Chapter 1. Introduction

1-1. Purpose of This Manual

The Aviation Stormwater Design Manual (ASDM) provides design guidance for best management practices (BMPs) for stormwater flow control and water quality treatment at or near airports (within the airport influence areas) that protect receiving waters and meet federal and state water quality standards in a safe manner. The ASDM is a joint effort by the Federal Aviation Administration (FAA), the Washington State Department of Transportation (WSDOT) Aviation Division and WSDOT Environmental Services.

The Washington State Department of Ecology (Ecology) has reviewed this manual to confirm that the modifications proposed to BMP design guidelines will not impact treatment or flow control mechanisms and are acceptable alternatives to guidelines presented in the Stormwater Management Manual for Western Washington (SMMWW) and the Stormwater Management Manual for Eastern Washington (SMMEW) (Ecology 2004, 2005). Section 1-3.4 provides information on other guidance manuals and documents that should be reviewed to determine applicable requirements. This manual does not provide guidance for determining when, or to what standard or threshold, treatment or flow control is required.

1-2. How to Use This Manual

- **Chapter 1** provides the regulatory background for stormwater management requirements in Washington State, emphasizing how they apply to airport operations.
- **Chapter 2** describes airport operations zones and how they affect stormwater management planning.
- **Chapter 3** discusses stormwater and wildlife planning, hazardous wildlife and provides recommendations for monitoring and designing based on airport-specific concerns. Chapter 3 also provides recommendations for adaptive management techniques that can be used with existing and new stormwater facilities.
- **Chapter 4** includes flow charts that provide guidance for selecting BMPs depending on pollutants of concern and site characteristics.
- **Chapter 5** provides guidance on hydrologic analysis for sizing of BMPs.
- **Chapter 6** provides design guidance for design of stormwater BMPs.

- **Appendix A** provides lists of vegetation recommended in airport settings, along with general guidelines for plant selection.
- **Appendix B** provides technical documentation for analyses that formed the basis for airport-specific design criteria for detention ponds (AR.09) and infiltration ponds (AR.04).

The three most common situations for use of this manual are described below. Please see the corresponding sections for additional information on how to perform each step.

A. Airports with new facility planned (runway, taxiway, etc.) or for other reasons, need new stormwater facilities		**See Section**
1	Determine applicable stormwater requirements	1-3.4
2	Identify other regulatory requirements	1-3.3
3	Map airport operational areas to determine potential sites for stormwater facilities, including maintenance access	2-1, 2-2.1, 2-2.2
4	Implement wildlife monitoring - consult with qualified airport wildlife biologist, if possible.	3-1.1
5	Based on monitoring, identify wildlife of concern and responsible attractants	3-1.2
6	Based on wildlife species, determine vegetative and structural considerations for BMPs	3-3.1, 3-3.2
7	Select BMPs for flow control	4-4
8	Select BMPs for runoff treatment	4-5

B. Airports with no new stormwater requirements but observed hazardous wildlife problems		**See Section**
1	Conduct a wildlife hazard assessment if any of the following apply: an air carrier aircraft experiences multiple wildlife strikes; an air carrier aircraft experiences substantial damage from a wildlife strike; an air carrier aircraft experiences an engine ingestion of wildlife near the airport; or wildlife are present in size, numbers, and locations such that there is a risk of wildlife strike (paraphrased from 14 CFR 139.337).	1-3.3
2	Implement wildlife monitoring - consult with qualified airport wildlife biologist, if possible.	3-1.1
3	Determine whether adaptive management techniques are needed for existing airport stormwater management facilities	3-4
4	Determine whether off-airport land is contributing to hazardous wildlife concerns	2-1.1, 2-2.4
5	If appropriate, coordinate with local jurisdictions regarding hazardous wildlife concerns	2-2.4
6	Identify any regulatory restrictions on adaptive design measures	1-3.3
7	Implement adaptive design measures	3-4

C. Airports with no new stormwater requirements and no hazardous wildlife issues		See Section
1	Implement wildlife monitoring	3-1.1
2	Make sure that planning documents reflect wildlife of concern and potential attractants (e.g. siting of proposed facilities)	3-2
3	Determine whether adaptive management techniques could benefit existing stormwater management facilities	3-4
4	Identify local jurisdictions and other land owners within Perimeter C, and identify which are most important in terms of hazardous wildlife concerns.	2-1.1, 2-2.4
5	Coordinate with local jurisdictions regarding hazardous wildlife concerns	2-2.4

1-3. Basis for Manual Development

1-3.1. Scope of Manual

This manual was developed to assist with the planning and design of stormwater management facilities on and around existing and new airports in the state of Washington, including those owned or operated by WSDOT. Airports are required to comply with federal, state, and local regulations to protect water resources by treating and controlling flow rates of stormwater runoff for new development and facility upgrades. However, airports are different from other industrial or commercial sites and must manage stormwater in a way that will not compromise aircraft safety. Many traditional stormwater BMPs, such as ponds, attract wildlife that may be hazardous to aircraft (Herrera 2007b). As a result, some traditional BMPs must be altered for use in the airport environment. This manual was developed to identify ways to treat and control stormwater without creating hazardous wildlife attractants. The manual focuses on technical issues related to stormwater management within the airport environment.

Wildlife attractants at airports are of concern because of the potential for collisions between wildlife and aircraft that threaten human safety. However, airports are not exempt from the Endangered Species Act (ESA), Bald and Golden Eagle Protection Act, or other federal, state, and local environmental regulations (see Section 1-3.3). Jurisdictional wetlands and other protected resources also may not be altered except as approved under applicable federal, state, and local regulations, even if they attract wildlife considered hazardous to aircraft. Active measures, such as sonic cannons, water sprays, dogs, and even laser beams have been used by airports to repel wildlife and will still need to be used in the future. However, airport managers also should design airports to avoid protected resources and/or ensure that the flight paths of birds that will be attracted to such protected resources will not pose an unacceptable risk of collisions. Chapter 3 provides general concepts for designing stormwater facilities to reduce the presence of hazardous wildlife.

In addition to posing a risk to wildlife and human life, wildlife-aircraft collisions cost the United States civil aviation industry at least $500 million in direct damage and associated costs and

more than 500,000 hours of aircraft downtime per year (FAA 2005b). The majority of aircraft and wildlife collisions occur in the immediate airport environment (FAA 2005b). At airports in the state of Washington, there were 1,245 wildlife-aircraft collisions documented from January 1990 to April 2006 (FAA 2006a). Several studies have estimated that only 11 to 25 percent of all wildlife strikes are reported to the FAA (Linnel et al. 1999; Wright and Dolbeer 2005), so it is likely that many more strikes actually occurred.

The most common known bird species involved in aircraft collisions that were recorded in Washington were gulls, Canada geese, European starlings, killdeer, sparrows, barn swallows, ducks, and various raptors. Chapter 3 presents a summary of research on the factors that attract these birds to airports, which are primarily related to food and shelter. Stormwater facilities designed in accordance with traditional BMP design guidelines often provide food and shelter for wildlife, and thus increase the likelihood of a hazardous wildlife-aircraft collision.

It is important to note that the intent of this manual is not to deter all wildlife from airports. Many forms of wildlife exist on airports and sometimes pose little or no risk to aircraft. In this manual, the terms “hazardous wildlife” or “hazardous wildlife attractant” are used. These terms are intended to distinguish wildlife that could pose risks to aircraft and human life if they occur in unacceptable locations in the airport environment.

1-3.2. Airport Regulatory Issues

This manual is intended for all airports within the Washington Aviation System Plan (WSDOT 2001).

1-3.3. Overview of Federal and State Regulations Related to Stormwater Management at Airports

This manual is intended to complement and be used in conjunction with other Ecology-approved stormwater manuals. To determine when new impervious surfaces require water quality treatment, when flow control is required for receiving water protection, or the effluent discharge limits for pollutants, the permit documents described in this section and locally approved and equivalent manuals described in Section 1-3.4 should be consulted.

A number of operational and regulatory requirements create the framework for how airports in Washington State must manage stormwater on their property. This section describes the applicable state and federal requirements.

Federal Aviation Regulations

The FAA issues airport operating certificates for airports serving certain air carrier aircraft under Title 14, Code of Federal Regulations (CFR), Part 139. Section 139.337 stipulates that airports must conduct a wildlife hazard assessment if one of the following occurs at or near the airport:

> an air carrier aircraft experiences multiple wildlife strikes; an air carrier aircraft experiences substantial damage from a wildlife strike; an air carrier aircraft experiences an engine ingestion of wildlife near the airport; or wildlife are present in size, numbers, and locations such that there is a risk of wildlife strike (paraphrased from 14 CFR 139.337).

In addition, all airports that have received Federal grant-in-assistance must comply with the standards outlined in FAA Circular Hazardous Wildlife Attractants on or near airports (AC 5200-33). The FAA recommends that all uncertified airports also adhere to these standards.

If a wildlife hazard management plan is deemed necessary based on the wildlife hazard assessment, it will become part of the Airport Certification Manual and, accordingly, federal law (for an explanation of the Airport Certification Manual, see the Glossary). The wildlife hazard management plan may contain provisions related to stormwater management and water quality, which should be reviewed for consistency with the provisions of this manual.

Clean Water Act, Section 404 Permits: Permit for Discharge of Dredge or Fill Material

While creating new constructed treatment wetlands is discouraged at airports, existing jurisdictional wetlands must be protected in accordance with Section 404 of the Clean Water Act.

Section 404 of the Clean Water Act prohibits the discharge of dredged and/or fill material into jurisdictional waters of the United States, including adjacent wetlands, without authorization from the U.S. Army Corps of Engineers (the Corps). The Corps evaluates the need to protect receiving waters from the effects of a proposed development, requires avoidance and minimization of proposed effects and requires mitigation to compensate for unavoidable effects. Section 404 of the Clean Water Act applies to airport management, especially because many airports are built in floodplains and flat areas near lakes, streams, and rivers.

Clean Water Act, Section 401 Permits

Applicants receiving a section 404 permit from the Corps, a Coast Guard permit, or a license from the Federal Energy Regulatory Commission (FERC), are required to obtain a section 401 water quality certification from the Ecology. Issuance of a certification means that Ecology anticipates that the applicant's project, if constructed and operated according to conditions included with the certification, will comply with state water quality standards and other aquatic resource protection requirements under Ecology's authority. Conditions of the 401 Certification become conditions of the Federal permit or license.

Clean Water Act, Section 402: National Pollutant Discharge Elimination System Permit

In 1972, as part of the Clean Water Act, the U.S. Congress initiated the federal National Pollutant Discharge Elimination System (NPDES) program. To comply with the NPDES program, as amended in 1987, municipalities and many types of industrial sites are required to obtain a permit to discharge stormwater pollutants into navigable or regulated waters. The Clean Water Act also requires management of runoff from construction sites for water resource protection. Ecology is the agency that administers NPDES permits in the state of Washington on behalf of the U.S. Environmental Protection Agency (U.S. EPA).

Public-use airports in Washington are under multiple ownerships including facilities owned by WSDOT Aviation, a port district, private or a local entity such as a county, city, or tribe ownership. In the state of Washington, air transportation is considered an industrial activity (Standard Industrial Classification [SIC] 4500 series) requiring coverage under the Industrial Stormwater General Permit ISGP). As of October 6, 2006, 41 facilities in the state with this SIC code were covered under the permit. Other airports may have an individual (rather than general) NPDES stormwater permit, such as the Seattle-Tacoma International Airport, which is owned by the Port of Seattle. Some airport-related activities, such as aircraft maintenance or refueling activities, may be covered by a permit for an on-site waste treatment system. These permits typically specify effluent limitations for regulated pollutants that are created or used for that activity.

Endangered Species Act

The purpose of the Endangered Species Act (ESA) is to protect and promote recovery of imperiled species and the ecosystems upon which they depend. Three provisions of the Endangered Species Act may apply directly to stormwater management (Ecology 2005): Section 4(d) rules, Section 7 consultations and Section 10 habitat conservation plans. Brief descriptions of these provisions are provided in the SMMWW (Ecology 2005). These provisions ensure that conservation of endangered species is considered when proposing actions that may adversely affect these species. For example, several endangered fish species in the state of Washington may be adversely affected by stormwater pollutants. Because of their potential impact on endangered species development projects—including those at airports—are required to implement stormwater plans to minimize and mitigate these impacts.

For federally-funded projects that drain to receiving waters with ESA-listed species, there may be special water quality treatment and/or flow control requirements imposed through consultation with NOAA Fisheries. These requirements may exceed the level of treatment or flow control required based on the Ecology manuals, the HRM, and locally approved and equivalent manuals.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 United States Code [U.S.C.] 668-668c), enacted in 1940, prohibits the “take” of “any bald eagle ... [or any golden eagle], alive or dead, or any

part, nest, or egg thereof." The act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." With regard to the act, "disturb" means: "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

This definition also prohibits impacts that result from "human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment" (USFWS 2007). To clarify activities that are prohibited or not prohibited under the act, the United States Fish and Wildlife Service (USFWS) released the National Bald Eagle Management Guidelines for landowners with the potential to encounter eagles while conducting activities on their property (USFWS 2007). Where bald or golden eagles use habitat at airports for breeding, feeding, or sheltering, these species must be protected in accordance with the Bald and Golden Eagle Protection Act. If bald eagles pose a threat to aircraft or human safety, a permit to disturb or trap and relocate bald eagles may be obtained from the USFWS (USFWS 2005).

Washington Growth Management Act

The Washington Growth Management Act (Revised Code of Washington, Chapter 36.70A [RCW 36.70A]), as well as Article 11 of the Washington State Constitution, require that local jurisdictions protect critical areas by adopting ordinances that classify, designate, and regulate land use. *Critical areas* are defined in this manual as wetlands, floodplains, aquifer recharge areas, geologically hazardous areas, and those areas necessary for fish and wildlife conservation. Critical areas are often found near airports and can, therefore, be affected by stormwater runoff from airports. Airport managers need to comply with the local jurisdictional requirements for protecting critical areas when managing stormwater at airports.

The Washington State Growth Management Act also contains provisions (RCW 36.70.547) whereby all general aviation airports operating for the benefit of the general public should discourage the siting of incompatible land uses adjacent to such airports through their comprehensive plan and development regulations.

Underground Injection Control Regulation

In accordance with Part C of the Federal Safe Drinking Water Act (SDWA), *Protection of Underground Sources of Drinking Water*, Washington State has an underground injection control (UIC) program which regulates discharges to UIC wells to protect groundwater quality. The UIC program is administered by Ecology under Chapter 173-218 Washington Administrative Code [173-218 WAC].

Infiltration facilities are the preferred BMPs for flow control and treatment, as noted in Chapter 4. Since infiltration facilities need to comply with UIC requirements, it is important that

airport managers are aware of UIC provisions. The two major requirements of the UIC program are 1) register UIC wells with Ecology (unless wells are located on tribal land, in which case they must be registered with EPA); and 2) make sure that current and future underground sources of groundwater are not contaminated.

The following are not considered by Ecology to be UIC wells, so registration requirements and other restrictions do not apply (Ecology 2006):

- Buried pipe and/or tile networks that serve to collect water and discharge that water to a conveyance system or to surface water.
- Surface infiltration basins and flow dispersion stormwater infiltration facilities (AR.01, AR.02, AR.03.AR.04, AR.06).
- Infiltration trenches designed **without** perforated pipe or a similar mechanism (BMP AR.05).

UIC wells may not receive stormwater from the following types of areas (this is a partial list only; see 173-218-040(5)(b) WAC for additional prohibited UIC wells):

- Vehicle maintenance, repair and service.
- Commercial or fleet vehicle washing.
- Airport de-icing activities.
- Storage or handling of hazardous materials.
- Generation, storage, transfer, treatment or disposal of hazardous wastes.

More information can be found on Ecology's UIC program home page:
http://www.ecy.wa.gov/programs/wq/grndwtr/uic/index.html

Sole Source Aquifer

There are currently twelve sole source aquifers (SSAs) (U.S. EPA undated) in Washington state. If an existing or proposed federally-funded airport project has the potential to contaminate a SSA, that project would be subject to EPA review. In particular, stormwater management plan(s) would be reviewed in light of the following restrictions:

- Stormwater Treatment and Disposal Practices - All federally funded projects with the potential to contaminate a SSA that may generate, increase, collect, or dispose of storm or surface water runoff from impervious surfaces, must use BMPs to treat stormwater. Shallow injection wells, such as dry wells, french drains, sumps, and drainfields, must be avoided whenever possible.

- Shallow Injection Wells - In those cases where stormwater treatment and disposal systems must utilize a shallow injection well, the project proponent must notify and register the shallow injection well with Ecology's UIC Program and ensure that the shallow injection well(s) does not dispose any fluids that do not meet Washington's ground water quality standards (Chapter 173-200 WAC).

1-3.4. Relationship of this Manual to Other Stormwater Programs

This manual is a technical design guidance manual that is intended to supplement other stormwater programs, manuals and permits to address airport-related concerns. To determine whether stormwater quality treatment and/or flow control is required, consult other locally approved and equivalent manuals or permit documents.

Minimum Requirements/Core Elements

To comply with Ecology stormwater management requirements, project proponents must complete a set of documentation, analysis, design, planning, and maintenance activities related to stormwater management. These activities are referred to as *minimum requirements* in the SMMWW and *core elements* in the SMMEW.

Ten minimum requirements pertaining to stormwater management may apply to new and redevelopment projects in western Washington, including such projects at airports. See Volume I of the SMMWW for details. The 10 requirements are:

1. Preparation of stormwater site plans
2. Construction stormwater pollution prevention
3. Source control of pollution
4. Preservation of natural drainage systems and outfalls
5. Onsite stormwater management
6. Runoff treatment
7. Flow control
8. Wetlands protection
9. Basin/watershed planning
10. Operation and maintenance

Similarly, in eastern Washington, the project must comply with the following core elements:

1. Preparation of a Stormwater Site Plan
2. Construction Stormwater Pollution Prevention
3. Source Control of Pollution
4. Preservation of Natural Drainage Systems
5. Runoff Treatment
6. Flow Control
7. Operation and Maintenance

8. Local Requirements

Other Manuals and Permit Documents

To determine which of these minimum requirements apply, including requirements for water quality treatment and/or flow control, other locally approved and equivalent manuals or permit documents should be consulted. The following is a brief list of potentially applicable manuals and permit documents:

- **Highway Runoff Manual (HRM), Washington State Department of Transportation** (WSDOT 2008a)**:** The current version of this manual should be consulted for road projects adjacent to airports. The June 2008 version of the HRM was deemed equivalent to Ecology's Stormwater Manuals in November 2008 (Susewind 2008).
- **Ecology Stormwater Manuals (**Ecology 2004, 2005): Thresholds and requirements for water quality treatment and flow control can be found in the Ecology stormwater manuals for eastern Washington and western Washington (SMMWW or SMMEW), unless more stringent local guidelines apply.
- **Puget Sound Action Team (PSAT) Low Impact Development Technical Guidance Manual for Puget Sound (**PSAT 2005**)**: This manual does not provide information on thresholds and requirements for water quality treatment and flow control. However, some of the site planning and layout techniques described in Chapter 3 of the PSAT manual can effectively reduce impervious area, thereby reducing flow control and treatment requirements. The Puget Sound Partnership plans to update this manual as appropriate to reflect state-of-the-practice guidance for design of low impact developments and related stormwater facilities.
- **Locally Approved and Equivalent Manuals:** If an airport is located within a county or city with an Ecology-approved stormwater manual, the airport must comply with any applicable stormwater requirements in that locally approved and equivalent manual. These include manuals developed mainly by NPDES "Phase 1" communities in Washington as equivalent to the Ecology manuals. Examples are King County, Pierce County, and the city of Olympia.
- **FAA Wildlife Hazard Management Plan (FAA 2005b):** As described in Section 1-3.3, for airports where wildlife strikes have occurred or with a high risk of wildlife strikes, a wildlife hazard management plan may be part of the regulatory Airport Certification Manual. Stormwater management facilities must be designed in accordance with any applicable safety requirements documented in the wildlife hazard management plan.

- N**PDES Permits**, as described in Section 1-3.3, may include effluent discharge limits and other restrictions applicable to stormwater management. Some airports have individual NPDES permits or are subject to a local municipality's NPDES permit (if they discharge to a regulated small Municipal Separate Storm Sewer System [MS4]) that may impose requirements beyond those described in this manual. The more stringent flow control and water quality treatment requirements apply.
- **Basin Plan, Waste Load Allocation (WLA), or Water Cleanup Plan**: An adopted and implemented basin plan, a WLA required by Total Maximum Daily Load (TMDL) requirements established by Ecology, or a water cleanup plan may also govern runoff treatment requirements that are tailored to a specific basin. However, basin-specific requirements must be at least as rigorous as Ecology's basic treatment requirements (Ecology 2004, Ecology 2005).
- **ESA Recovery Plans**: Section 4(f) of the ESA requires that NMFS and USFWS develop and implement recovery plans for threatened and endangered species, unless such a plan would not promote conservation of the species. These plans incorporate management actions necessary to achieve recovery of the species, which could affect stormwater management requirements.