Selecting Wetland Mitigation Sites Using a Watershed Approach

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Ecology Publication #09-06-032
December 2009

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Make sure you have the most recent version of this document
Due to the dynamic nature of wetland science, this document is subject to revision. As we learn more on the science of wetland restoration, and as we receive suggestions from users for improving this guide, the document will be periodically updated. Make sure you have the most recent version. You can find the most up-to-date version at: www.ecy.wa.gov/mitigation/resources.html.

This report should be cited as:

Hruby, T., K. Harper, and S. Stanley (2009). Selecting Wetland Mitigation Sites Using a Watershed Approach. Washington State Department of Ecology Publication #09-06-032.

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Selecting Wetland Mitigation Sites Using a Watershed Approach

The Washington Department of Ecology (Ecology), U.S. Army Corps of Engineers Seattle District (Corps), and the U.S. Environmental Protection Agency Region 10 (EPA) (collectively the Agencies) prepared this guide on selecting mitigation sites for unavoidable wetland impacts. The Agencies encourage state, federal, and local decision-makers, as well as project applicants, to use this guide as one step in the process of making decisions on compensatory mitigation projects. The goals of this guide are to improve mitigation success and to better address the ecological priorities of Washington's watersheds. We provide specific recommendations on how to apply a watershed approach when selecting sites and in choosing between on-site and off-site mitigation in western Washington. A similar guide is planned for eastern Washington.

Use of this guide is not required by the authoring agencies, but the federal rule on compensatory mitigation does require that some type of watershed approach be used in siting mitigation. This guide is offered as one way to fulfill that requirement.

Background

Permitting agencies require compensatory mitigation when applicants cannot reasonably avoid all impacts to wetlands and their functions and values. State and national studies of wetland mitigation, however, show a disappointingly low success rate in meeting performance measures and replacing wetland functions (Ecology 2002; National Research Council 2001). The studies identify a number of reasons for this including poor site selection. Our past policies and practices have over-emphasized the need to replace lost functions at or near the wetlands impacted (the impact site), rather than choosing mitigation sites that best fit with the mitigation goals of the project and its contributing basin. The studies demonstrate a clear need to change this approach.

> ***Watershed Approach*:** A *watershed approach* when used in selecting sites for mitigation is based on:
>
> 1. Understanding how ecological processes, such as the movement of water, determine the characteristics and ecological functions in a drainage basin (watershed). NOTE: There are no size limits to the drainage basin used for the analysis. A watershed approach can be used in small drainage basins that are only several square miles in size to entire river basins such as the Snohomish River.
> 2. Determining the extent to which the processes have been altered (e.g., change in groundwater flows resulting from loss of forests).
> 3. Identifying areas where these processes can be most effectively restored, and where they need to be protected.
> 4. Assessing the role restoration, including compensatory mitigation, can play in repairing those processes and replacing wetland functions lost in the watershed.

In the last ten years we have seen a shift in national and state policies towards using a watershed-based approach to choose mitigation sites. Recent guidance recommends that mitigation be done in areas where ecological processes can best be restored, unless it is necessary to maintain the affected functions on or near the impact site (Ecology et al. 2006, USACE & EPA 2008). While this shift in policy is becoming widespread among regulatory agencies[1], we see a lag in applicants actually using a watershed approach when selecting mitigation sites. This guide clarifies our agencies' support of this change and provides practical tools that will help close this gap.

This guide promotes mitigation that is located appropriately on the landscape, addresses restoration of watershed processes, is sustainable, and has a high likelihood of ecological success. On-site mitigation may achieve these goals in many circumstances. However, we should not risk mitigation success or bypass opportunities for improving ecological processes in a watershed by unnecessarily prioritizing on-site mitigation over more effective and sustainable off-site options.

Appendix A (a separate document available at: www.ecy.wa.gov/mitigation/resources.html.) presents more information on the importance of using a watershed planning framework and includes an example of how watershed planning can be applied to identify solutions to specific problems in a watershed. This appendix also explains the connection between ecological processes and wetland structure and functions.

Sustainable mitigation site

Mitigation is often targeted at replacing specific functions at a site. The goal is to maintain these functions for many years into the future. A site is considered sustainable if the functions can be maintained without long-term management or maintenance. Unfortunately, many watersheds have been so heavily disturbed by human activities that the functions at a site can no longer be maintained by ecological processes in that watershed. In this case, a site is considered not sustainable because maintaining the functions in time will require continuous management to counteract the effects of the altered processes.

Scope of this Guide

This guide is meant to help users select the best locations for wetland mitigation sites. The Agencies recognize that selecting a site is a complex process involving many variables. This guide simplifies the process by asking questions that characterize the potential of a site to be sustainable, restore watershed processes, and replace the functions lost in other wetlands. The guide does not help users to design site-specific mitigation plans, although it does identify some issues that need to be addressed in a mitigation plan. There are two parts to this guide: **Part 1 guides users in locating a mitigation site by analyzing the watershed and its general functions.** Analyzing the watershed also helps determine whether a potential site will be sustainable.

Part 2 characterizes the constraints and issues that might be present in, or immediately adjacent to, a site. This analysis can be used to determine what functions can be mitigated at a site. It also identifies the major elements that need to be included in a mitigation plan specific to the site.

[1] Most local jurisdictions in Washington that have revised their critical areas ordinances (CAOs) in the past 5 years now allow for off-site mitigation, typically with a preference for it being within the same drainage basin, sub-basin or watershed as the impact site. Many include language urging consideration of landscape principles in siting mitigation. In some cases, limits by local CAOs may necessitate modifying the methods used in this guidance.

This guide does not include strategies for avoiding or minimizing impacts. We assume that this step in the mitigation process has been taken before the need for compensatory mitigation is established. For existing information on avoidance and minimization of impacts see the documents listed below. Additional guidance on this topic is being developed by federal agencies and is expected to be published in 2010.

- Compensatory Mitigation for Losses of Aquatic Resources, Final Rule, 33 CFR Parts 325 and 332 and 40 CFR Part 230 (http://www.epa.gov/owow/wetlands/pdf/wetlands_mitigation_final_rule_4_10_08.pdf)

- Regulatory Programs of the Corps of Engineers, Final Rule, 33 CFR Part 320.4(r) (http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title33/33cfr320_main_02.tpl)

Regional limits of this guide:

- This guide is intended to be used in western Washington, west of the Cascade Divide. We do not advise using it in the semi-arid areas east of the Cascade Range where the geology and rainfall patterns are quite different. In the future, we hope to develop a separate guide for selecting mitigation sites in eastern Washington.

- This guide is not intended to be used in locating estuarine mitigation sites as it does not address many of the ecological processes at work in estuarine settings. The Agencies continue to support a policy of compensating for impacts to estuarine wetlands by mitigating in estuarine settings.

- This guide considers ecological processes in floodplain areas but it does not address mitigating for in-channel stream impacts.

Who Should Use This Guide

This is a technical guide intended for use by wetland consultants, biologists, hydrologists and other practitioners with some familiarity with landscape processes. It is important that the person applying this tool have experience and/or education in hydrologic processes and how they affect wetland functions. The guide will typically be used by those designing wetland mitigation. We advise permit applicants who need to mitigate for adverse wetland impacts to hire a qualified consultant to apply the approach explained in this document.

Making Choices Using a Watershed Approach

In urbanizing areas, many functions wetlands provide may not be sustainable long term. This may be particularly true for wetlands in a highly altered landscape where ecological processes are unlikely to be restored and losses in wetland functions are expected to increase with development (Azous and Horner 2001). In such cases, it may be preferable to compensate for impacts to those wetlands by locating mitigation sites in nearby drainages that have a lesser degree of urbanization. In this way, the mitigation site has greater potential to provide functions over time. By reducing the risk of failure that results from ongoing development, we can achieve a net gain in wetland functions and also restore lost or damaged watershed processes.

In some cases proposed alterations to a wetland will impact a function or value that is very important in the immediate area of the site. For example, a wetland in an urban area may provide significant recreational and educational opportunities for local residents. Also, the wetland may be receiving untreated stormwater, thus providing water quality and hydrologic functions to the immediate area. These types of functions and services may need to be replaced on-site. If so, it may be necessary to mitigate at two sites: on-site to replace the functions and services that cannot be moved elsewhere and off-site for all the rest. For example, if a wetland that will be impacted is retaining stormwater, a stormwater facility can be built on-site and the other functions, such as habitat, can be replaced elsewhere. In many cases in urban areas, the landscape setting may preclude replacing habitat functions on site unless the project sponsor provides intensive long-term management and maintenance.

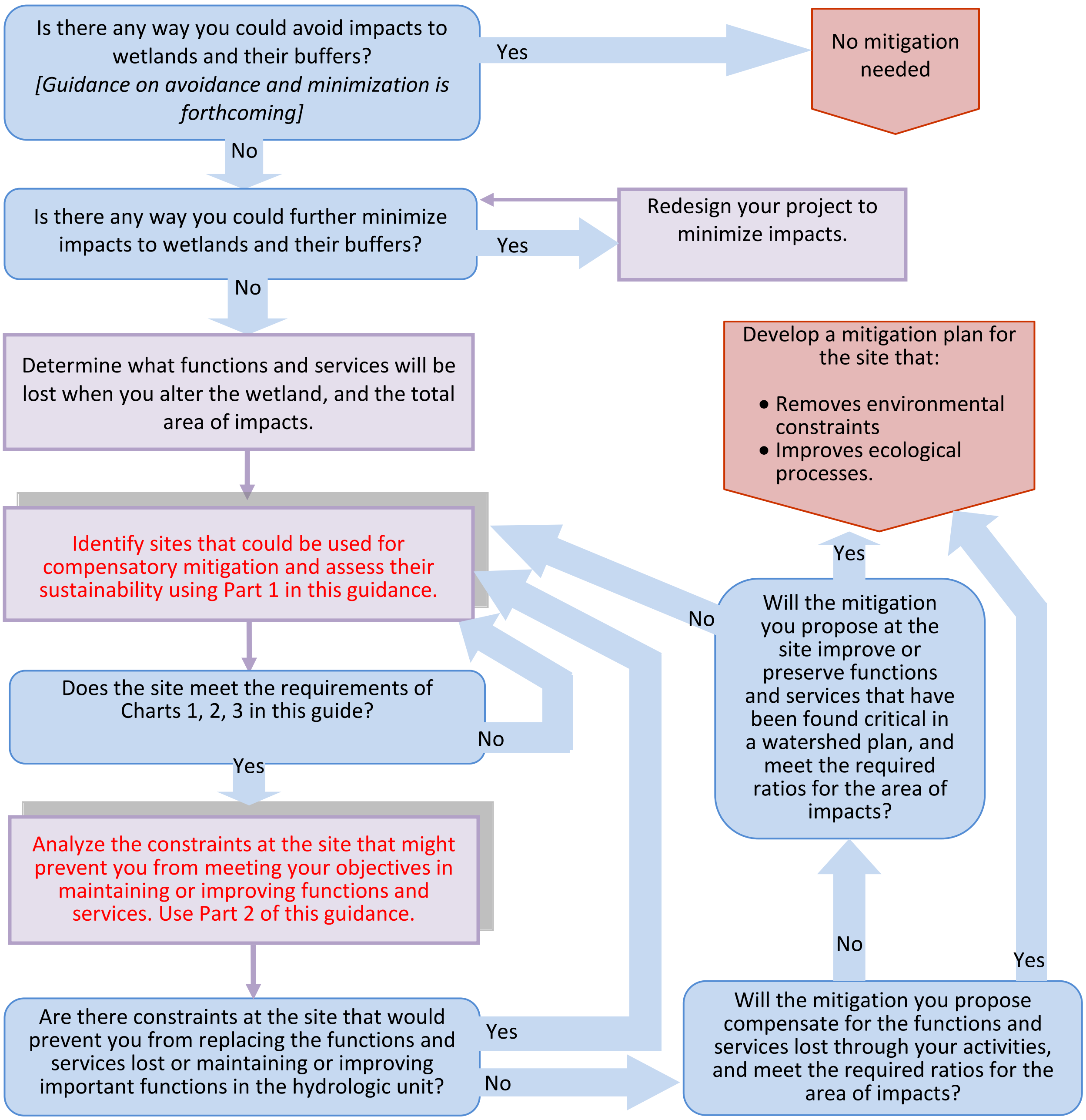
Current research indicates that on-site mitigation in urban and urbanizing areas is not sustainable without continual monitoring and maintenance to counteract the effects of human disturbance. For example, re-creating a plant community indicative of less disturbed conditions will require continual removal of opportunistic (invasive) species that are better adapted to disturbed sites.

The Process for Selecting Mitigation Sites

It is a complex process to select a mitigation site that has a good chance of being sustainable and that also compensates for the functions and services (also called "values") lost at the impact site. First, you must identify the functions and services lost at the impact site, then you must try to find a site where those functions and services can be compensated, and finally you must determine if the mitigation will be feasible and sustainable. Figure 1 provides a graphical representation of the steps that must be taken in selecting an appropriate mitigation site. This guide addresses only two of the steps in the process (shown in red font): 1) selecting potential sites using information from the surrounding hydrologic unit (see definitions below) and 2) identifying constraints that may be found at individual sites.

Figure 1: Process for Selecting Mitigation Sites

Note: This document provides information on only the two steps that are shown in red font with boxes highlighted by a shadow.



Defining Geographic Scales in Watersheds

This guide uses ***hydrologic unit*** as a general term referring to drainage areas of varying size on the landscape, and ***contributing basin*** as a specific term referring to the area that drains to a particular aquatic resource. Hydrologic units are often called watersheds, but over time the latter word has come to mean, for many people, a hydrologic unit of a certain size only (e.g., Water Resource Inventory Areas [WRIAs] or the drainage area of a large river such as the Skagit). Smaller hydrologic units are given other names such as basins or sub-basins. This has created much confusion when terms such as ***watershed processes*** or ***watershed characterization*** are used.

In this guidance, ***watershed*** is used as an adjective to describe processes and tools that apply throughout a drainage area, except as noted below in the classification of hydrologic units. Thus, when used as an adjective, watershed can mean a drainage area at whatever scale is being discussed.

Hydrologic unit: A geographic area representing part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature. The United States is divided and sub-divided into successively smaller hydrologic units. In Washington and Oregon we have standardized names for eight hydrologic units of progressively smaller geographical scale. The largest is r***egion***, followed by s***ubregion, basin, subbasin, watershed, subwatershed, catchment*** and ***subcatchment***. Each unit is identified by a unique ***Hydrologic Unit Code*** (HUC). Scientists and geographers use a shortened version of the code to represent drainage areas of different scales. Thus a region is often called a HUC-1, subregion is HUC-2, and so on. The last, subcatchment, is a HUC-8. Under this system, watersheds are generally about 200 square miles in size and subwatersheds are about 40 square miles in size. A subcatchment is often only a few square miles in size and is more commonly used by local governments in watershed planning.

Watershed characterization: An analysis of existing and potential watershed processes in a hydrologic unit. A characterization can be done at any geographic scale described above. The characterization of the drainages into Birch Bay in Whatcom County is an example of a characterization done at the subcatchment scale. The characterization of Clark County, on the other hand, is at the subwatershed to catchment scale. These examples can be found at: http://www.ecy.wa.gov/mitigation/landscapeplan.html. A watershed characterization is the first step in a ***watershed approach*** (see definition on page 1).

Contributing basin: The drainage area of an individual wetland or other specific aquatic resource, such as a stream reach or lake. This is the area that contributes surface and groundwater to the site. The contributing basin may be very small for “kettle-hole” wetlands and very large for riverine wetlands near the mouth of large rivers. Most discussions of contributing basin, however, refer only to the areas contributing surface water because it is very difficult to map the sources of groundwater to individual wetlands.

Watershed Processes: The dynamic physical, biological, and chemical interactions that form and maintain the landscape and ecosystems in a hydrologic unit. These processes include the movement of water, sediment, nutrients, pathogens, toxins, and wood as they enter into, pass through, and eventually leave the hydrologic unit.

PART 1: Analyzing Mitigation Sites at a Watershed Scale

In this guide we urge users to:

1. Locate mitigation activities where they will help protect or restore ecological processes that are important in the hydrologic unit as well as on the site (Dale et al. 2000).
2. Characterize hydrologic units in advance of mitigation to:
   - determine where critical watershed processes have been altered and where they are still intact, and
   - prioritize areas for protecting and restoring those processes and related functions.
3. Select a site based on the principles of landscape ecology when a watershed characterization does not exist (see Charts 2 and 3 in this guide).
4. Select on-site mitigation when:
   - the wetland functions at the impact site are important to the ecological processes of the hydrologic unit, and
   - the opportunities for improving functions on-site have a high likelihood of being successful and sustainable.
5. Be aware that the impact site may provide services or values such as "green space" or recreation that cannot be addressed in terms of functions and the sustainability of the proposed mitigation. These may need to be replaced on site and actively managed to counteract the impact of continuous human disturbance that would degrade these functions and services.
6. Allow for options that may sometimes result in wetlands of different types (e.g., different hydrogeomorphic class) or that provide different functions than the impacted wetlands. This may be preferable from an ecological perspective if the watershed characterization shows that the restored processes and functions are more important in the watershed than those lost at the impact site. The final decision however, still lies with the agencies approving the permits.
7. Be aware that it may be difficult to show that trade-offs between functions and wetland types are appropriate in the absence of a watershed characterization. Applicants will have to provide much more information to the regulatory agencies to support trade-offs in this case.

NOTE: Certain wetlands are not replaceable, or are very difficult to compensate for. Examples include bogs, alkali wetlands, and mature forested wetland. For guidance on identifying and managing these types of wetlands, refer to:

- Wetland Mitigation in Washington State – Part 1: Agency Policies and Guidance (www.ecy.wa.gov/biblio/0606011a.html)
- Washington State Wetland Rating System for Western Washington (www.ecy.wa.gov/biblio/0406025.html)
- Best Available Science for Wetlands, Vols. 1 and 2 (www.ecy.wa.gov/program/sea/wetlands/bas/index.html)

Following One of Two Paths

Watershed plans typically require computerized mapping (Geographic Information Services - GIS) and analysis. Such analyses are resource-intensive and are usually done by county or tribal planning departments with the support of state or federal agencies such as Ecology, Washington Department of Fish & Wildlife (WDFW), or EPA. When possible, mitigation sites should be selected using watershed plans that take into account the ecological processes of the area (Path 1, Chart 1). When there are no existing watershed plans of this type in an area, criteria such as those presented in Chart 2 should be used (Path 2).

Path 1 (starting with Chart 1)
This chart helps users determine whether existing watershed planning documents are appropriate for selecting mitigation sites and explains how this information can be applied. Where relevant watershed plans are available, mitigation sites should be located in areas targeted by those plans for restoring ecological processes. Plans may identify specific restoration sites, or they may only target broader areas for mitigation or restoration. Characterizing watershed processes and planning for restoration priorities are steps that can be effective in reducing the uncertainties involved in choosing a mitigation site.

Many existing watershed planning efforts focus on improving habitat and stream flow for fish. Other watershed planning documents include plans for maintaining biodiversity or restoration to meet the needs of local shoreline master programs. These planning efforts, however, generally have not used a systematic approach to identifying the best areas for restoring or protecting ecological processes. To meet the need for finding sustainable mitigation sites, watershed plans need to focus more specifically on analyzing the alteration of watershed processes and the consequences these alterations have for the landscape and associated aquatic resources.

There is no standard method for characterizing watersheds, and a variety of tools are available. Ecology has developed one method to characterize watershed processes and develop management plans based on the results. The approach is described in *Protecting Aquatic Ecosystems: a Guide for Puget Sound Planners to Understand Watershed Processes* (available at http://www.ecy.wa.gov/biblio/0506027.html). This method is useful for planning in watersheds in western Washington. Some local jurisdictions in Washington have completed watershed characterizations using the method developed by Ecology, some have used other methods based on wetland or shoreline inventories, and others have focused primarily on watershed planning for fish habitat. The following link provides examples of landscape planning documents: http://www.ecy.wa.gov/mitigation/landscapeplan.html.

Shoreline Management Plans:
Updated Shoreline Management Plans provide summaries of environmental information for wetlands and streams, including water quality, quantity and habitat conditions, and recommend restoration actions. Links to completed shoreline planning documents by county are available at: www.ecy.wag.gov/program/sea/sma/local_planning/index.html.

Characteristics of Watershed Plans for Selecting Mitigation Sites:
While there is not one "correct" method to follow, and different approaches may have different objectives, watershed plans should generally have the following characteristics if they are to be used to locate mitigation activities:

- Use an analytical approach based on existing data (e.g., precipitation, geology, stream flow, topography) to identify areas important to watershed processes.
- Assess how those areas have been altered, and identify the most suitable areas for protection and restoration.
- Identify specific restoration goals for wetlands and other aquatic resources in the watershed.
- Identify specific areas or individual sites where restoration should be targeted.
- Discuss the connections between the functions of wetlands and other aquatic resources and watershed processes.
- Do not focus on a single species.

Path 2 (starting with Chart 2)
This chart provides criteria for selecting mitigation sites in areas where watershed planning has not been done. In areas lacking watershed plans, it can be difficult to know where to start looking for mitigation sites. Applicants often select sites based primarily on technical feasibility of construction, availability of the land, and cost. While these are important considerations, they should be considered only <u>after</u> sites that could contribute to restoration of watershed processes based on the criteria described here are identified. Path 2 can also be applied to areas with an existing watershed plan that does not meet the criteria listed in the preceding box under Path 1. This type of watershed plan can be used to inform your decision but potential mitigation sites should be run through Chart 2.

Chart 2 in combination with Chart 3, helps users place potential mitigation sites in their landscape context but does not identify important restoration areas based on the level of disturbance to ecological processes. This approach is clearly less desirable than Path 1 in that it leaves greater uncertainty as to whether the selected mitigation sites will be effective in restoring ecological processes. However, in the absence of watershed plans, Path 2 gives the user basic information on the sustainability of a mitigation site in the long-term.

Using the Charts

Part 1 of this document includes three charts that guide the user through a series of questions on characteristics of the hydrologic unit and potential mitigation sites. The charts help the user determine if a specific mitigation site can address problems at both the landscape and site scale and if it will be likely to be sustainable in the long term.

To use the charts:

- Begin with Chart 1 if there is a relevant watershed plan for the impact site area (i.e., meets characteristics listed above under Path 1). The chart provides guidance on using a watershed plan to choose between on-site and off-site mitigation.
- Begin with Chart 2 if there is no relevant watershed plan for the impact site area. Chart 2 provides guidance for selecting a mitigation site based on the extent of alterations to the hydrologic unit.
- After completing Chart 1 or 2, use Chart 3 to evaluate sites for their potential to address alterations to watershed processes and to provide successful and sustainable mitigation.
- The answers to some of the questions in Chart 3 require more detailed explanations than can be included in the graph. These are numbered (Question 3A, 3B, etc.) and are described in the text after the charts.

Choosing a Hydrologic Unit

When starting Chart 2, begin your analysis in the hydrologic unit in which the contributing basin of the impact site occurs. Most counties and cities in Washington have already divided their areas into hydrologic units of different scales. Use the smallest unit defined by the local jurisdiction in their planning efforts. These may be called sub-units, drainages, or other terms not consistent with the terms used at the national level. **When the chart suggests looking for off-site mitigation in a different hydrologic unit, it means look in hydrologic units of the same scale adjacent to the one where the impacts will occur.**

Chart Symbols

- **Blue ovals** = yes/no questions.
- **Purple rectangles** = information you need to collect and analyze before going on to the next step.
- **Red pentagons** = the end point in the chart and where to go as a next step.

Note: The charts include recommendations for selecting mitigation sites. **The final decision is always up to the regulatory agencies.** Those planning mitigation should consult other relevant documents (see "Finding Other Resources") and contact permitting agency staff (including Corps, EPA, Ecology, WDFW, etc.) early in the process.

Chart 1: Analyzing Potential Wetland Mitigation Sites Using Existing Watershed Plans

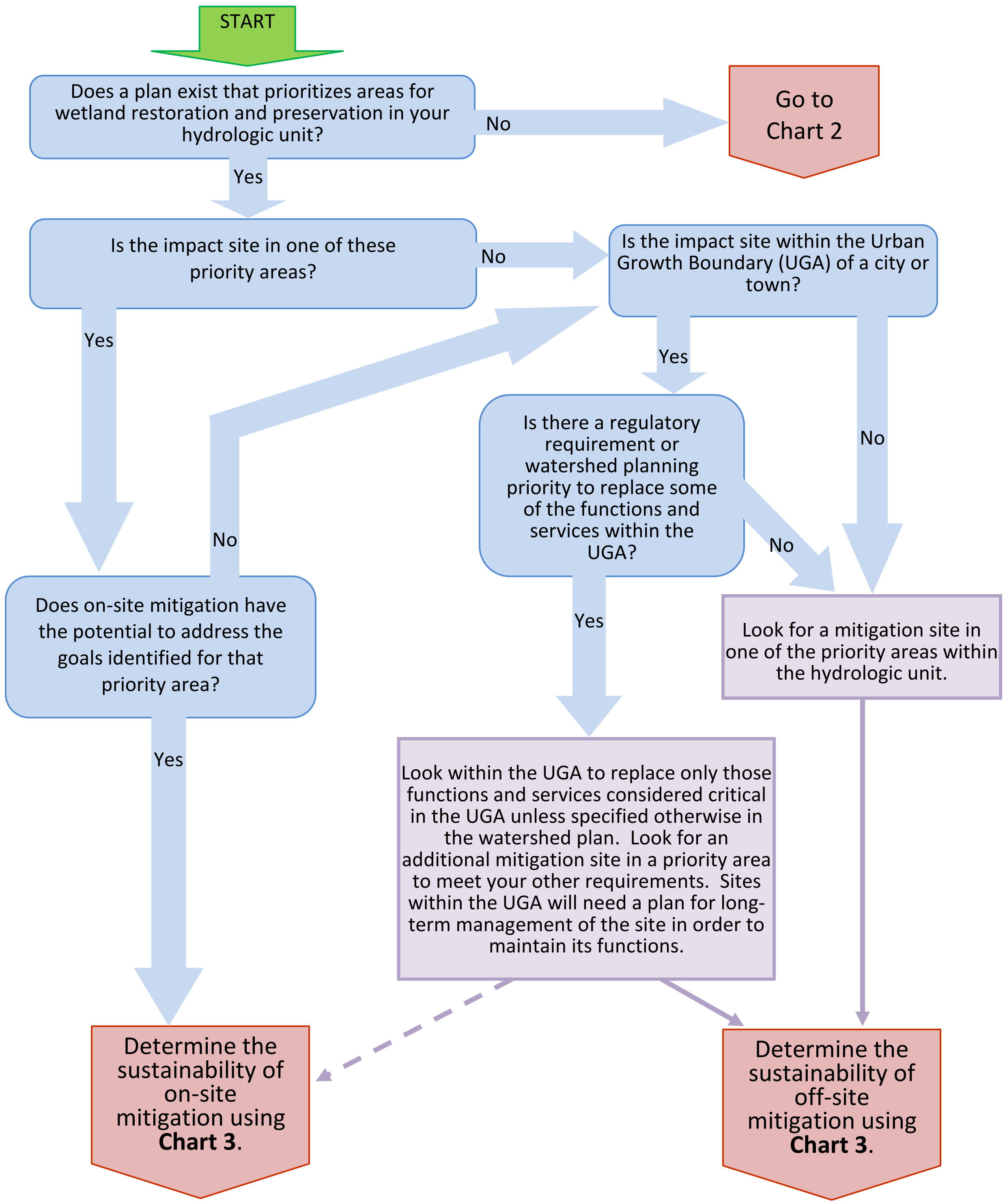


Chart 2: Analyzing Potential Wetland Mitigation Sites Without a Watershed Plan

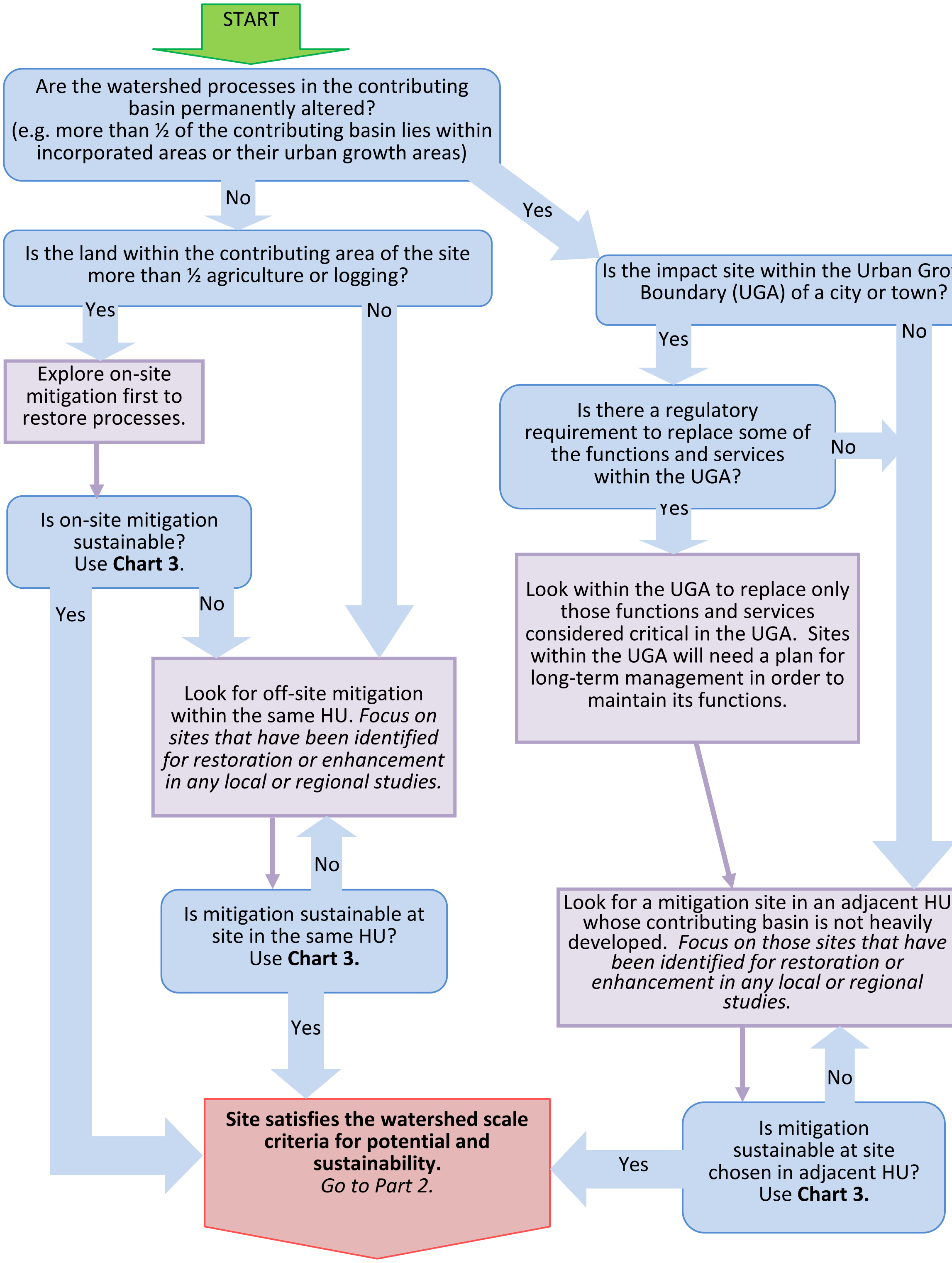
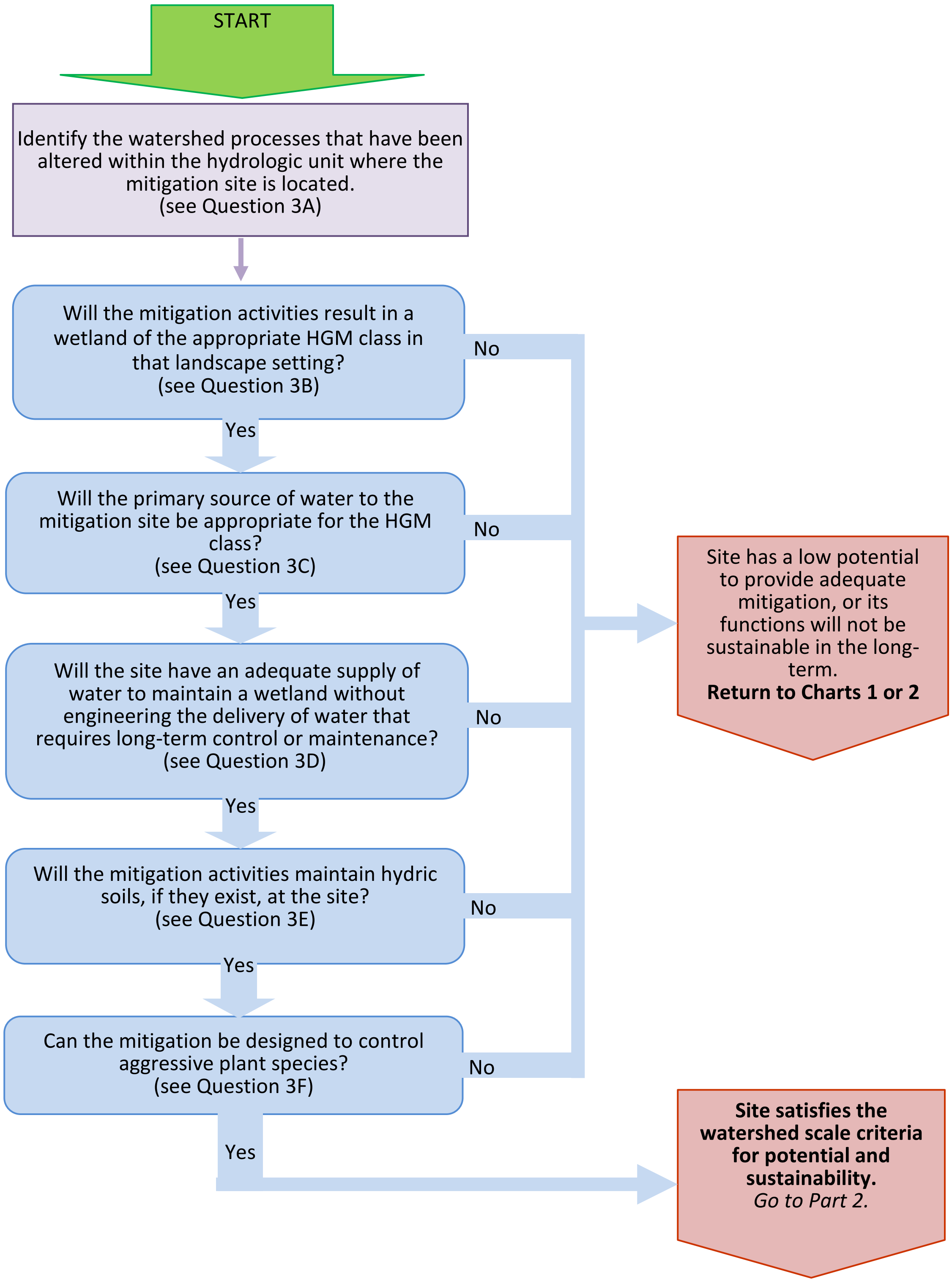


Chart 3: Analyzing the Potential of Sites to Provide Sustainable Mitigation in a Watershed Context



Question 3A: Identify the watershed processes that have been altered within the hydrologic unit where the mitigation site is located.

Human activities can change watershed processes by changing water flows; introducing nutrients, pollutants, non-native species, and sediment; and by fragmenting habitats. Changes in these processes often create problems that can be improved through mitigation activities.

To begin you need to identify the major landscape-scale problems (i.e., alterations to processes, not structure) that exist in the hydrologic unit where your site is found. This will help you identify which restoration or enhancement actions will be the most effective in that hydrologic unit. Check the appropriate column in the following table to identify problems that might exist. The last column notes if the altered process has already been identified in an existing watershed plan as a problem that needs to be addressed.

Problems caused by altered watershed processes in the hydrologic unit	Yes	No	In watershed plan?
Increased flooding			
Eutrophication in streams, rivers, and lakes			
Impaired water quality			
Erosion of stream and river banks that threaten human and natural resources			
Fragmentation and loss of habitat			
Other ____________ (especially if noted in a plan)			

Question 3B: Will the mitigation result in a wetland of the appropriate hydrogeomorphic (HGM) class for the landscape setting?

Wetland mitigation sites are sustainable only if the type of wetland being proposed is appropriate for its position in the landscape. The HGM classification of wetlands is based on characteristics of water movement and position in a landscape. Therefore, it can be used to identify appropriate wetland types for different locations in a hydrologic unit.

Use the following table to verify if the wetland you propose for mitigation is of the appropriate HGM class. For more detailed guidance on determining HGM class, see the Washington State Wetland Rating System, pp. 24-31 of Part 2 of the western Washington volume, or pp. 21-25 of the eastern Washington volume. These documents can be found at: http://www.ecy.wa.gov/programs/sea/wetlands/ratingsystems/index.html.

Landscape Setting	HGM Class	Major Characteristics of Site
Along shores of marine waters and river mouths	Tidal Fringe	Mitigation site would have water levels controlled by tides.
Terraces where rainfall is the only source of water and tops of hills at higher elevations (e.g. blanket bogs)	Flat	Topography in the mitigation site would be flat and precipitation would be the only source of water.
Fringe along lakes	Lake-fringe	Mitigation site is on shores of body of permanent open water that is greater than 20 acres, and at least 30% of the open water area is deeper than 6.6 feet (2 meters).
Hillside slopes	Slope	Mitigation site would have water flowing through the wetland in one direction without being impounded.
Areas that are flooded at least once every two years from a river or stream	Riverine	Mitigation site would be in a valley or stream channel, inundated by overbank flooding from that stream or river at least once every two years.
Topographic depressions	Depressional	Mitigation site would be in topographic depression where water ponds or is saturated to the surface some time of the year.

Question 3C: Will the primary source of water to the mitigation site be appropriate for the HGM class?

HGM Class	Primary Source of Water
Tidal Fringe	Tidal waters with daily fluctuations – may be freshwater or saline
Flat	Direct precipitation
Lake fringe	Lake water
Slope	Groundwater discharge
Riverine	Most of the time from the hyporheic zone, but gets overbank flow from stream or river at least once every two years
Depressional	Groundwater or surface flows from precipitation on the surrounding landscape

Question 3D: Will the site have an adequate supply of water to maintain a wetland without engineering the delivery of water that would require long term control or maintenance?

A mitigation site will provide functions over time if there is an adequate source of water to maintain wetland conditions. You will need to determine that there will be adequate water available (including water rights if needed) to maintain the predicted levels of ponding or saturation in your plan. At this stage, you will need to understand the basic movement of water in and out of the site.

1. Determine if the water regime at the site will be dominated by groundwater, surface, water, hyporheic water, or a combination of sources. Note: groundwater is the only source of water that should be used if slope wetlands are proposed as mitigation.
2. If your site is to be maintained by groundwater or hyporheic water you will need some information on the depth to saturation over the growing season at several locations on your site using shallow monitoring wells. If the mitigation involves plugging ditches or culverts, or breaking tiles in an area that was once a wetland you can assume that soil saturation will be raised at least to the elevation of the bottom of the outlet.
3. If surface flows are the main source of water, you will need to identify the contributing basin to your site and make some estimates on the water regime in the mitigation site based on the current and future flows into the site, the outlet characteristics, and infiltration and evapotranspiration rates. This is a difficult calculation and usually requires a hydrologist. Designing a mitigation site that relies mostly on surface run-off may require engineering a system to reduce infiltration such as adding a clay layer, or excavating to a layer of glacial till. If you decide at this stage that surface run-off will be the main source of water, the site will most likely require a detailed design and complex monitoring of the water regime both before construction and for at least five to ten years afterward.

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A good reference for issues to consider in designing the water regime, such as duration and frequency of ponding, is *Wetlands and Stormwater Management Guidelines* (Horner et al. 2001).

Question 3E: Will the mitigation activities maintain hydric soils, if they exist, at the site?
Removing hydric soils can decrease the potential for success of wetland restoration. Hydric soils often contain a seedbank of wetland plants that supplement any planting you may propose.

Question 3F: Can the mitigation be designed to control aggressive plant species?
Aggressive species are often also called invasive. These are the species that can come to dominate a wetland ecosystem in areas that have been disturbed by human activities. Such species have evolved to take advantage of disturbances and can come to dominate an area that was previously colonized by many different species. They are often considered to be an

unwanted part of the plant or animal community at a mitigation site because they can change the way a wetland functions from the way it did before the disturbance occurred.

Most of the aggressive species are erroneously called “invasive.” Recent research has shown that the species do not “invade” wetlands that are not disturbed. Rather they should be considered as “opportunistic” species that come into a wetland after a disturbance has removed or reduced the vigor of the existing plant community (Zedler and Kercher 2004, MacDougall and Turkington 2005, Kercher and others 2007, McGlynn 2009). Once established however, they will exclude the re-colonization of the site by the species that were found there originally. The dominance by these aggressive species can be considered an “alternate state” of the wetland ecosystem (see the introduction to part 2). Common aggressive plant species in the wetlands of western Washington include reed canarygrass (*Phalaris arundinacea*), soft rush (*Juncus effusus*), purple loosestrife (*Lythrum salicaria*), non-native blackberries (*Rubus spp*.) and cattails (*Typha spp.*). Aggressive animal species include the Norway rat (*Rattus norvegicus*), the American Bullfrog (*Rana catesbeiana*), nutria (*Myocastor coypus*), and in heavily stocked ponds, trout (*Salmo spp.*).

Since a common restoration goal is to change a wetland ecosystem that has become dominated by one or more of the aggressive species, it is important to understand the types and duration of the disturbances that allowed the colonization in the first place. Restoration of a pre-disturbance plant or animal community will be very difficult if the disturbances that facilitated the original “invasion” are not understood and controlled.

Many disturbances, such as changes in the water regime, the introduction of excess nutrients, and the introduction of toxic compounds occur at the landscape scale over large areas of the hydrologic unit. If a mitigation site is chosen in an area where disturbances will continue as a result of permanent changes in land use, then controlling aggressive species becomes a major issue in the design of the project. If the project cannot be designed to control aggressive species in the long-term, then the site is not suitable for restoration or enhancement.

A number of different tactics have proved successful at controlling aggressive species. Since the information on this topic is continually being updated in the scientific literature, we suggest you do a web search on ways to control the species most likely to colonize your site. For example, recent articles that describe effective control of reed canary grass include:

- Kima, K.D., K. Ewing, and D.E. Giblin (2006). Controlling *Phalaris arundinacea* (reed canarygrass) with live willow stakes: A density-dependent response. *Ecological Engineering* 27:219-227.

- Wilcox, J.C., M.T. Healy, and J.B. Zedler (2007). Restoring native vegetation to an urban wet meadow dominated by reed canarygrass (*Phalaris arundinacea* L.) in Wisconsin. *Natural Areas Journal* 27:354–365.

- Hovick, S.M., and J.A. Reinartz (2007). Restoring forest in wetlands dominated by reed canarygrass: the effects of pre-planting treatments on early survival of planted stock. *Wetlands* 27:24-39.

PART 2: Analyzing the Suitability of an Individual Site for Mitigation

Part 2 discusses the constraints and issues that might be present within a site or immediately adjacent to it. This analysis at the site scale can be used to determine what functions can be mitigated at a site. It also identifies the major elements that need to be included in a mitigation plan specific to the site. The approach presented here differs from that commonly used in wetland restoration. This change in approach is based on new research on the success and sustainability of wetland mitigation and restoration.

The Changing Science of Mitigation

In the last 15 years ecologists have focused on improving mitigation by incorporating newly developed principles in the planning and design of a mitigation project. Traditionally, efforts have focused on ways to re-establish the natural vegetation and structure at a site. It is often assumed that, once the historical structure is re-established, natural successional processes will return the biotic system to its original condition. This approach, however, has had limited success. It usually works when the original degradation was a result of only one type of human disturbance that did not last. Sites degraded by multiple disturbances, or those that continue in time, are not successfully restored using this approach (Suding and others 2004).

As a result, ecologists are developing a new framework for designing mitigation activities. First, one must recognize that some ecosystems are in an alternative state. This alternative state may be a result of major changes in ecological processes throughout the watershed as well as changes at the site. The success of mitigation will depend on identifying and addressing the changes to the ecological processes that create and maintain the alternative states.

Alternative states are different combinations of species and environmental conditions that can persist at a particular location. These specific combinations are often mutually exclusive; one group of species will move in and eliminate the previous one. A change in the "state" of a location is often caused by a disturbance or a change in ecological processes. It is, however, very difficult to change a new state of the ecosystem and restore a previous state even if the disturbances that caused the change are removed.

Lakes provide a good example of alternative states. In the absence of high nutrient levels, lakes are usually dominated by large plants such as water lilies. When the amount of nutrients are increased as a result of human activities, the plant community changes to one dominated by algae and the large plants disappear. However, the large plants will not come back if the nutrients levels are reduced to the concentrations present at the time of the switch. To get the water lilies to come back nutrient levels have to be reduced to levels that were significantly lower than those found at the time of the "switch."

If only a single environmental constraint exists, decisions regarding the mitigation strategy can be relatively straightforward. Often, re-establishing the historical disturbance regime and/or physical processes will enable the rest of the system to restore itself with little or no further management intervention (Prach and others 2001, Mitsch and Wilson 1996). If several environmental constraints exist, research indicates that actions need to be taken simultaneously to be successful (e.g., burning and adding native seeds) (Zedler 2000). However, if resources are limited, prioritizing these constraints might be crucial to ensure at least a moderate level of success.

Changing the structure and functions of an existing site are not easy tasks, especially if the ecosystem has shifted to an alternative state in response to changes in the environmental processes. Ecosystems represent a balanced set of conditions, processes, and structure. Changing one element often means many other elements will also change. If these changes are made without understanding the basic environmental processes that maintain the current and future conditions at a site, unforeseen changes often occur. For example, a wetland that has changed to a reed canarygrass ecosystem requires modifications to the water regime and soils to restore the natural system. Removing the reed canarygrass alone will not result in a natural system.

Key Points in Designing the Restoration or Enhancement of Wetlands

Part 2 includes a series of linked charts, one for each major group of wetland functions. The charts guide the user through a list of questions about conditions in the watershed and at the site. Blank worksheets are provided in Appendix B where you can record your answers. The answers to the questions will help you determine appropriate tactics when designing a mitigation plan. The goal of a mitigation plan should be to improve wetland functions by removing the environmental constraints that currently limit them.

A good mitigation plan should (from Suding and others 2004):

1. Establish specific goals that are appropriate for the site based on an analysis of the surrounding landscape.
2. Identify limiting factors (constraints caused by human activities) instead of focusing on the physical structure of the habitat or a single species.
3. Identify a range of possible outcomes instead of setting a goal of matching one reference condition.
4. Ensure there are good buffers and connectivity at the site, if habitat is a goal.
5. Focus on ecological processes rather than physical structure of the environment.

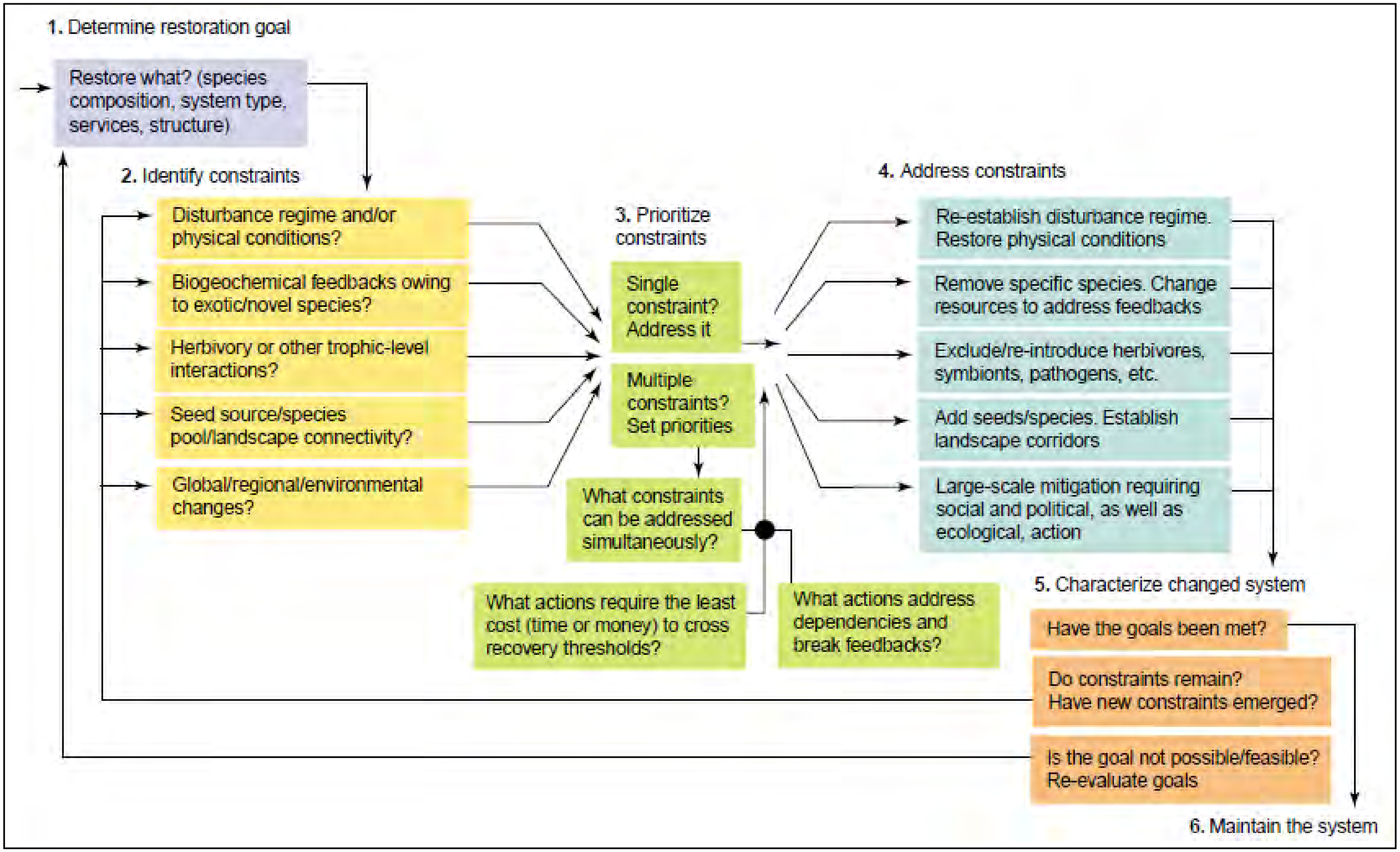
Guidance on the first point is provided in watershed plans, where they exist. If no watershed plan exists, refer to *Wetland Mitigation in Washington State* (Ecology et al. 2006) for guidance in developing mitigation goals. Part 2 of this guide addresses the second point: identifying the constraints on the ecosystem that might be removed to restore or enhance the site. Points 3, 4, and 5 are to be addressed in the mitigation plan, based on the functions and values that need to be replaced. **If the site does not have any constraints that limit its**

functions, it is not suitable for restoration or enhancement but may be suitable for preservation. Sites where constraints cannot be removed are not suitable for mitigation.

Suding and others (2004) provide a basic outline for developing a mitigation plan as shown in Figure 2. Figure 2 also provides a few examples of questions that can be asked and tactics used. There are six major steps in the process, and **all six need to be addressed in a mitigation plan.** These are:

1. Determine goals.
2. Identify constraints.
3. Prioritize constraints, if needed.
4. Address constraints by developing specific tactics for their removal.
5. Monitor system to determine if constraints have been removed and system is achieving initial goals.
6. Maintain the system through adaptive management as necessary.

Figure 2: Six Steps in Planning a Mitigation Project
(copied from Suding and others 2004).



It is assumed that the objectives of most mitigation activities will be to improve one or all of the three groups of functions provided by wetlands – flood control, improving water quality and habitat. The guide is organized to help you identify environmental constraints on these functions through a series of questions about the site and its surrounding watershed. These questions are presented as decision trees, organized by each major function. Within each function, separate decision trees (charts) are provided for different geomorphic settings.

The last columns in the decision trees describe some of the issues that have to be addressed when removing the constraints that impair functions. Constraints can occur both within the hydrologic unit and at the site itself. Thus, both types of constraints need to be identified and corrected if restoration or enhancement is to be successful and sustainable. The charts do not, however, attempt to prioritize constraints. Priorities should be determined by site conditions and by the needs of the mitigation project.

A worksheet for each chart, where you can enter specific site information, is included in Appendix B. This information should be the basis for your mitigation plan, and the worksheets should be provided as an appendix to the plan.

Charts 4 – 5: Can a site be used to improve hydrologic functions?

Use Chart 4 for a site in a floodplain or stream corridor.
Use Chart 5 for a site that will become a depressional wetland outside the floodplain.

Lake-fringe and slope wetlands are not suitable for restoring hydrologic functions. These wetlands cannot perform the functions to the same level as riverine or depressional wetlands, and not much can be done to increase hydrologic functions as a replacement for their loss elsewhere.

Charts 6 – 9: Can a site be used to improve water quality functions?

Use Chart 6 for a site in a floodplain or stream corridor.
Use Chart 7 for a site that will become a depressional wetland outside the floodplain.
Use Chart 8 for a site along the shores of a lake.
Use Chart 9 for sites on slopes where water will not be ponded and the lowest topographic elevation is along one side of the site.

NOTE: Improving hydrologic and water quality functions does not require planting native species or eradicating non-native or invasive species. These functions are performed by wetlands based on topography, the local water regime, soils, and the presence or absence of herbaceous species.

Charts 10 – 11: Can a site be used to improve habitat?

Individual species respond differently to disturbances in their environment. Thus the constraints on habitat are specific to the different groups of species that might be using the site. For example, a major constraint on salmon habitat in a wetland may be a culvert that restricts access. This constraint, however, has little effect on the wetland's ability to provide habitat for mammals, invertebrates, or amphibians.

One way to improve the habitat function of a wetland is to target individual species or small groups of species and develop a mitigation plan that addresses the constraints specific to that group. It is not the purpose of this guide, however, to provide such species-specific information. The Washington State Department of Fish and Wildlife has already developed management guidance for individual species and groups of species. This information is available on their web site at: http://wdfw.wa.gov/hab/phsrecs.htm.

A second approach is to target biodiversity in general. Charts 10 and 11 identify the constraints and possible solutions for species richness. Chart 10 describes the constraints on all wildlife, including invertebrates, and Chart 11 does the same for plant species.

Chart 4: Goal – Improving Hydrology Functions in Riverine/Floodplain Systems

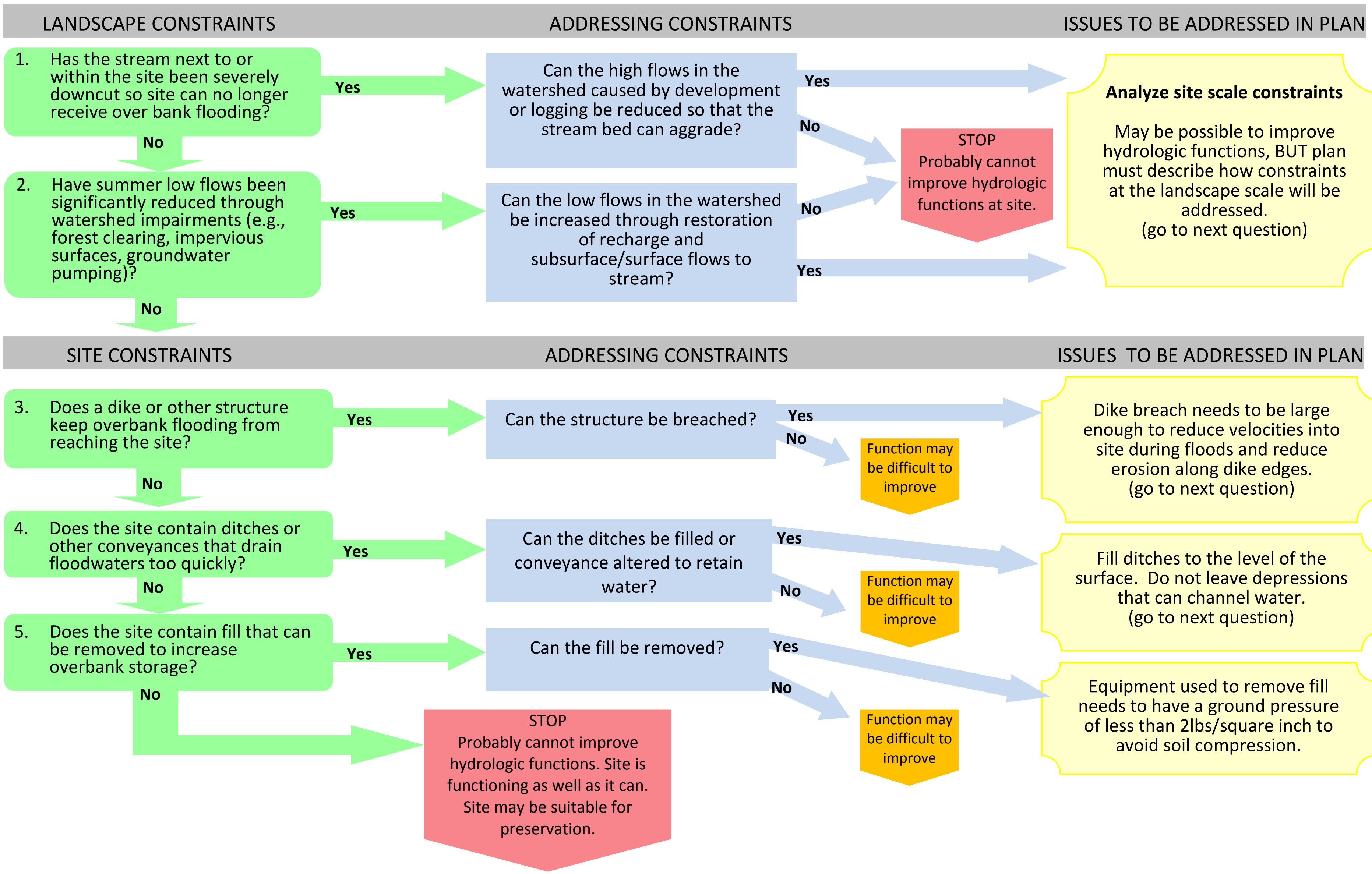


Chart 5: Goal – Improving Hydrology Functions in Depressional Systems Outside of Floodplains

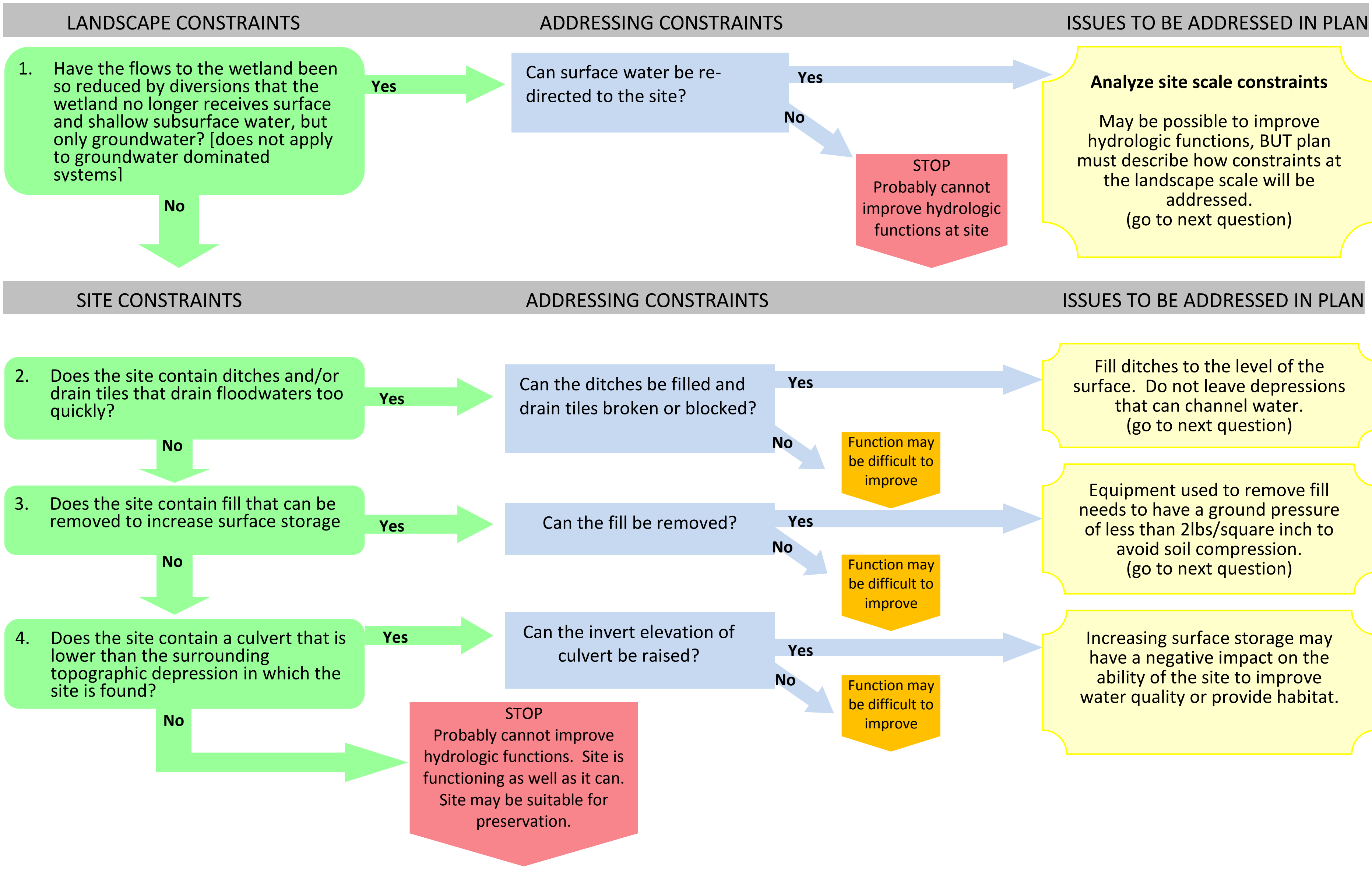


Chart 6: Goal - Improving Water Quality (WQ) Functions in Riverine/Floodplain Systems

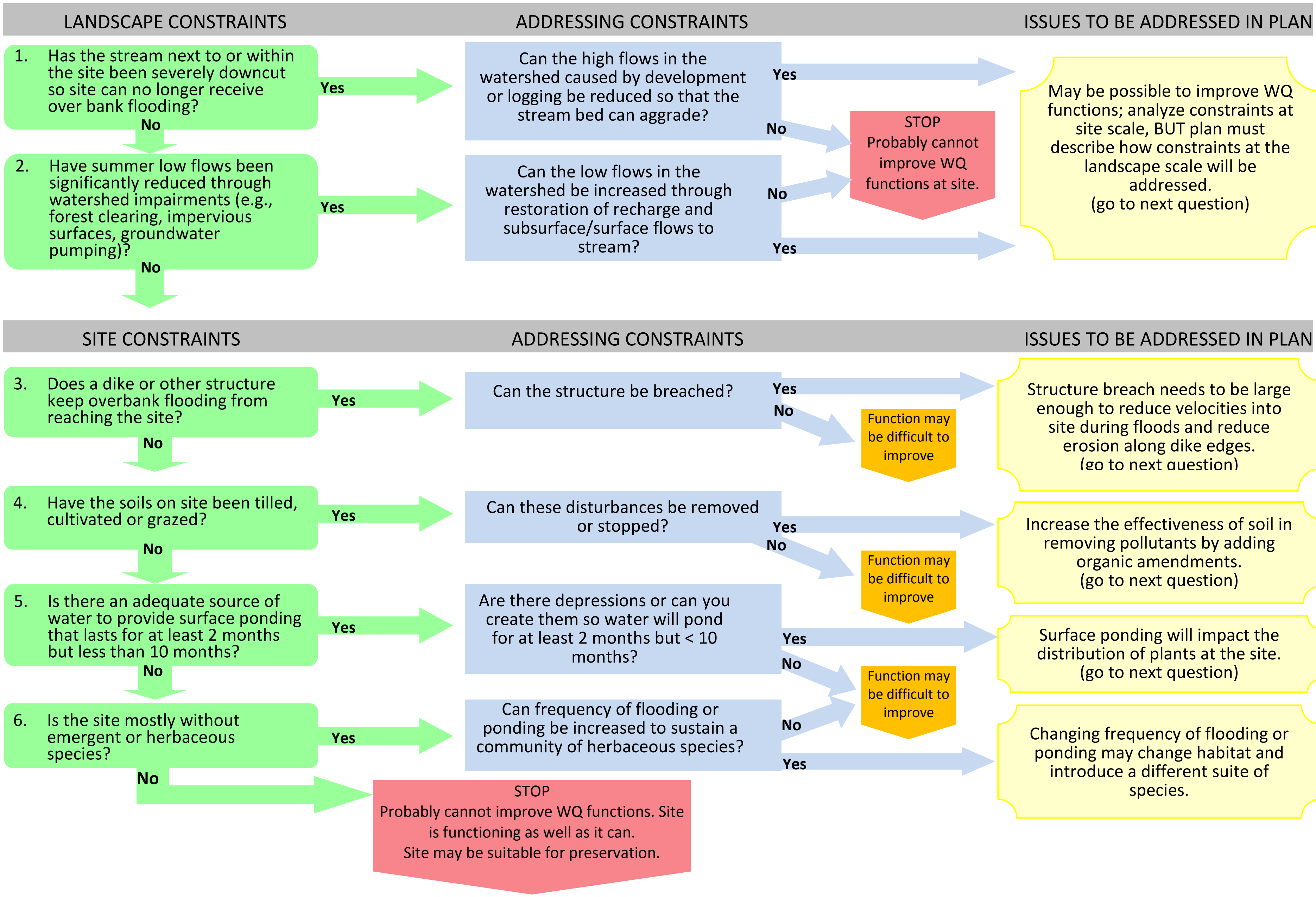


Chart 7: Goal - Improving Water Quality (WQ) Functions in Depressional Systems Outside of Floodplains

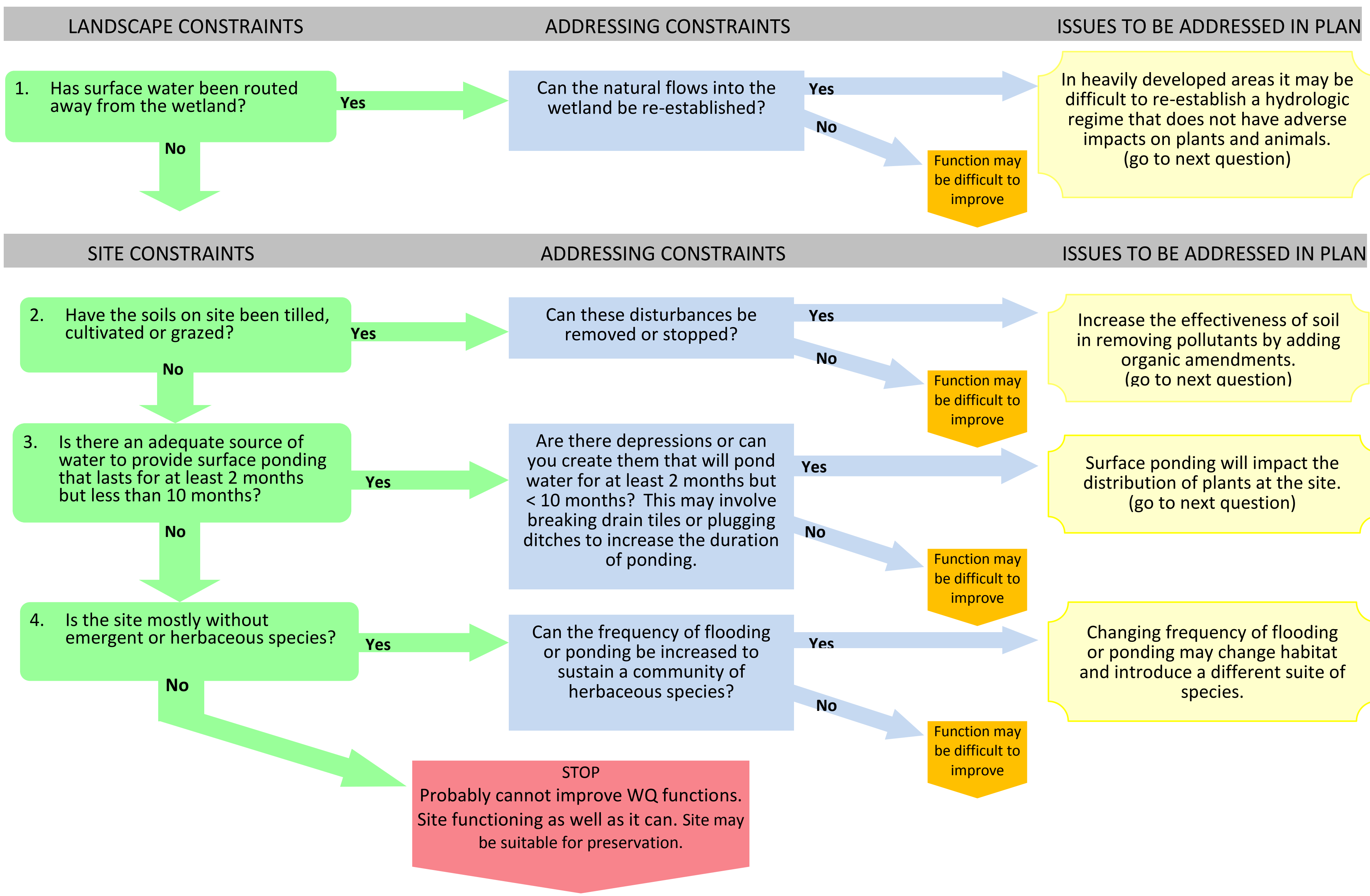


Chart 8: Goal - Improving Water Quality (WQ) Functions along the Shores of Lakes

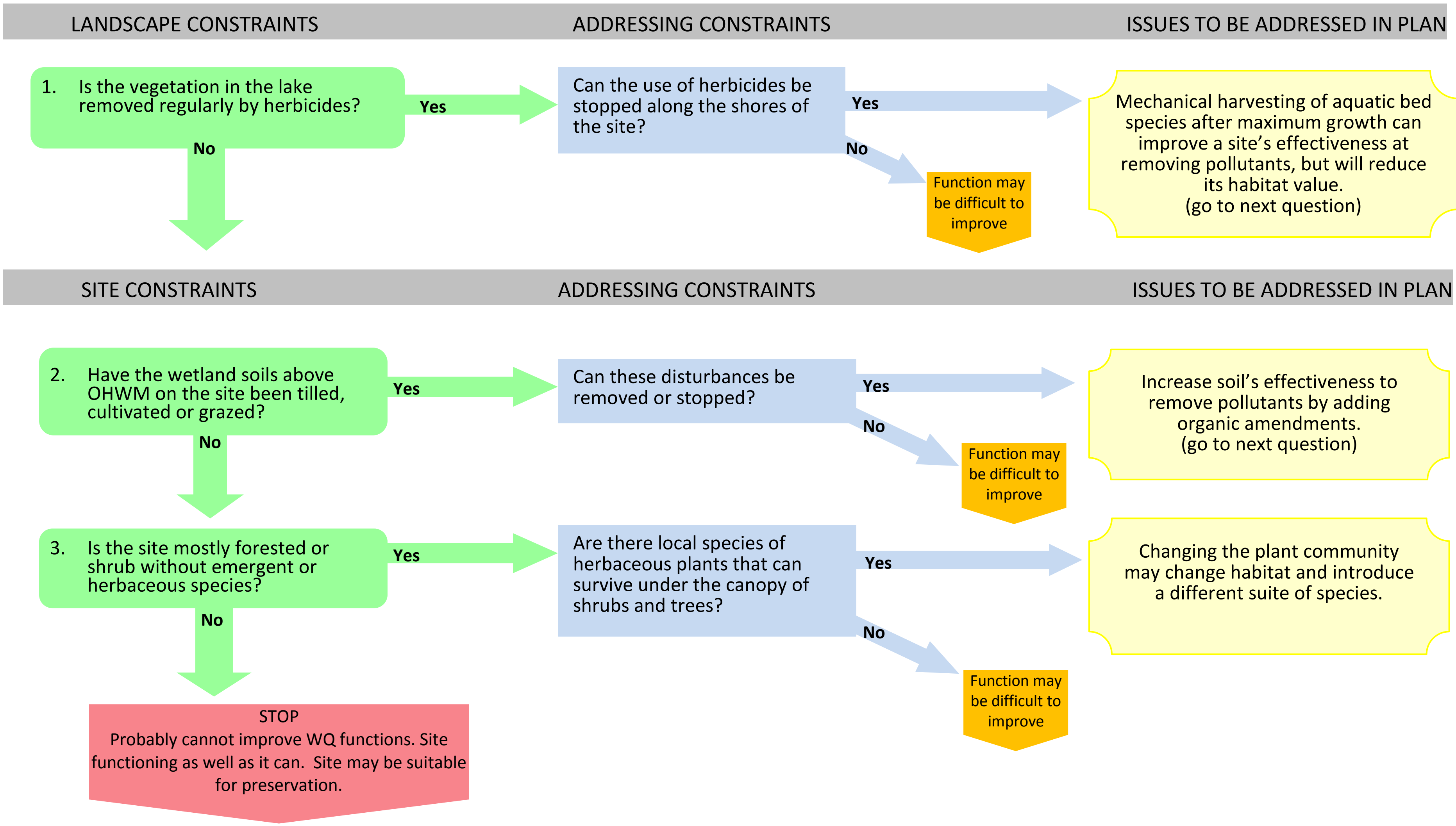


Chart 9: Goal - Improving Water Quality (WQ) Functions in Slope Systems

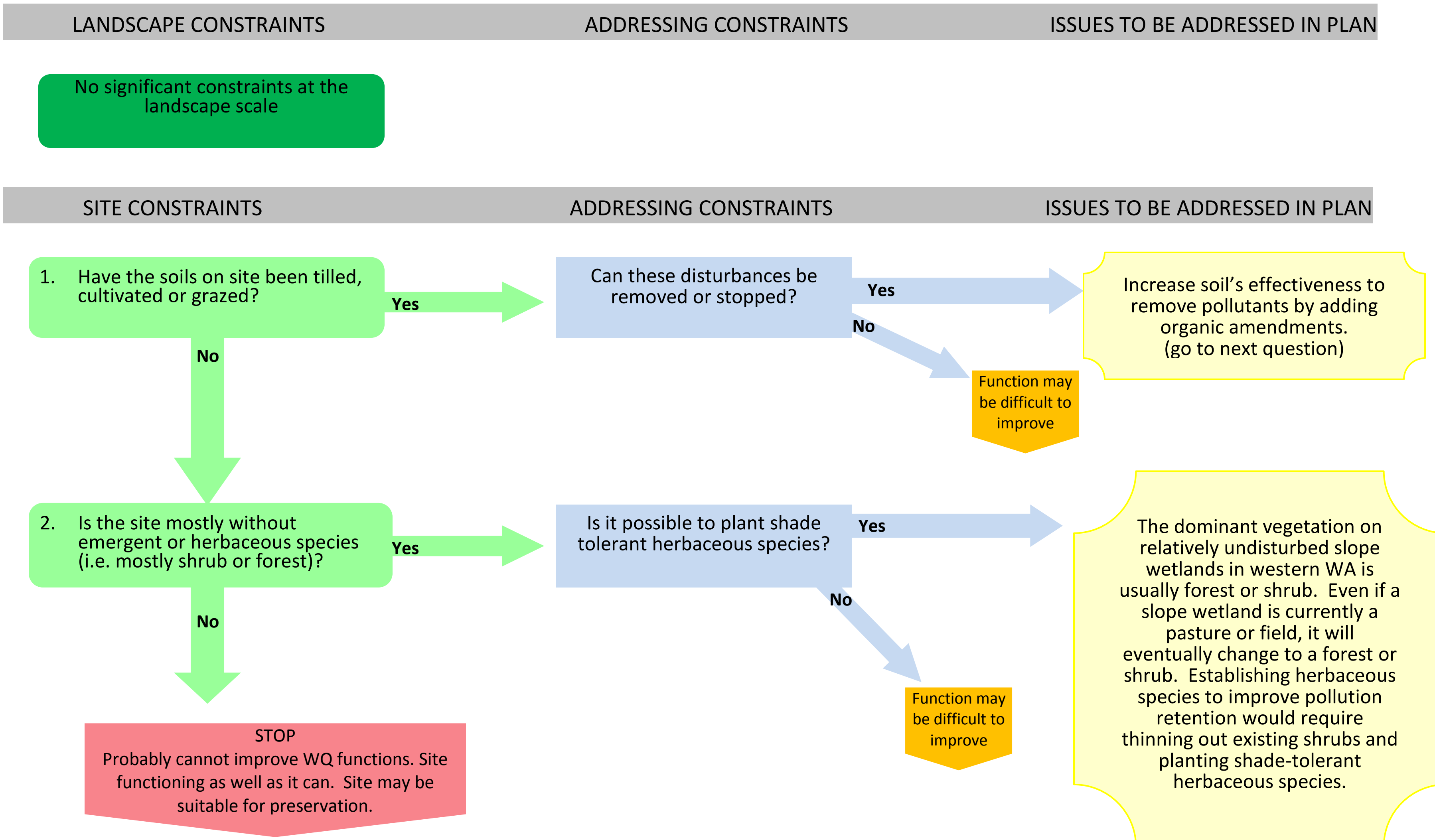


Chart 10: Goal - Improving Species Richness of Wildlife

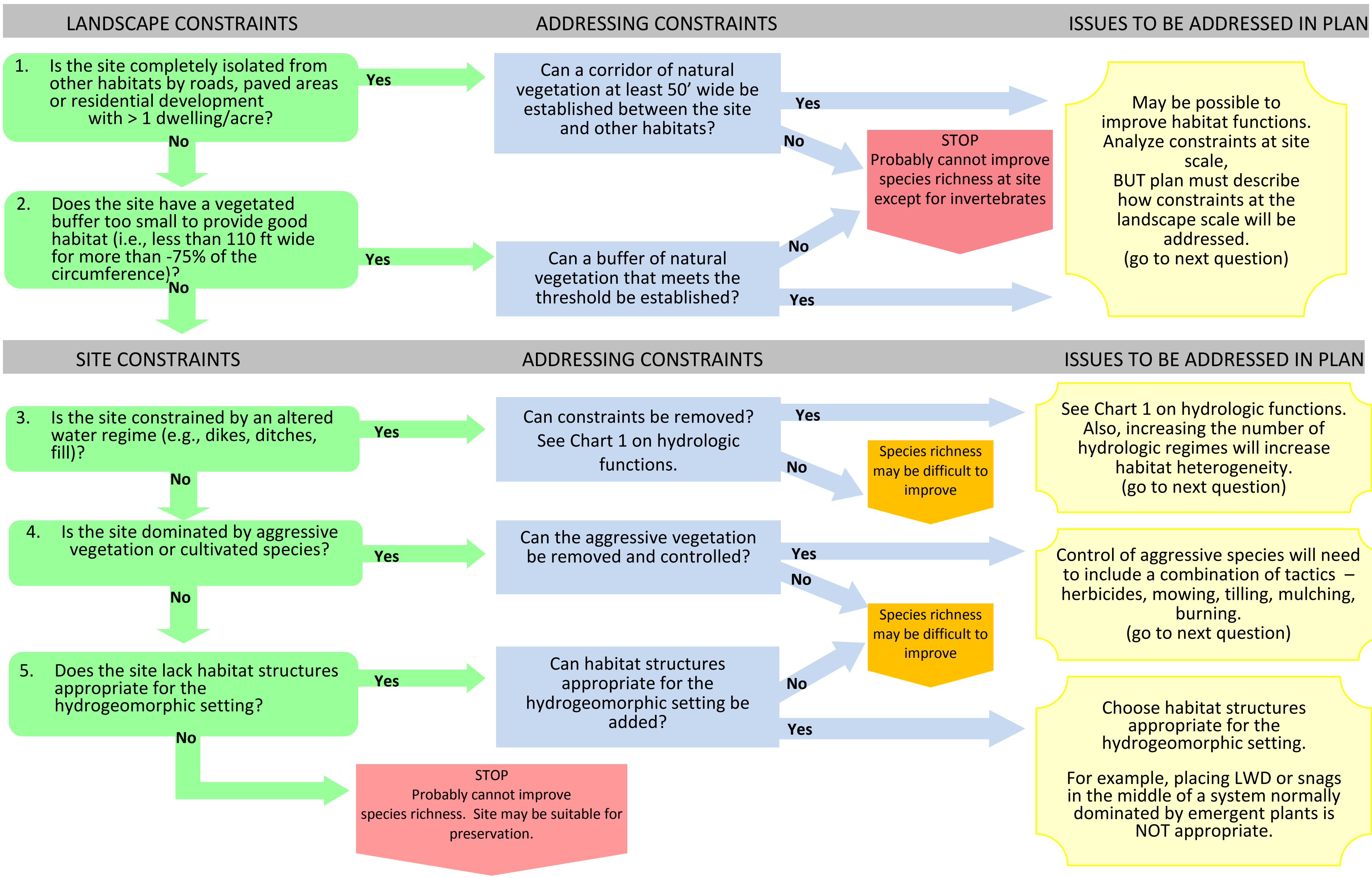
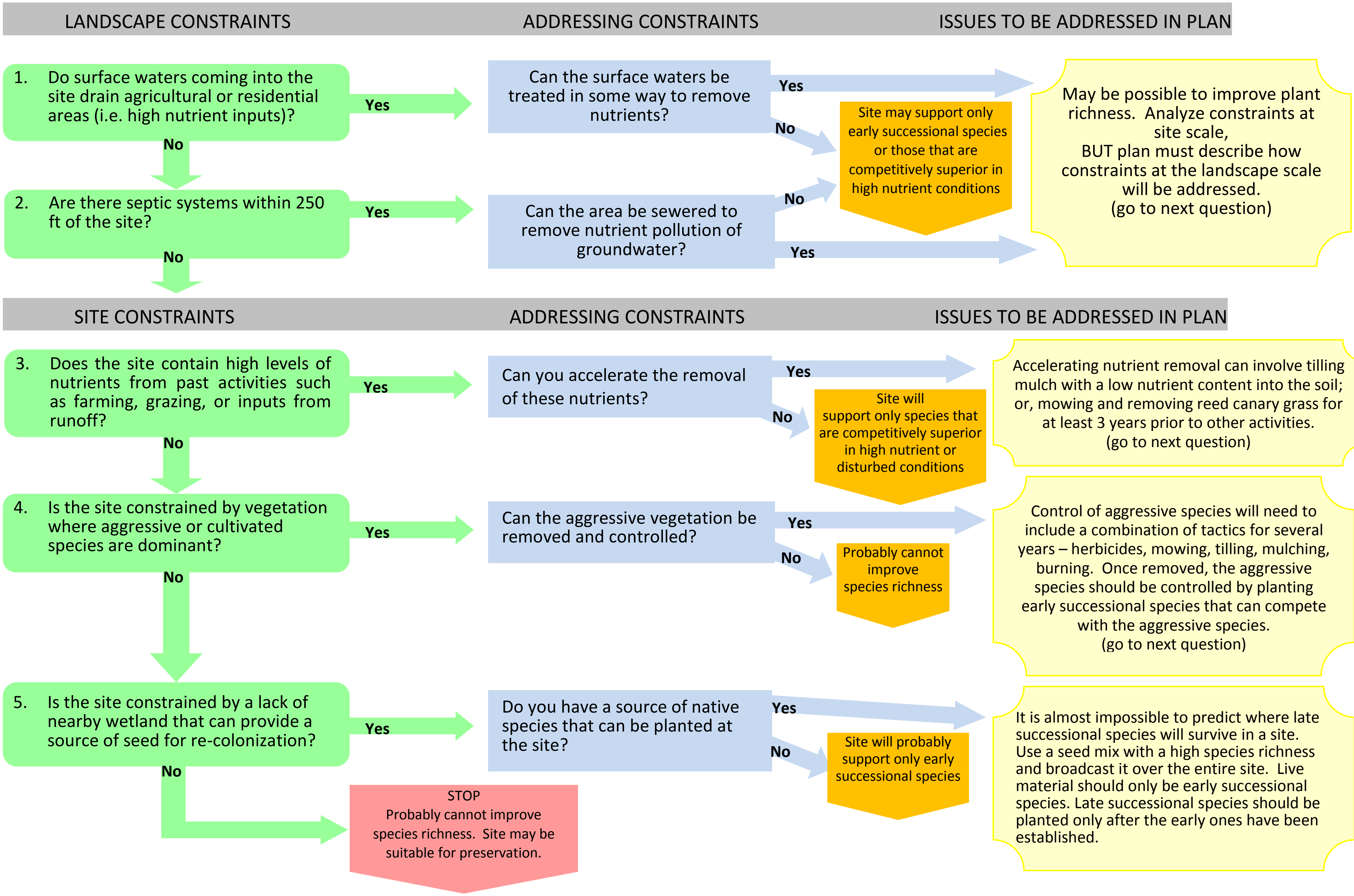


Chart 11: Goal - Improving Species Richness of Plants



Permitting Requirements

This guidance does not affect the requirements of any permits or rules that may apply to wetland (or other regulated waters) impact projects. The Governor's Office of Regulatory Assistance (www.ora.wa.gov/resources/permitting.asp) can help you understand your permitting requirements. The following is a brief list of current wetland permitting authorities:

- Impacts to wetlands, streams, lakes and other waters of the state must be authorized by Ecology pursuant to the delegation by the EPA for Ecology to administer Section 401 of the Federal Clean Water Act and/or the Washington Water Pollution Control Act (RCW 90.48). Wetlands designated as non-jurisdictional by the Corps are regulated by Ecology under RCW 90.48. Section 401 is administered by the EPA on federal lands (e.g., military bases, national parks) and some Indian reservations and tribal lands located off-reservation. To date, the EPA has delegated its authority to administer Section 401 on their respective reservations and off-reservation lands to eight Indian tribal governments in Washington.
- Impacts to wetlands, streams, lakes and other waters that occur on Indian reservations must typically be authorized by one or more tribal governmental agency (e.g. Natural Resources Departments, Planning Departments, Cultural Resources Departments/Historic Preservation Offices).
- Impacts associated with the discharge of dredged or fill materials to jurisdictional wetlands, streams, lakes, and other waters of the United States must be authorized by the Corps under Section 404 of the Federal Clean Water Act.
- Impacts to streams, rivers, and lakes must be authorized by WDFW under a Hydraulics Project Approval permit process.
- All requirements of local government regulations must be met, including Shoreline Master Plans and Critical Areas Ordinances.
- Regulatory requirements and guidance on stormwater treatment must be followed (consult with Ecology Water Quality Program).
- Projects must meet all federal, state, and local floodplain requirements.

Definitions

Contributing Basin – The watershed of an individual wetland or other specific aquatic resource such as a stream reach or lake. This is the area that contributes surface and groundwater to the individual site. The contributing basin may be very small for "kettle-hole" wetlands and very large for riverine wetlands near the mouth of large rivers. Most discussions of contributing basin, however, refer only to the areas contributing surface water because it is almost impossible to map the sources of groundwater to individual wetlands.

Ecological processes - The five basic processes at work in all landscapes: geological changes, water cycle, mineral cycle, energy flow, and community dynamics that link all living organisms and their environment. Ecological processes occur at multiple scales from the microscopic to the global and can often extend beyond watershed boundaries. Community dynamics include a wide range of interactions among different species such as predation, competition, and colonization.

Hydrogeomorphic (HGM) class – An approach to classifying wetlands to aid in distinguishing the functions that each class can perform. The classification is based on the hydrologic and geomorphic "controls" responsible for maintaining many of the functions of wetland ecosystems. These hydrogeomorphic characteristics include geomorphic setting, water source, and hydrodynamics.

In-kind mitigation – Replacing an affected wetland with one of a similar HGM class and similar functions.

Off-site mitigation – Compensating for lost wetland area and functions at a site other than where the impact will occur.

On-site mitigation – Compensating for lost wetland area and functions on or adjacent to the impact site.

Out-of-kind mitigation – Replacing an affected wetland with one of a different HGM class, different functions, or with resources other than wetlands.

Watershed – The drainage area contributing water, organic matter, dissolved nutrients, and sediments to aquatic resources. This includes the area that contributes groundwater to aquatic ecosystems, which may be different from the area contributing surface water. Watersheds can be drawn at varying scales from the smallest watershed of a first order stream to that of a major river (tens to thousands of square miles).

Watershed characterization – A process of collecting information and data within a watershed on factors that control watershed processes and analyzing this information. The purpose is to identify and rank the areas most suitable for protection, restoration and development. These results are then synthesized into a management framework that provides clearly defined regulatory and non-regulatory actions.

Watershed processes – The dynamic physical, biological, and chemical interactions that form and maintain the landscape and its ecosystems. These processes include the movement of water, sediment, nutrients, wildlife and other biota, pathogens, toxins, and wood as they enter into, pass through, and eventually leave the hydrologic unit. Watershed processes can operate at any geographic scale, from regions to sub-catchments.

Other Resources

The following is a list of other federal and state rules, policies, guidelines and resources that provide guidance on mitigation planning:

- Wetland Mitigation in Washington State, Parts 1 and 2 (2006) (http://www.ecy.wa.gov/programs/sea/wetlands/mitigation/guidance/index.html)

- State of Washington Alternative Mitigation Policy Guidance for Aquatic Permitting Requirements from the Departments of Ecology and Fish and Wildlife (2000) (http://wdfw.wa.gov/hab/ahg/altmtgtn.pdf)

- State of Washington Wetland Mitigation Banking Law, RCW 90.84 (http://apps.leg.wa.gov/RCW/default.aspx?cite=90.84)

- State of Washington Draft Wetland Mitigation Banking Rule (2001) (http://www.ecy.wa.gov/laws-rules/wac173700/draftruleeasyread.pdf)

- State Water Pollution Control Act, RCW 90.48 (http://apps.leg.wa.gov/RCW/default.aspx?cite=90.48)

- Compensatory Mitigation for Losses of Aquatic Resources, Final Rule, 33 CFR Parts 325 and 332 and 40 CFR Part 230. (2008) (http://www.epa.gov/owow/wetlands/pdf/wetlands_mitigation_final_rule_4_10_08.pdf)

- Center for Watershed Protection (http://www.cwp.org).

- Federal Clean Water Act Section 401 (http://www.epa.gov/OWOW/wetlands/regs/sec401.html)

- Federal Clean Water Act Section 404 (http://www.epa.gov/OWOW/wetlands/regs/sec404.html)

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APPENDIX A – Achieving an Ecosystem Based Approach to Planning in the Puget Sound

This is a “stand-alone” document. If it is not attached here, please download the appendix at: www.ecy.wa.gov/mitigation/resources.html.

APPENDIX B – Worksheets for Charts 4 through 11

Chart 4 Worksheet: Goal - Improving Hydrologic Functions in Riverine/Floodplain Systems

Landscape Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Downcutting				
Reduced Flows				
Site Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Dikes				
Ditches				
Fill				

Chart 5 Worksheet: Goal - Improving Hydrologic Functions in Depressional Systems

Landscape Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Flows to wetland have been diverted				
Site Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Ditches				
Fill				
Culverts				

Chart 6 Worksheet: Goal - Improving Water Quality Functions in Riverine/Floodplain Systems

Landscape Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Downcutting				
Reduced Flows				
Site Constraints	**Constraint present? (yes/no)**	**Tactics to address constraint**	**Special features of your project**	**How will tactics impact other functions?**
Dikes				
Altered Soils				
Source of water to created ponding				
No emergent or herbaceous plant species				

Chart 7 Worksheet: Goal - Improving Water Quality Functions in Depressional Systems

Landscape Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Flows to wetland have been diverted				
Site Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Altered Soils				
Source of water to created ponding				
No emergent or herbaceous plant species				

Chart 8 Worksheet: Goal - Improving Water Quality Functions Along Shores of Lakes

Landscape Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Vegetation in lake removed by herbicides				
Site Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Altered Soils above OHWM				
No emergent or herbaceous plant species				

Chart 9 Worksheet: Goal - Improving Water Quality Functions in Slope Systems

Landscape Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
None				
Site Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Altered Soils				
No emergent or herbaceous plant species				

Chart 10 Worksheet: Goal - Improving Species Richness of Wildlife

Landscape Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Isolated from other habitats				
Poor buffers				
Site Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
Altered water regime				
Invasive or cultivated plant species				
Lack of habitat structure				

Chart 11 Worksheet: Goal - Improving Species Richness of Plants

Landscape Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
High nutrient inputs from watershed				
Septic systems				
Site Constraints	Constraint present? (yes/no)	Tactics to address constraint	Special features of your project	How will tactics impact other functions?
High nutrients on site				
Invasive or cultivated plant species				
Lack of seed sources nearby				