not to raise the water level to more than 2- 3 cm (about 1 in.) above the substrate. Too much water during the initial establishment of new plants will result in severe stress to the new plants. Maintain the water at 2- 3 cm for about one week. This will inhibit the germination and growth of any terrestrial species that may be present in the new wetland. The water level can then be lowered to the substrate surface for 15- 20 days. This will expose the mud surface, stimulating any wetland seeds that were brought in with your transplants (if used) or by waterfowl to germinate as well as increase the rate of spread of the transplants. You can then raise the water level to 3- 5 cm (1- 2 in.) for another week. Then lower the water to the substrate surface for another 15- 20 days. After this period, slowly raise the water level to 10- 15 cm (4- 6 in.) for 3- 5 days. Continue to gradually increase the water depth to 15- 20 cm (6- 8 in.). The aerenchymous tissues in the plant shoots supplies the roots with oxygen, so be careful not to raise the water level over the tops of the emergent vegetation. If the plants are not showing stress, continue to carefully raise the water level to 30- 50 cm (12- 20 in.) if possible. The goal here is to inundate the transition zone between wetland and upland as much as possible to control any invading terrestrial species. After about 20 days, lower the water level to about 5- 7 cm (2- 3 in.). For the rest of the growing season, adjust the water level to maximize the desired community type. The key to determining the appropriate water level is to monitor the emergent wetland

plant community. Raise the water level if weed problems surface. Lower the water level to encourage emergent wetland plant growth and spread.



Ideally, the water level should be raised to 10- 15 cm (4- 6 in.) or more before the onset of winter. This allows for free water between the ice and the substrate to protect the roots of the plants from freezing. Be extremely careful however, as you don't want to drown the plants. In areas that do not have ice buildup, keep the fluctuating schedule.

In many areas of the Intermountain West, water availability is tied to the irrigation season and therefore not available through the winter months. Many western wetlands are dry for most of the winter, but recover with little damage in the spring. During the second spring, raise the water level again to flood most of the transition zone. Maintain this level until warm weather sets in and new growth has started. Once the wetland vegetation starts to grow, lower the water to the level of the substrate for 5- 10 days followed by 1- 2 cm (1/2 in.) of water for 2- 3 days. Again, lower the water to the surface of the substrate for 5- 10 days or more. This creates a warm moist mud flat situation, which is ideal for the germination and growth of wetland seeds that may be in the wetland. When new plant growth is evident gradually raise the water level to 8- 10 cm (3- 4 in.). Again, for the rest of the growing season, adjust the water level to maximize the desired community type.

Monitor weed incursion and emergent plant stress. Treat the fall and winter water levels the same as the first year. Once the wetland is well established, the water levels can be manipulated to maintain the desired conditions for your system. The key to remember is that wetland plant communities are dynamic and require a fluctuating water level to remain healthy and to function properly.

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