Chapter 3

Key Conclusions from Volume 1

3.1 Introduction

This chapter briefly summarizes the information and conclusions presented in Volume 1 of this two-volume document. The first section highlights the major conclusions from the scientific literature that relate to protecting and managing wetlands. The subsequent sections summarize the findings of Chapters 2 through 7 of Volume 1.

Please note that this is intended to be a brief overview of Volume 1. More detailed lists of key points and discussions of conclusions are provided at the end of major sections in each chapter of Volume 1.

3.2 Major Conclusions About Our Current Efforts to Protect Wetlands

In spite of wetland regulatory programs at federal, state, and local levels, the data show that impacts to wetlands continue. The existing scientific information points to the fact that we have not achieved the federal and the state of Washington goal of "no net loss of wetland functions or area." From 1986 to 1997, the estimated annual loss of wetlands nationwide continued to be about 58,500 acres per year. On a positive note, this was about a quarter of the rate of previous losses (National Research Council 2001). Such losses of wetlands have also been documented for the Pacific Northwest (see Chapter 7 in Volume 1).

The review of the information on how we manage wetlands points to several reasons why losses continue. These include:

- Case-by-case permitting under current regulations does not meet the goal of "no net loss" (National Research Council 2001). The majority of decisions concerning wetlands in Washington State and the nation are based on case-by-case actions related to specific projects, without any opportunity to consider the broader landscape, the environmental factors that control wetland functions, or consequences. This pattern is a result of the current structure of programs at local, state, and federal regulatory agencies. The results of the research on case-by-case permitting processes are clear: There are consistent wetland losses regionally and statewide. These impacts are often the result of cumulative and synergistic impacts across the landscape.

- The functions performed by wetlands can be affected by actions taken in other parts of the watershed (see Chapter 2 in Volume 1).

- Decisions made without an understanding of how a wetland is affected by and can affect its watershed often result in actions that do not adequately protect functions of wetlands. Since the case-by-case approach has not worked to ensure that there is "no net loss" of wetland area and functions for over 20 years, it can be assumed that wetlands and their functions will be adequately protected to meet this goal only if protection and management occur at a larger geographic scale. The National Research Council (2001) concludes that "a watershed approach would improve permit decision-making."

3.3 Wetlands in Washington and How They Function (Chapter 2 of Volume 1)

3.3.1 Types of Wetland Functions and How They Are Controlled

Chapter 2 of Volume 1 discusses the functions of wetlands, which are things that wetlands "do." Wetland functions are generally grouped into three broad categories:

- Biogeochemical functions, which are related to trapping and transforming chemicals and include functions that improve water quality in the watershed
- Hydrologic functions, which are related to maintaining the water regime in a watershed and include such functions as reducing flooding
- Food web and habitat functions

The functions that wetlands perform are controlled by environmental factors that occur in the broader landscape as well as within the wetland. The primary factors that control wetland functions are climate, geomorphology, the source of water, and the movement of water. These factors affect wetland functions directly or through a series of secondary factors including nutrients, salts, toxic contaminants, soils, temperature, and the connections between different ecosystems.

The most important environmental factors that control wetland functions at an individual site may occur outside the boundary of the wetland. For example, riverine wetlands are affected to a great degree by processes operating at the scale of the entire watershed of the river. In contrast, depressional wetlands often are subject to processes that occur primarily within the basin that contributes surface or groundwater to the wetland. Thus, the environmental factors that control the structure and functions of a wetland occur at both the landscape scale (in the watershed where the wetland is located and beyond) as well as at the site scale (within and near the wetland).

Information about the factors that control functions at the landscape scale is still evolving. Ongoing research is continually strengthening our understanding of these factors.

An understanding of wetland functions for the purposes of protecting and managing them will require knowledge of how the major controls of functions change or are affected by humans at different geographic scales. We need to understand how climate, topography, and the movement of water, nutrients, sediment, etc. are affected by human activities in the larger landscape as well as within and in the immediate vicinity of the wetland. Environmental disturbances caused by human activities and their affects on the functions of wetlands are summarized in Sections 3.3 and 3.4 below.

3.3.2 Classification of Wetlands in Washington as a Key to Understanding Their Functions

The diverse areas of Washington State support many kinds of wetlands that vary in functions. For example, vernal pools on the scablands differ greatly from the floodplain marshes along the Snoqualmie River, and wetlands that formed in the potholes created by glaciers have different functions from those found along the shores of salt lakes in the Grand Coulee.

Scientists have divided wetlands in Washington into different groups based on their functions (see Table 3-1). The environmental factors of geomorphology, the source of water, and the movement of water are the basic characteristics used to divide wetlands into these groups.

Table 3-1. Subclasses and families of wetlands in different regions of Washington State. (Hruby et al. 1999, 2000)

Class	Subclasses and Families by Region			
	Lowlands of Western WA	**Lowlands of Eastern WA**	**Columbia Basin**	**Montane (East and West)**
Riverine	Impounding Flow-through	ND	ND	ND
Depressional	Outflow Closed	ND	Alkali Freshwater Long-duration Short-duration	ND
Slope	ND	ND	ND	ND
Flats	ND	Probably does not occur in the region.	Probably does not occur in the region.	ND
Lacustrine (lake) Fringe	ND	ND	ND	ND
Tidal Fringe	Salt Water Fresh Water	Does not occur in the region.	Does not occur in the region.	Does not occur in the region.
ND = Subclasses in the region have not yet been defined.				

3.4 Environmental Disturbances Caused by Human Activities and Uses of the Land (Chapter 3 of Volume 1)

Chapter 3 of Volume 1 discusses the major types of environmental disturbances created by human activities and uses of the land and water. These disturbances change the environmental factors that in turn control wetland functions. Chapter 3 of Volume 1 addresses the disturbances created by four major types of land uses in Washington State: agriculture, urbanization, forest practices, and mining.

Several types of disturbances have been documented to change the factors that control wetland functions. These disturbances include:

- Changing the physical structure within a wetland (e.g., filling, removing vegetation, tilling soils, compacting soils)
- Changing the amount and velocity of water (either increasing or decreasing)
- Changing the fluctuation of water levels (volume, frequency, amplitude, direction of flow)
- Changing the amount of sediment (increasing or decreasing the amount)
- Increasing the amount of nutrients
- Increasing the amount of toxic contaminants
- Changing the temperature
- Changing the acidity (acidification)
- Increasing the concentration of salt (salinization)
- Fragmentation (decreasing area of habitat and its spatial configuration)
- Other disturbances that are not as well documented including, alteration of soils, construction of roads, noise, recreational access, invasion of exotic species, and access by domestic pets

As with performance of functions, a general conclusion that can be made from the scientific literature is that disturbances can also occur at several geographic scales. Much of the early research focused on disturbances at a single site or wetland. More recent research has documented the significance of disturbances that occur at the much larger scale of the landscape.

The effects of different human land uses on the flow and fluctuations of water are well documented. Changes in land uses and vegetation communities alter the patterns of surface and shallow groundwater movement across a landscape. Flows of water can be reduced or increased by different land uses, as can the volume, frequency, and amplitude of water levels downgradient of the disturbance. Removal of vegetation and/or compaction of native soils through agricultural practices, creation of lawns or grazed pastures, or creation of impervious surfaces through urbanization all have the same relative consequence: increased volumes of water and rates of flow after a given storm event. As with urbanization, agriculture can influence the water regime of wetlands, leading to loss of wetlands in some areas and creation or maintenance of wetlands in other areas where wetlands did not originally exist, such as areas influenced by irrigation.

Human activities also increase sediment and other pollutants in runoff. Pollutants often adhere to sediment particles that enter wetlands. In agricultural areas, pesticides and fertilizers can contribute to contamination of surface waters. In urban areas, stormwater runoff frequently contains sediment, organic matter, phosphorus, metals, and other pollutants. Mining increases the acidity of surface waters as well as adding toxic heavy metals. Logging increases sediments and can also change the amount of water and its fluctuations.

Fragmentation of habitats is also of increasing concern in the literature. As connections between wetlands and other habitats are broken and more wetlands across the landscape are converted to other uses, the remaining habitat becomes more isolated. This potentially puts wildlife populations at risk.

A key finding is that different land uses may cause the same change in the controls of wetland functions. For example, changing the input of sediment can affect wetland functions (as discussed in Section 3.4 below). Urban land uses, agricultural practices, and forest practices have all been shown to increase sediments in a watershed. From the wetland's "point of view," the source of the sediment is irrelevant—the impact of excess sediments on wetland functions is similar, regardless of the source of the sediments.

The disturbances created by some types of land use are summarized in Table 3-2. The table is organized by the type of land use and the scale at which the disturbance occurs. This table represents a synthesis of the severity of impacts as compiled by the authors of Volume 1 based on the information in the literature.

Table 3-2. Summary of types of environmental disturbances created by some types of land use.

Disturbance	Scale of Disturbance	Agriculture	Urbanization	Mining
Changing the physical structure within wetlands (filling, vegetation removal, tilling of soils, compaction of soils)	Site scale	xx	xx	h
Changing the amounts of water	Landscape scale Site scale	xx xx	xx xx	? h
Changing fluctuations of water levels (frequency, amplitude, direction of flows)	Landscape scale Site scale	xx xx	xx xx	? h
Changing the amounts of sediment	Landscape scale Site scale	xx xx	xx xx	h h
Increasing the amount of nutrients	Landscape scale Site scale	xx xx	xx xx	nm nm
Increasing the amount of toxic contaminants	Landscape scale Site scale	xx xx	xx xx	x xx
Changing the acidity	Landscape scale Site scale	nm nm	nm nm	x xx
Increasing the concentrations of salt	Landscape scale Site scale	x x	nm nm	nm nm
Fragmentation	Landscape scale	xx	xx	h
Other disturbances	Site scale	xx	xx	h
Key to symbols used in table: (xx) land use creates a major disturbance of environmental factors that affects large areas in the state (x) land use creates a disturbance (nm) studies on impacts of this land use do not mention this disturbance (h) literature is lacking but disturbances can be hypothesized based on authors' experiences (?) information lacking				

3.5 Negative Impacts of Human Disturbances on the Functions of Wetlands (Chapter 4 of Volume 1)

As described above, Chapter 3 of Volume 1 discusses how human land uses cause disturbances in the environmental factors that control wetland functions. Chapter 4 takes the discussion a step further by explaining how a change in these environmental factors can actually result in a change in wetland functions.

The literature findings are displayed in a summary format in Table 3-3. This table summarizes the effects on wetland functions of each type of human disturbance listed in Table 3-2 (e.g., change in physical structure, change in the amount of water, change in the amount of sediment, etc.).

By combining the information in Tables 3-2 and 3-3, it is possible to associate changes in functions of wetlands with general types of human land use, as shown in Table 3-4.

For example, Table 3-2 shows that urbanization creates significant disturbances that change the amount of water, fluctuations of water levels, input of sediments, nutrients, and contaminants to wetlands. Table 3-3 shows that disturbances to water flows, fluctuations of water levels, and input of sediments, nutrients, and contaminants have a significant impact on the wetland functions of providing habitat for plants, invertebrates and reptiles/amphibians. Table 3-4 synthesizes the information from the previous two tables to show that urbanization impacts the habitat for plants, invertebrates, reptiles, and amphibians in wetlands. These tables, therefore, summarize how human land uses create various disturbances in the environment, and those disturbances in turn affect the factors that control wetland functions, ultimately leading to changes in those functions.

Table 3-3. Synthesis of the information reported in the literature on the negative impacts of different human disturbances on wetland functions.

	Functions							
Disturbance Type	**Hydrologic**	**Water Quality**	**Plants**	**Habitat for Invertebrates**	**Habitat for Amphibians and Reptiles**	**Habitat for Fish**	**Habitat for Birds**	**Habitat for Mammals**
Changing the physical structure within a wetland	+	+	++	++	+	+	++	+
Changing the amount of water	+	+	++	++	++	+	+	?
Changing fluctuations of water levels	?	?	++	+	++	+	?	?
Changing amounts of sediment	+	?	++	++	?	?	?	?
Increasing amounts of nutrients	+	+	++	++	++	+	+	+
Increasing amounts of toxic contaminants	?	+	++	++	++	++	++	?
Changing acidity	0	+	+	++	++	+	+	+
Increasing concentrations of salt	0	?	++	++	?	?	+	?
Fragmentation	0	?	?	?	++	?	++	+
Other disturbances	?	?	++	+	++	++	++	++

Note: A disturbance can decrease or increase a function depending on the intensity of the disturbance (e.g., small amounts of nutrients can increase invertebrate richness and abundance, but too much will cause eutrophication and a negative impact).

Key to symbols used in table:

++ Major negative impacts on specific functions have been documented

\+ Some data suggest impacts, or impacts could be hypothesized

0 Data indicate that impacts are minimal

? Information is lacking and/or may vary by species

Table 3-4. Synthesis of the negative impacts of some land uses on wetland functions.

Land Use	Functions							
	Hydrologic	Water Quality Improvement	Plants	Habitat for Invertebrates	Habitat for Reptiles and Amphibians	Habitat for Fish	Habitat for Birds	Habitat for Mammals
Agriculture	+	+	++	++	++	++	++	+?
Urbanization	+	+	++	++	++	++	++	+?
Mining	?	?	+	++	++	+	+	+?

Key to symbols used in table:

++ Major negative impacts on specific functions have been documented
+ Some data suggest impacts or impacts could be hypothesized
? Information is lacking
+? Some impacts have been documented but more information is needed

3.6 The Science and Effectiveness of Wetland Management Tools (Chapter 5 of Volume 1)

3.6.1 How Wetlands Are Defined

Wetlands are defined using well established language that is generally consistent between federal and Washington State laws. In some jurisdictions, all lands that meet the definition of wetland are regulated. However, it is not unusual for a jurisdiction to differentiate within its regulations between *wetlands* (i.e., biological wetlands) and *regulated wetlands* (i.e., wetlands that they intend to regulate). The definition of what constitutes a regulated wetland may vary from jurisdiction to jurisdiction.

Delineation of wetland boundaries is conducted according to either the federal or state delineation manual. These manuals are consistent and, when applied correctly, will result in the same wetland boundary. In the State of Washington, however, local jurisdictions are required by state law to use the state manual (RCW 36.70A.175, Chapter 173.22.080 WAC).

As discussed in Chapter 5 of Volume 1, certain wetland types are sometimes excluded from regulation. These can include small wetlands, isolated wetlands, and wetlands that are designated as Prior Converted Croplands. The scientific literature makes clear that small wetlands and isolated wetlands provide important functions and does not provide any rationale for excluding these wetlands from regulation. Little scientific information is available on Prior Converted Croplands that are wetlands, but there is no evidence to suggest that they are unimportant in providing wetland functions.

Wetland rating systems are a useful tool for grouping wetlands based on their needs for protection. In Washington, a wetland rating system for both eastern and western Washington (Hruby 2004a, 2004b) has been developed, which places wetlands in categories based on their rarity, sensitivity, our inability to replace them, and their functions. Many local governments in Washington have modified these state rating systems for use in their own jurisdictions.

3.6.2 Wetland Buffers

Wetland buffers are one management tool for protecting wetland functions. The findings in the literature on buffers and their effectiveness are related to the type of wetland function, what activities are being buffered, and the characteristics of the wetland and the buffer itself.

The literature confirms that for improving water quality (e.g., sediment removal and nutrient uptake) there is a non-linear relationship between the width of the buffer and increased effectiveness in water quality improvement. Sediment removal and nutrient uptake are provided at the greatest rates within the immediate outer portions of a buffer (nearest the source of sediment/nutrient), with increasingly larger widths of buffers required to obtain measurable increases in those functions beyond this initial removal. Additionally, the long-term effectiveness of buffers in providing this function is not well documented in the literature and represents a need for future research.

To protect wildlife that depends on wetlands, the literature has documented the need for significantly larger buffers than those that are adequate to provide sediment removal and nutrient uptake. Research confirms that many wildlife species depend upon wetlands for only portions of their life cycles and they require upland habitats adjacent to the wetland to meet all their life needs. Some species use upland habitats that are far removed from the wetland. The literature documents that, without access to appropriate upland habitat and the opportunity to move safely between habitats across a landscape, it is not possible to maintain viable populations of many species.

In the long term, human actions can reduce the effectiveness of buffers through removal of buffer vegetation, soil compaction, sediment loading, and dumping of garbage.

Authors who synthesized the literature on the effectiveness of buffer widths suggest buffers between 25 and 75 feet for wetlands with minimal wildlife habitat functions and adjacent low-intensity land uses; 50 to 150 feet for wetlands with moderate habitat functions or adjacent high-intensity land uses; and 150 to 300 feet for wetlands with high habitat functions. Effective buffer widths for protecting water quality ranged from 25 to 50 feet for 60% removal of pollutants, to 150 to 200 feet for 80% removal of pollutants.

3.7 The Science and Effectiveness of Wetland Mitigation (Chapter 6 of Volume 1)

As discussed in Chapter 6 of Volume 1, according to the rules implementing the Washington State Environmental Policy Act (Chapter 197.11 WAC), mitigation involves the following steps that are performed sequentially (WAC 197.11.768):

1. *Avoiding the impact altogether by not taking a certain action or parts of an action;*
2. *Minimizing impacts by limiting the degree or magnitude of the action and its implementation by using appropriate technology or by taking affirmative steps to avoid or reduce impacts;*
3. *Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;*
4. *Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;*
5. *Compensating for the impact by replacing, enhancing, or providing substitute resources or environments; and/or*
6. *Monitoring the impact and taking appropriate corrective measures.*

The term *compensatory mitigation* refers to the compensation stage of the mitigation sequence (number 5 in the list of steps above). For wetlands, it typically involves producing new wetland area, functions, or both as compensation for wetland area, function, or both that have been or will be lost due to a permitted activity. Compensatory wetland mitigation generally entails performing one or more of the following types of compensation:

- **Restoring** wetland conditions (and functions) to an area
- **Creating** new wetland area and functions
- **Enhancing** functions at an existing wetland
- **Preserving** an existing high-quality wetland to protect it from future development

Chapter 6 of Volume 1 synthesizes the literature on compensatory mitigation from the last 15 years. The majority of projects that provide compensatory mitigation described in the literature have been neither fully successful nor complete failures. One challenge in synthesizing this information was the range of meanings for and the implications of the very terms success and failure.

3.7.1 Compliance of Projects with Permit Requirements (Volume 1 Section 6.4)

While most of the mitigation projects documented in the literature were implemented, compliance of the projects with permit requirements was generally low. This was a result of inadequate acreage of wetland, failure to achieve performance standards, and a lack of monitoring and maintenance. The few studies that examined the effect of regulatory follow-up suggested that it had a positive influence on the level of compliance and success for compensatory wetland mitigation projects.

3.7.2 Ecological Effectiveness of Different Types of Compensation (Volume 1 Section 6.5)

There is a general lack of information about the relative ecological effectiveness of the various types of compensation (e.g., restoration, creation, enhancement, etc.). Creation is generally the most frequently used type of compensation, but studies of its effectiveness produced mixed results.

Enhancement of wetlands is also frequently used, but few studies have examined its effectiveness. Limited studies from Washington indicated a low level of success among enhanced wetlands, primarily due to a minimal gain in functions in the timeframe between construction of the mitigation project and the evaluation of gain in functions. It may simply take longer for a gain in functions to appear (15 to 20 years rather than 5 to 10 years).

Restoring wetlands was noted as a high priority in the literature, but this type of compensation is not frequently used. This could be because restoration is often not an option on a project-by-project basis when costs and local regulations defer to on-site mitigation options. Restoration appears to be a more frequent choice in non-regulatory situations.

Preservation and the use of a mixture of compensation types appear to be used occasionally based on the literature review, and studies provided limited information on the effectiveness of these types of compensation. Two studies from Washington indicated that mixed compensation projects had a higher level of compliance than creation or enhancement, and all mixed projects were moderately successful.

3.7.3 Replacement Ratios (Volume 1 Section 6.6)

Replacement ratios are a tool used to account for the risk of mitigation failure and the temporal loss of functions. Required replacement ratios vary from one jurisdiction to another, based on the type of compensation proposed and project-specific circumstances.

The review of the literature indicated that the wetland functions and acreage achieved by using replacement ratios were less than what was required. In some cases the result was less than 1:1 replacement of acreage and a net loss of wetland acreage and function on the landscape.

3.7.4 Functions and Characteristics of Mitigation Wetlands (Volume 1 Section 6.8)

The functions performed and the structural characteristics that developed in created and restored wetlands usually differed from those in reference wetlands discussed in the literature. The one exception was the group of functions that improve water quality; these appeared to be performed in a similar capacity in mitigation wetlands as in reference wetlands. (Studies reviewed for Volume 1 did not compare the functions provided by wetlands that had been developed as compensation against the functions provided by the wetlands that were lost. Instead, reference wetlands were used as the basis for comparison with mitigation wetlands.)

For the most part, reference wetlands were found to provide habitat for a greater diversity or abundance of wildlife than created or restored wetlands. Birds were an exception since half of the studies found no difference between created/restored sites and reference wetlands, particularly for ducks.

Created and restored wetlands were also found to exhibit different vegetation characteristics and plant communities than reference wetlands. The effect of wetland age on the vegetation of created and restored wetlands was noted in various studies.

3.7.5 Types of Wetlands Produced through Compensation Projects (Volume 1 Section 6.9)

The review of the literature indicates that compensatory mitigation is producing more acreage of open water wetlands than has been lost. The ability of compensatory mitigation projects to produce wetlands of other Cowardin classes (e.g., emergent, scrub-shrub, forested) varies.

Compensatory mitigation is also producing wetlands with significantly different hydrogeomorphic (HGM) classes than were present in the reference wetlands near that location. (The HGM classification is based on the position of the wetland in the landscape, the wetland's water source, and the flow and fluctuation of the water once in the wetland.) This has resulted in mitigation wetlands that have more inundation for a longer period than in reference wetlands, as well as HGM classes of wetlands that are atypical for the landscapes in which they are being created.

Some unique types of wetlands, such as bogs, fens, and mature forested wetlands, may not be reproducible, especially not within current regulatory timeframes. Other wetland types, such as vernal pools, may be reproducible given the right conditions.

3.7.6 Suggestions for Improving Compensatory Mitigation (Volume 1 Section 6.10)

The literature provides numerous suggestions on virtually every aspect of the compensatory mitigation process. Key suggestions include:

- Improving regulatory guidance on a variety of topics, such as measurable, meaningful, and enforceable performance standards for compensatory mitigation
- Finding better sites that provide increased benefits due to their location within a watershed
- Monitoring compensatory mitigation wetlands more effectively
- Maintaining compensatory mitigation sites
- Increasing the regulatory follow-up of compensation projects

The review of the literature indicates that improvements have been made in compensatory mitigation over the past two decades, particularly in terms of what is required. Based on the research reviewed, the overall success and permit compliance have not noticeably improved. Most studies indicate that created and restored wetlands do not provide the same characteristics or level of functions as reference wetlands (water quality functions may be the exception). Though older created and restored wetlands generally exhibit characteristics of the vegetation that lead to improved habitat for wildlife, the soils and the hydroperiods may remain so modified that they will not replicate reference systems in the foreseeable future. Since the effectiveness of compensatory mitigation remains highly variable, it is important to understand the cumulative effects of the continuing loss of wetland acreage and functions (summarized in the next section).

3.8 Cumulative Impacts to Wetlands and the Need for a New Approach (Chapter 7 of Volume 1)

The literature reviewed for Volume 1 indicates that project-by-project decisions cannot, by their very site-specific nature, adequately address the complexities of wetland systems as they function in a landscape context. The majority of wetland management decisions in Washington State are related to individual projects, without an opportunity to consider the environmental factors that control functions or cumulative impacts.

As discussed in Chapter 7 of Volume 1, the causes of cumulative impacts are not limited to the policies or regulations of a single agency but can also result from multiple agencies making land-use decisions in isolation. Also, cumulative effects are difficult to assess because of the large spatial and temporal scales involved, the wide variety of processes and interactions, and the lag times that often separate a land use activity from resulting effects.

While the literature did not focus on the reasons for the lack of landscape-scale wetland management in Washington, some impediments can be assumed:

- The costs of analysis, inventories, assessments, and rankings
- The costs of implementing a landscape-scale program relative to existing project-driven programs that are often funded by applicant fees
- Inconsistent mandates driving the agendas and priorities of regulatory agencies
- Lack of examples of successful tools for interagency collaboration and implementation
- Lack of awareness and understanding of the ecological consequences of existing regulatory programs by the public and the staff of implementing agencies
- Lack of support for local jurisdictions to tackle the process of identifying and prioritizing aquatic resources for long-term protection and/or potential alteration

The literature recommends a broader approach for the management and restoration of aquatic resources including wetlands. Researchers recognize the need for an analysis of the broader landscape and the environmental factors that control functions and cumulative effects (i.e., the historic, ongoing, and future impacts on an ecosystem).

For this reason, the guidance provided in Volume 2 stresses the importance of starting with an understanding of the landscape as well as wetland functions at the site scale. This understanding of the landscape can then be incorporated into more effective planning, regulatory, and non-regulatory tools.