JOINT BASE LEWIS-MCCHORD
STORMWATER DESIGN GUIDANCE

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JBLM Stormwater Public Website:
https://home.army.mil/lewis-mcchord/index.php/my-Joint-Base-Lewis-Mcchord/all-services/public_works-environmental_division/stormwater

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ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
AOA	Aircraft Operations Area
Aviation Manual	Aviation Stormwater Design Manual
BASH	Bird/Wildlife Aircraft Strike Hazard Management Program
BMPs	Best Management Practices
Ecology	Washington State Department of Ecology
EISA	Energy Independence and Security Act
EPA	Environmental Protection Agency
EPP	Environmental Protection Plan
GIS	Geographic Information System
JBLM	Joint Base Lewis-McChord
LID	Low Impact Development
LIDM	Low Impact Development Technical Guidance Manual for the Puget Sound
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NPGIS	Non pollutant generating imperious surface.
PGHS	Pollution-Generating Hard Surface
PGPS	Pollution Generating Pervious Surfaces
RCW	Revised Code of Washington
SWMMWW	Stormwater Management Manual for Western Washington (2012 Ed)
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UIC	Underground Injection Control
WAC	Washington Administrative Code
WWHM	Western Washington Hydrology Model
WSDOT	Washington State Department of Transportation

JOINT BASE LEWIS-MCCHORD

STORMWATER DESIGN GUIDANCE

1. PURPOSE

This stormwater management document provides a step-by-step process to assist designers in meeting the requirements of Joint Base Lewis-McChord's (JBLM) Municipal Separate Storm Sewer System (MS4) Permit No. WAS-026638.[9] The objective of JBLM is to manage stormwater from developed areas, new development, and redevelopment project sites in a manner that maintains the site's predevelopment runoff conditions, prevents or minimizes water quality impacts, and preserves and restores the area's predevelopment hydrology. Specifically, JBLM and its contractors will manage stormwater runoff from all public and private new development or redevelopment project sites to the maximum extent feasible.

For site specific requirements and best management practice (BMP) selection, this document is required to be used in conjunction with the 2012 *Stormwater Management Manual for Western Washington* (SWMMWW) and the *Aviation Stormwater Design Manual* (Aviation Manual), as applicable.[1, 10]

Regulatory Agency. JBLM is a federal installation requiring compliance with the United States Environmental Protection Agency (EPA) Region 10 permits, which include the EPA and Washington State requirements. References to State Permits in the SWMMWW should be replaced with EPA Permits, as required. Similarly, any references to contacting the State should be replaced with the JBLM Stormwater Program.

For guidance or further clarification contact the JBLM Stormwater Program at:
usarmy.jblm.id-readiness.list.dpw-stormwater1@mail.mil

2. SITE PLANNING PROCESS

a. **GENERAL.** Stormwater designs must be prepared consistent with Chapter 3, Volume I-Minimum Technical Requirements and Site Planning of the SWMMWW and with Chapter 3 of the *Low Impact Development Technical Guidance Manual for the Puget Sound* (LIDM) and the *Army Low Impact Development Technical Guidance*.[7, 8]

b. **SUBMITTALS AND COORDINATION.** Designers must coordinate with Stormwater Program staff as early in the project as feasible. The current stormwater management practice of JBLM includes on-site treatment and infiltration; thus, it is imperative that stormwater drainage plans are developed at an early stage of design.

(1) All Projects: The following information shall be provided for all projects disturbing soil regardless of project size:

(a) A detailed site plan layout (e.g., locating stormwater controls)

(b) A map showing drainage paths

(c) A list of Best Management Practices (BMPs) for sediment and erosion control from Tables 4.1.1 and 4.2.1 in the SWMMWW

(2) Projects MORE than 5,000 square feet need to submit Stormwater Drainage Plans with all items listed in the Drainage Plan Checklist. **The initial Drainage Plan shall be submitted with the 35% design and the Draft Final shall be submitted with the 65%.** A minimum of 14 days shall be allotted for review for each submittal or re-submittal. See Section 3 on Drainage Plans and Appendix A for the Drainage Plan Checklist.

(a) The 35% design submittal includes a geotechnical report with infiltration rates, a drainage map of the site, and highlighted flow charts for BMP selection (Figures 5 through 9 of this guidance document) with highlighted decision process.

(b) A 65% submission includes permanent BMPs selected from the SWMMWW with corresponding modeling (i.e., WWHM project report), justifications for BMP selection, the completed Stormwater Low Impact Development (LID) Form, the drainage plan checklist, and a completed Underground Injection Control (UIC) well checklist, if applicable.

(c) A 95% submission should include all components of the drainage plan.

(3) Operation and Maintenance Manual. O&M Manuals shall be prepared for permanent stormwater facilities that require maintenance and submitted with the 100% design. See Section 3.c. (9) of this document for further information.

(4) Stormwater Pollution Prevention Plan (SWPPP). A SWPPP is a separate submission to the Environmental Division for review and approval by the stormwater program as part of the proposed construction process. SWPPPs are generally prepared by the construction contractor and not by project designers.

(a) Follow guidelines in the Construction Stormwater Runoff Control Program and use the appropriate SWPPP template found at the JBLM Stormwater website.

(b) An EPA SWPPP is prepared for projects over 1 acre and requires an electronic Notice of Intent (eNOI) be submitted to the EPA for Construction General Permit coverage. A copy of the eNOI must be submitted to the stormwater program and included in the SWPPP submission.

c. **EXEMPTIONS.** Exemptions must be requested through the Stormwater Program and require approval of the PW Director. Refer to Appendix B for types of projects exempted from all or part of the development and redevelopment requirements.

d. **AIRPORT OPERATIONS AREA.** For sites disturbing 5,000 square feet or more on McChord Field, in an Airport Operations Area (AOA), or surrounding buffer of Grey Army Airfield (GAAF), drainage plans must be prepared consistent with the Washington State Department of Transportation Aviation Manual.[10] See the JBLM Stormwater website or the references in Appendix E for an electronic copy of the Aviation Manual.

(1) Stormwater Control Zone. All stormwater facilities within an AOA or the surrounding Stormwater Control Zone must be selected to minimize the retention of water and potential attraction of hazardous wildlife (i.e., lead to an increase in bird strikes). Refer to the

Aviation Manual for mitigation strategies. See **Figures 2 and 3** for defined AOAs and Stormwater Control Zones.

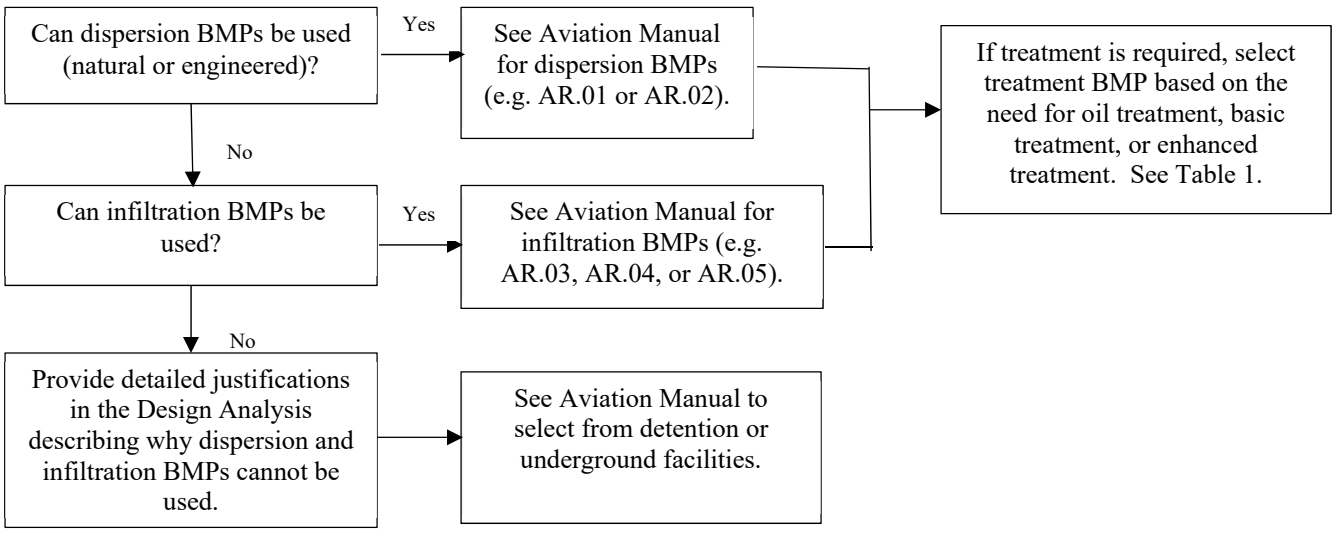
(2) Required Coordination. Coordination is required with the following contacts to review selected stormwater facilities for vegetation/plant selection and ponding potential.

(a) Projects in the GAAF AOA contact the GAAF Aviation Safety Program Manager. Email: Octavian.a.petrescu.civ@mail.mil.

(b) Projects in the McChord AOA contact the Bird/Wildlife Aircraft Strike Hazard (BASH) Management Program. Email: 62.AW.SEF@us.af.mil

(3) Drainage Plans. Drainage plans must address stormwater facility restrictions due to clearways, object-free areas, runway protection zones, runway safety areas, stopways, and taxiway safety areas. A description of these areas and their associated restrictions are in Section 2-1 of the Aviation Manual. The designer may determine infiltration rates using the detailed approach described in Section 5-3 of the Aviation Manual. Include documentation that the risks associated with wildlife-aircraft interactions are minimized to include vegetation selection from Appendix A of the Aviation Manual or Appendix C below.

Figure 1. AOA BMP Decision Tree



(4) BMP Selection. Utilize Chapters 4 and 6 of the Aviation Manual in addition to **Figure 1** and **Table 1**. Consider implementing treatment trains where appropriate. A treatment train is a combination of two or more BMPs connected in a series to accomplish treatment. First, assess dispersion BMPs, if not feasible, move to infiltration BMPs. After a flow control BMP is selected, select a treatment BMP if needed. If dispersion and infiltration BMPs are not feasible, assess the site for potential implementation of underground facilities. If detention facilities are selected they must be designed for the minimum necessary detention time. Provide a detailed

justification in the Design Analysis to support the BMP assessment and selection process. Additionally, we recommend review of requirements UFC 3-260-01 (airfields that deal with Stormwater Management Facilities) and UFC 3-201-01 (airfield drainage design) (National Institute of Building Sciences, 2017 & 2020).

(a) Oil treatment is required if an area is used for refueling or maintenance. Refer to Chapter 4 Section 4-5.6 of the Aviation Manual and Table 1 below. Design details for each BMP can be found in Chapter 6 of the Aviation Manual.

(b) Enhanced treatment must be assessed for AOAs and documentation must be included in the drainage plan. Areas discharging to Clover Creek and high traffic areas such as parking garages, terminal areas, aircraft service and fueling areas, and touchdown areas of runways likely require enhanced treatment. Refer to Chapter 4 Section 4-5.10 of the Aviation Manual and Table 1 below. Design details for each BMP can be found in Chapter 6 of the Aviation Manual.

Table 1. AOA Treatment BMPs – Assess options from top to bottom before considering other BMPs in the Aviation Stormwater Design Manual.

Oil Control BMPs	Enhanced Treatment BMPs (Metals Removal)
Filter Train AR.12 Vegetated Filter Strip with AR.15 Linear Sand Filter	AR.12 Compost Amended Vegetated Filter Strip
AR.15 Linear Sand Filter	AR.14 Media Filter Drain
AR.21 Baffled Oil/Water Separator	Amended AR.18 Sand Filter Basin or AR.15 Linear Sand Filter
AR.22 Coalescing Separator	Filter Train: AR.12 Vegetated Filter Strip with AR.15 Linear Sand Filter

Figure 2. McChord Airport Operations Area & Stormwater Control Zone

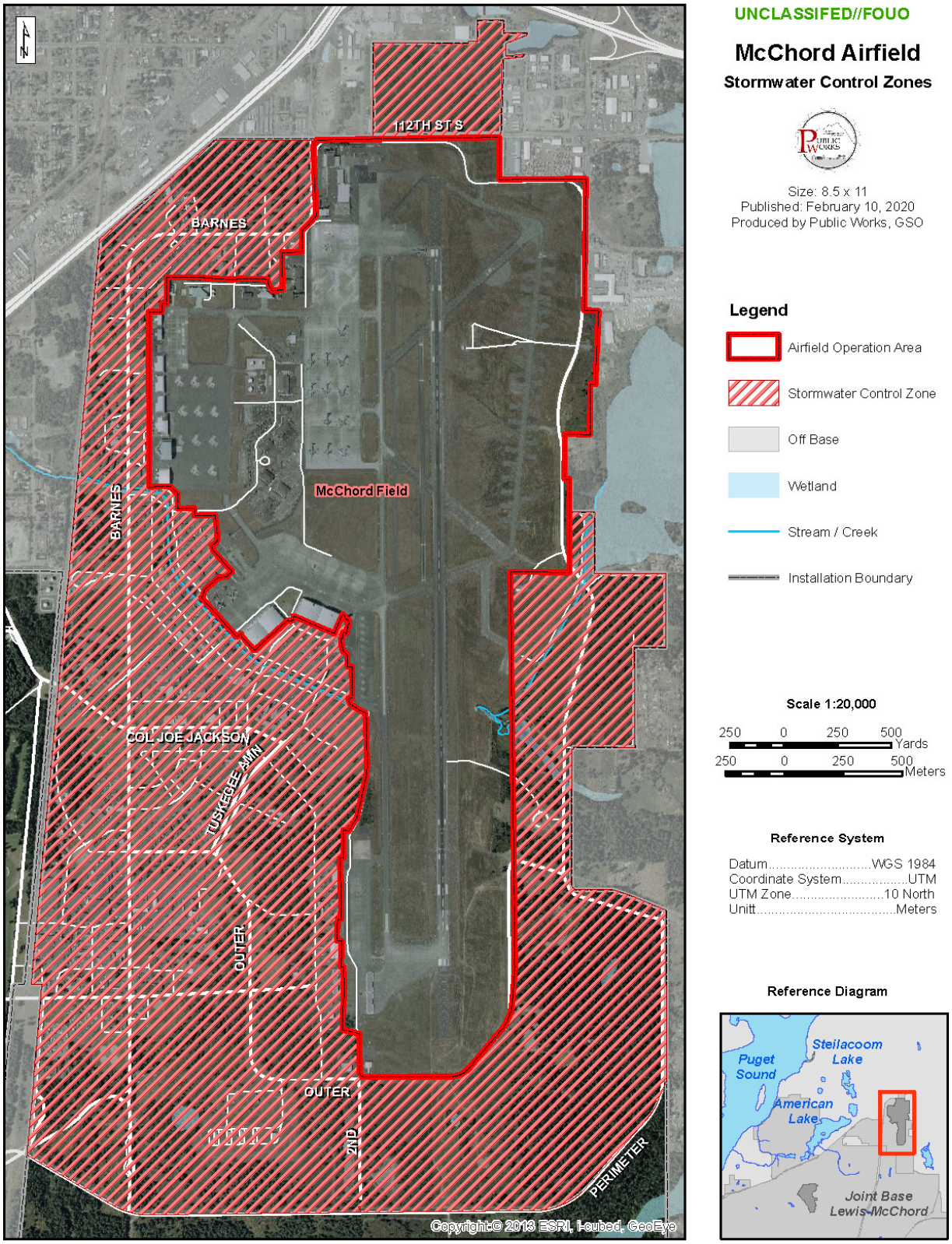
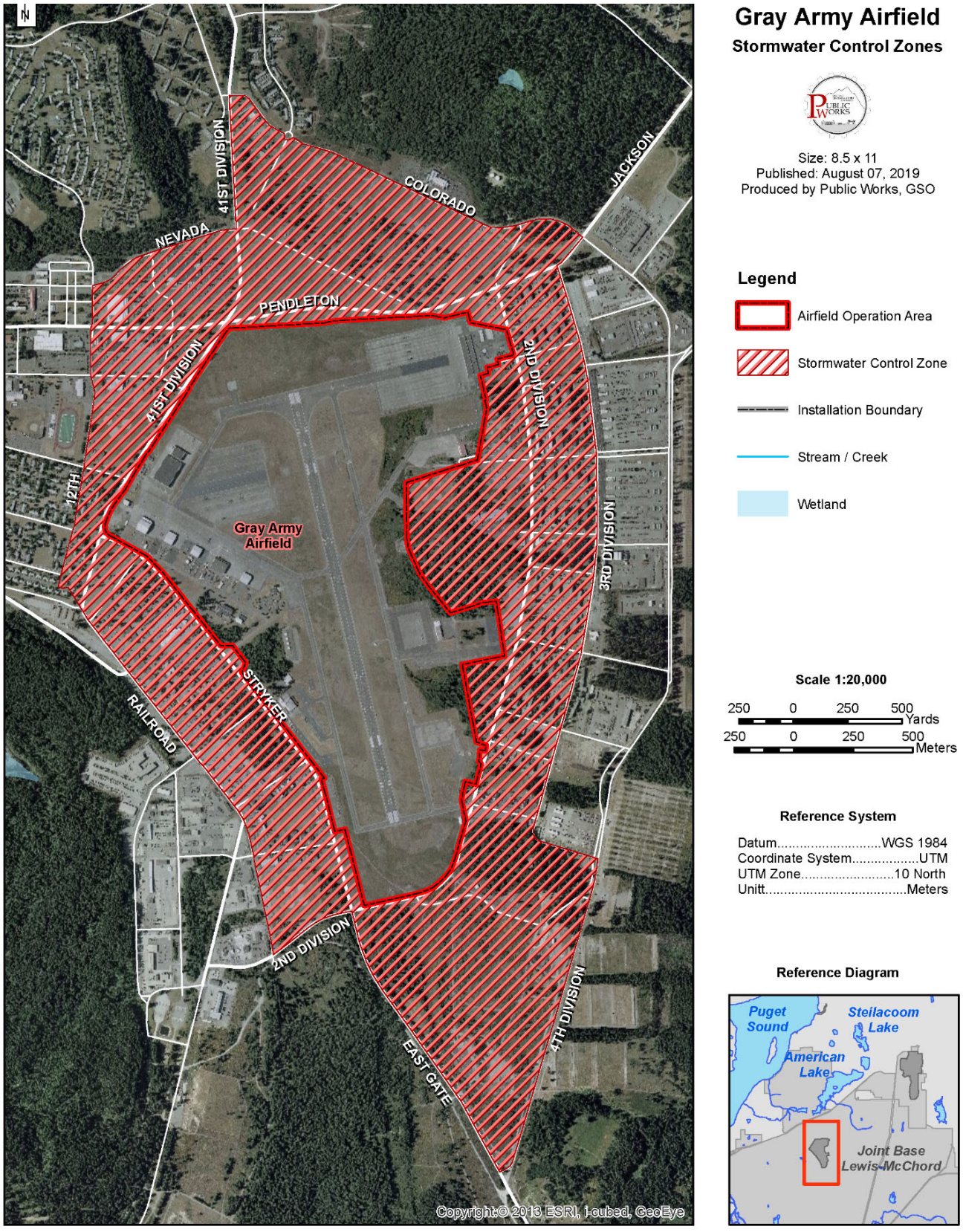


Figure 3. Gray Army Airfield Airport Operations Area & Stormwater Control Zone



3. STORMWATER DRAINAGE PLAN

a. **GENERAL.** A site specific Stormwater Drainage Plan shall be developed by the designer for project sites disturbing more than 5,000 square feet. The Stormwater Drainage Plan shall be prepared describing the measures that will be implemented to manage stormwater runoff from the new development/redevelopment site, and submitted as part of design narratives and drawings. Content of the Stormwater Drainage Plan is described in the following sections and is shown in **Figures 5 through 9** below. Designers should use Figures 5 through 9 to determine the Drainage Plan process for each site.

b. **CHECKLIST.** Designers are required to use the checklist in Appendix A during drainage plan preparation to ensure compliance with JBLM's stormwater permit. The Drainage Plan Checklist must be submitted with the Drainage Plan.

c. **STORMWATER DRAINAGE PLAN COMPONENTS.** The stormwater drainage plan is subdivided into ten different sections outlined as follows:

(1) Project Overview and Existing Conditions (SWMMWW Vol. I Ch. 3 Steps 1-4 – Minimum Requirement #1). Volume I, Section 3.1.1 of the SWMMWW describes the information required in the site overview and existing conditions section.[1]

(a) *Site Layout.* A site layout showing property lines and existing structures and conditions shall be prepared by a qualified professional. Unlike a municipality or other local government, all property on JBLM is federally owned. Therefore, a registered land surveyor is not needed to establish ownership or boundaries of property to be developed or redeveloped except where the project site borders the installation boundaries. However, care shall be taken by the professional designer to ensure that site boundaries, buildings, utilities, appurtenances, and improvements are accurately shown on maps and drawings.

(i) Base maps for the installation in Geographic Information System (GIS) format are available from the Directorate of Public Works Geospatial Office, in the basement of Building 2012 or email request to: usarmy.jblm.id-readiness.list.dpw-geospatial-requests2@mail.mil

(ii) The site layout must be accompanied by vicinity and site maps, which must include all components listed in the Drainage Plan Checklist under Site Map.

(b) *Geotechnical Report.* A geotechnical report containing information about underlying soils, infiltration test results, and evaluation of any hydraulic restrictions underlying the site shall be included. It is the designer's responsibility to ensure that the soil types of the site are properly identified and correctly used in the hydrologic analysis. Soil type, infiltration rates, and cation exchange capacity are vital to verifying treatment capabilities of stormwater facilities. NOTE: If collecting infiltration data is postponed until construction, the designer/ government risks potential contract changes if conditions are not suitable for adequate infiltration.

(c) *Western Washington Hydrology Model (WWHM).* Use Ecology approved modeling software such as the Western Washington Hydrology Model (WWHM) to analyze flow and run off volume and verify water quality treatment of selected BMPs during project design phase. Refer to Volume III Appendix III-C of the SWMMWW for BMP specific

modeling guidance. WWHM guidance can be found in the WWHM manual and Vol III Chapter 2.2 and Appendix III-B of the SWMMWW.[1, 2]

(2) Permanent Stormwater Control (SWMMWW Vol. I Ch. 3 - Step 5). All information regarding proposed BMPs must be provided in the Stormwater LID Form (available on the JBLM Stormwater Public Website) as part of Drainage Plan submittals. Provisions for permanent stormwater control shall be prepared consistent with Volume I - Chapter 3 on the Permanent Stormwater Control Plan and Chapter 2 Section 2.5.5. using List #2 of the SWMMWW and Chapter 3 of the LIDM.[1,8] Required components are described in the following sections.

(a) *LID.* Small scale dispersion or infiltration LID practices shall be prioritized instead of large scale retention or detention practices. Preferred BMPs on JBLM include: T5.12 Sheet Flow Dispersion, T5.30 Full Dispersion (See also Engineered Dispersion), and T7.40 Compost-amended Vegetated Filter Strips (CAVFS). Select vegetation and plants based on BMP recommendation in the SWMMWW or refer to Appendix C for additional options.

(b) *Discharge Requirements*: **Figure 4.** Discharge from a site must be evaluated per the requirements of List #2 in Volume I Section 2.5.5 of the SWMMWW, which is documented below. For each runoff surface, evaluate the BMPs in the order listed for that type of surface. Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface. The objective is to use practices distributed across a site that reduce the amount of disruption of the natural hydrologic characteristics.

(c) *Feasibility.* Feasibility shall be determined by evaluation against:

(i) Design criteria, limitations, and infeasibility criteria identified for each BMP in the SWMMWW; and

(ii) Competing needs criteria including requirements of the following federal or state laws, rules, and standards:

1. Historic Preservation Laws and Archaeology Laws as listed at: http://www.dahp.wa.gov/learn-and-research/preservation-laws

2. Federal Superfund or Washington State Model Toxics Control Act

3. Federal Aviation Administration requirements for airports

4. Americans with Disabilities Act

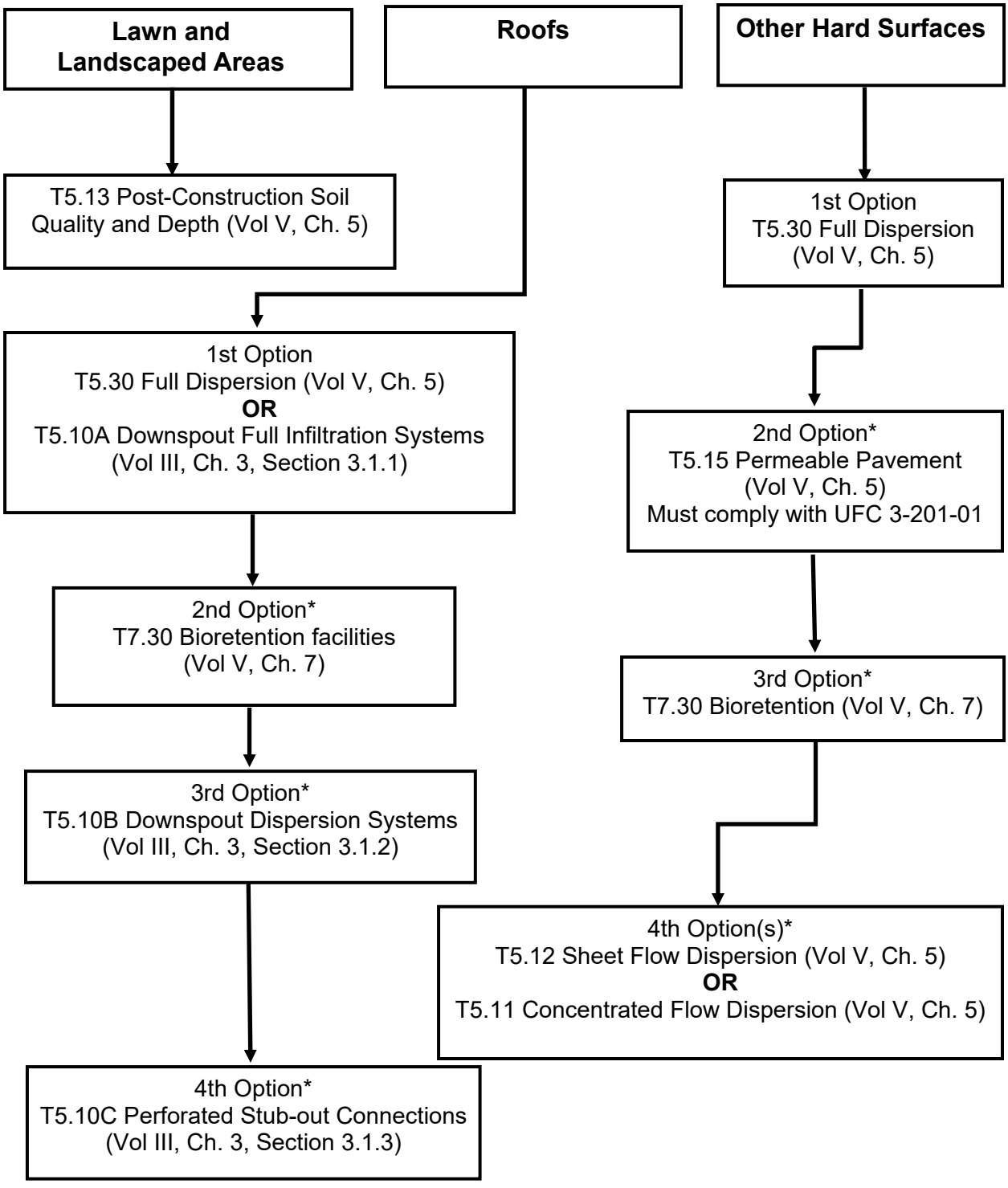
5. Where a LID requirement has been found to be in conflict with special design criteria adopted and being implemented pursuant to the JBLM Master Plan, the existing Plan may supersede or reduce the LID requirement

6. Public health and safety standards

7. Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way

8. Any applicable JBLM Critical Areas

Figure 4. LID BMP Selection (List #2 from the SWMMWW)



* Provide justification for infeasibility prior to moving on to the next option in series.

(3) Source Control of Pollution (SWMMWW Vol. I Ch. 2 -Minimum Requirement #3). **See Figure 5.** Source control BMPs must be selected and designed consistent with Volume IV of the SWMMWW. For construction sites see Vol. II, Ch. 4.

(4) Minimize Impervious Areas, Preserve Vegetation, and Preserve Natural Drainage Systems (SWMMWW Vol. I Ch. 2 -Minimum Requirement #4)**. See Figure 5**. All project sites shall be designed to minimize impervious surfaces, retain vegetation, restore native vegetation, and preserve natural drainage systems while considering the techniques in the SWMMWW and meeting the following requirements:

(a) Site design shall be developed that minimizes the project's roadway surfaces and parking areas, incorporates clustered development, and ensures vegetated areas receive stormwater dispersion from all developed project areas.

(b) Natural drainage patterns shall be maintained, and discharge from the project site shall occur at the natural location.

(c) The manner by which runoff is discharged from project site shall not cause a significant adverse impact to downstream receiving waters and/or down gradient properties.

(d) All outfalls shall utilize dissipation devices.

(5) Hydrologic Performance Requirement for On-site Stormwater Management (SWMMWW Vol. I Ch. 2 - Minimum Requirement #5)**. See Figure 6.** On-site stormwater management practices intended to infiltrate, disperse, retain, and/or harvest and reuse stormwater runoff shall be used as follows:

(a) *Lawn and landscape areas.* Soil quality of all disturbed land within the project site shall meet the specifications of **BMP T5.13** (Post Construction Soil Quality and Depth) in SWMMWW Vol. V Ch. 5.

(b) *Hard surfaces replacing 2,000 - 4,999 square feet.* Stormwater dispersion or infiltration BMPs will be used consistent with the SWMMWW Vol. V Ch. 5 and Vol. III Ch. 3 Sections 3.1, 3.3, and 3.4, and/or the LIDM.

(c) *Hard surfaces replacing 5,000 square feet or more.* Sites must meet one of the three conditions below.

(i) Hydrology Modeling: The Project Report from the model shall be included in the Drainage Plan. The post-development stormwater discharge flows from the project site shall not exceed the pre-development discharge flows for the range of 8% of the 2-year peak flow to 50% of the 2-year peak flow, as calculated by using the Western Washington Hydrology Model or another continuous runoff model. The modeled pre-development condition for all new development and redevelopment project sites must be "forested land cover" (with applicable soil and soil grade), unless reasonable historic information indicates the site was prairie prior to settlement (and may be modeled as "pasture").

(ii) Controls for post-development discharge flows shall meet the requirements of List #2 of Minimum Requirement #5 in Volume I of the SWMMWW.

(iii) Stormwater controls may be designed to retain on-site the volume of stormwater produced from the 95th percentile rainfall event. Feasibility must be determined by evaluating design criteria, limitations and infeasibility for each BMP in the SWMMWW.

(6) Hydrologic Performance Requirement for Flow Control (SWMMWW Vol. I Ch. 2 - Minimum Requirement #7)**. See Figure 7**.

(a) Project sites shall be designed to control post development discharge flows where such sites:

(i) Create >10,000 square feet effective impervious surface area

(ii) Convert ¾ acres or more from native vegetation to lawn/landscaping, and from which there is a surface discharge to a natural or manmade conveyance system

(iii) Convert 2.5 acres or more of native vegetation to pasture, and from which there is a surface discharge to a natural or manmade conveyance system

(b) For these sites, post-development stormwater discharge flows must not exceed the pre-development discharge flows for the range of 50% of the 2-year peak flow to 100% of the 50-year peak flow, as calculated by using the WWHM (or other continuous runoff model).

(c) When using the WWHM, the pre-development condition for all sites must be "forested land cover" (with applicable soil and soil grade), unless reasonable historic information indicates the site was prairie prior to settlement (and may be modeled as "pasture").

(d) Small scale dispersion or infiltration practices, or other appropriate LID practices shall be prioritized to meet this flow control requirement. **Sites may not meet this hydrologic performance requirement for flow control solely through the use of large scale retention or detention practices.**

(7) Runoff Treatment (SWMMWW Vol. I Ch. 2 - Minimum Requirement #6)**. See Figure 8.** Facilities for runoff treatment shall be constructed in accordance with **Section 5. Runoff Treatment Requirements**. Stormwater treatment facilities shall be constructed for projects in which:

(a) The total area of pollution-generating hard surface (PGHS) is 5,000 square feet or more, or

(b) The total area of pollution-generating pervious surfaces (PGPS), exclusive of permeable pavements, is 3/4 of an acre or more, and from which there will be a surface discharge in a natural or man-made conveyance system from the site.

(8) Wetlands Protection (SWMMWW Vol. I Ch. 2 - Minimum Requirement #8). Projects will ensure that discharges to wetlands from sites maintain the hydrologic conditions, hydrophilic vegetation, and substrate characteristics necessary to support existing and designated uses. A hydrologic analysis will be conducted that uses the existing land cover condition to determine the existing hydrologic conditions, unless directed otherwise by the JBLM Stormwater Program. For further information visit the SWMMWW section on Guidelines for Wetlands when Managing Stormwater.

(9) Operation and Maintenance Manual (SWMMWW Vol. I Ch. 2 - Minimum Requirement #9)**.** An operation and maintenance manual shall be prepared for permanent stormwater facilities that require maintenance. A draft manual shall be submitted to the Stormwater Program once the project has reached 100% design prior to construction. A final manual shall be submitted with project close-out documents. The manual shall include but is not limited to the following:

(a) Plans or map showing the facility construction with accurate dimensions

(b) A description of the operation of the facility and maintenance associated with its operation

(c) Maintenance schedule

(d) A list of materials or special equipment required for the facility operation and maintenance

(10) Underground Injection Control (UIC) Wells**.** Runoff from a site that discharges to the subsurface may require registration or permitting under the Underground Injection Control Well Program (Ecology, 2008). Ecology's UIC program falls under the Safe Drinking Water Act and includes management of Class V wells, which are UIC wells managing stormwater. Registration will be completed by the JBLM Stormwater Program. Designers shall contact Stormwater Program staff with a complete UIC Well Checklist (found in Appendix D) if a proposed item meets the below definition or examples. This checklist shall be submitted with the 65% design and drainage plan.

(a) **It is required to assess implementation of dispersion and infiltration BMPs prior to considering UICs**. Underground facilities should typically be considered a last resort and require justification within the design narrative.

(b) UIC wells are defined as wells used to discharge fluids into the subsurface including any of the following[4]:

(i) A subsurface fluid distribution system, which includes perforated pipes, drain tiles or other similar mechanisms intended to distribute fluids below the surface of the ground

(ii) A bored, drilled or driven shaft, or dug hole whose depth is greater than the largest surface dimension

(iii)An improved sinkhole; which is a natural crevice that has been modified

(c) Examples of UIC Wells or subsurface infiltration systems are the following:

(i) Bioretention systems intending to infiltrate water from a perforated pipe below the treatment soil

(ii) French Drains

(iii)Drywells

(iv)Drain Fields

(v) Infiltration trenches with perforated pipe

(vi) Storm chamber systems with the intent to infiltrate

(vii) Other similar devices that discharge to the ground

(d) UIC wells may not receive stormwater from the following areas:

(i) Vehicle maintenance, repair and service

(ii) Commercial or fleet vehicle washing

(iii) Airport de-icing activities

(iv) Storage of treated lumber

(v) Storage or handling of hazardous materials

(vi) Generation, storage, transfer, treatment or disposal of hazardous wastes

(vii) Handling of radioactive materials

(viii) Recycling facilities, except for those that recycle only glass, paper, plastic, or cardboard

(e) Stormwater UIC wells must either be rule-authorized or covered by a state waste discharge permit to operate. If a UIC well is rule-authorized, a permit is not required, but the facility must be registered. If a UIC well requires a treatment BMP for rule authorization, the BMP must be constructed in accordance with the SWMMWW. Complete guidance may be obtained from Ecology's UIC Program updates to the SWMMWW 2019 Vol. 1, Chapter 4.[4]

d. **SPECIAL REPORTS AND STUDIES.** Include any special reports and studies conducted to prepare the Stormwater Drainage Plan (e.g., a soils report that could include the results of soil sampling and testing, infiltration tests and/or soil gradation analyses, depth to ground water, or wetlands delineation).

e. **OTHER PERMITS.** Include a list of other necessary permits and approvals as required by regulatory agencies other than JBLM (e.g. EPA Construction General Permit) if those permits or approvals include conditions that affect the drainage plan, or contain more restrictive drainage-related requirements.

4. RUNOFF TREATMENT REQUIREMENTS

a. GENERAL. Runoff treatment requirements are described in the following sections. See Volume V Chapter 3 for treatment menus in the SWMMWW. **Figure 9** shows the runoff treatment evaluation process.

b. TREATMENT-TYPE THRESHOLDS.

(1) Basic Treatment: **Figure 9**. Basic treatment is always required for discharge to the ground unless the discharge is not from a pollutant generating surface. Discharge to the JBLM Canal or infiltration within ¼ mile of a body of water require Basic Treatment. This requirement can be fulfilled by selecting BMPs from List #2 (Figure 4) and ensuring requirements for all other runoff treatment requirements are met. The Basic Treatment Menu from the SWMMWW choices are intended to achieve 80% removal of total suspended solids for influent concentrations that are greater than 100 mg/l, but less than 200 mg/l.

(2) Oil Control: **Figure 8**. Treatment to achieve Oil Control is required for projects with high-use sites, which typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. High-use sites include areas for fueling stations, vehicle maintenance or repair, or aircraft maintenance areas.

(a) *High use sites.* High use sites are defined as:

(i) Commercial or industrial sites with an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area.

(ii) Commercial or industrial sites storing and transferring petroleum in excess of 1,500 gallons per year, such as gasoline service stations. This does not include routinely delivered oil or occasional filling of oil tanks.

(iii)Commercial or industrial sites with parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (e.g., trucks, buses, trains, heavy equipment, etc.). In general, this does not include all-day parking areas.

(b) *BMP Selection.* Oil Control facilities should achieve goals of no ongoing or recurring visible sheen, and a 24 hour average Total Petroleum Hydrocarbon concentration no greater than 10 mg/L or a maximum of 15 mg/L for a grab sample. More information on high-use sites and BMP selection can be found in the SWMMWW Volume V Section 2.1 Step 2 and the V-3.2 Oil Control Menu. Recommended BMPs to consider first include:

(i) BMP T11.10 API (Baffle type) Oil/Water Separator

(ii) BMP T11.11 Coalescing Plate (CP) Oil/Water Separator

(iii)BMP T8.30 Linear Sand Filter, recommended preceded by BMP T9.40 Vegetated Filter Strip

(3) Phosphorus Treatment: **Figure 9**. Phosphorus treatment is required for any project discharging to American Lake or infiltration within ¼ mile of American Lake. There is currently no EPA approved TMDL for American Lake, although it is a water body reported under section 305(b) of the Clean Water Act, and is designated by the State of Washington as not supporting beneficial uses due to phosphorous. The SWMMWW Phosphorus Menu facility choices are intended to achieve a goal of 50% total phosphorus removal for a range of influent concentrations of 0.1 – 0.5 mg/l total phosphorus while also achieving the Basic Treatment performance goal. Recommended BMPs include:

(a) Two facility treatment trains:

(i) BMP T9.40 Vegetated Filter Strip **and** BMP T8.30 Linear Sand Filter

(ii) BMP T9.10 Basic Biofiltration Swale **and** BMP T8.30 Linear Sand Filter

(b) BMP T8.11 Large Sand Filter Basin

(c) BMP T10.30 Stormwater Treatment Wetlands

(4) Enhanced Treatment: **Figure 9**. The Enhanced Treatment Menu BMPs in the SWMMWW are intended to exceed Basic Treatment performance with a higher rate of removal defined as greater than 30% dissolved copper removal and greater than 60% dissolved zinc removal. Enhanced treatment for reduction in dissolved metals is required for the following:

(a) Sites that discharge to or conveyance systems tributary to Clover Creek, Murray Creek, Morey Pond, Sequalitchew Lake, or any freshwater designated for aquatic life. Enhanced treatment is also recommended for discharge or conveyed discharge to the JBLM Canal. Sites with infiltration strictly for flow control - not treatment - within ¼ mile of a freshwater designated for aquatic life use or that has an existing aquatic life use are also required to implement enhanced treatment BMPs.

(b) Industrial project sites (e.g., McChord Airfield), Commercial project sites, and Multi-family project sites. Only Basic Treatment is required for landscaped areas or parking lots of industrial and commercial project sites dedicated to employee parking, which do not involve any other pollution-generating sources (e.g., industrial activities, customer parking, storage of erodible or leachable material, wastes or chemicals).

(i) High annual average daily traffic (AADT) roads (i.e., Roads with an AADT of 15,000 or greater). Examples of high AADT roads on JBLM that meet this criteria are:

1. 41st Division Dr. from the Main Gate to Pendleton
2. Jackson Ave from the Madigan Gate to Wilson Ave.
3. 41st Division Drive from the Lewis North Gate to A St.

(c) For developments with a mix of land use types, the Enhanced Treatment requirement shall apply when the runoff from the areas subject to Enhanced Treatment comprises 50% or more of the total runoff.

(d) The following are BMPs recommended to prioritize in descending order:

(i) BMP T7.40 Compost-amended Vegetated Filter Strip (CAVFS)

(ii) BMP T7.30 Bioretention

(iii) Treatment train: BMP T9.40 Vegetated filter strip **and** BMP T8.30 Linear Sand Filter

(iv) BMP T10.30 Stormwater Treatment Wetland

(v) BMP T8.11 Large Sand Filter

c. FACILITY SIZING. Prioritize small scale dispersion or infiltration, then size all stormwater treatment facilities for the entire area that drains to them including non-pollutant generating areas. The volume of runoff predicted from a 24-hour storm with a 6-month return frequency (i.e., the 6-month, 24-hour storm) is considered the Water Quality Design Storm Volume. Wetpool facilities are sized based upon the volume of runoff predicted through use of the Natural Resource Conservation Service curve number equations in Chapter 2 of Volume III SWMMWW, for the 6-month, 24-hour storm. Alternatively, when using an approved continuous runoff model (e.g., WWHM), the water quality design storm volume shall be equal to the simulated daily volume that represents the upper limit of the range of daily volumes that accounts for 91% of the entire runoff volume over a multi-decade period of record.

d. WATER QUALITY DESIGN FLOW RATE.

(1) Preceding Detention Facilities or when Detention Facilities are not required: The flow rate at or below which 91% of the runoff volume, (as estimated by an approved continuous runoff model) will be treated. Design criteria for treatment facilities are assigned to achieve the applicable performance goal (e.g., 80% TSS removal) at the water quality design flow rate. At a minimum, 91% of the total runoff volume, as estimated by an approved continuous runoff model, must pass through the treatment facility(ies) at or below the approved hydraulic loading rate for the facility(ies).

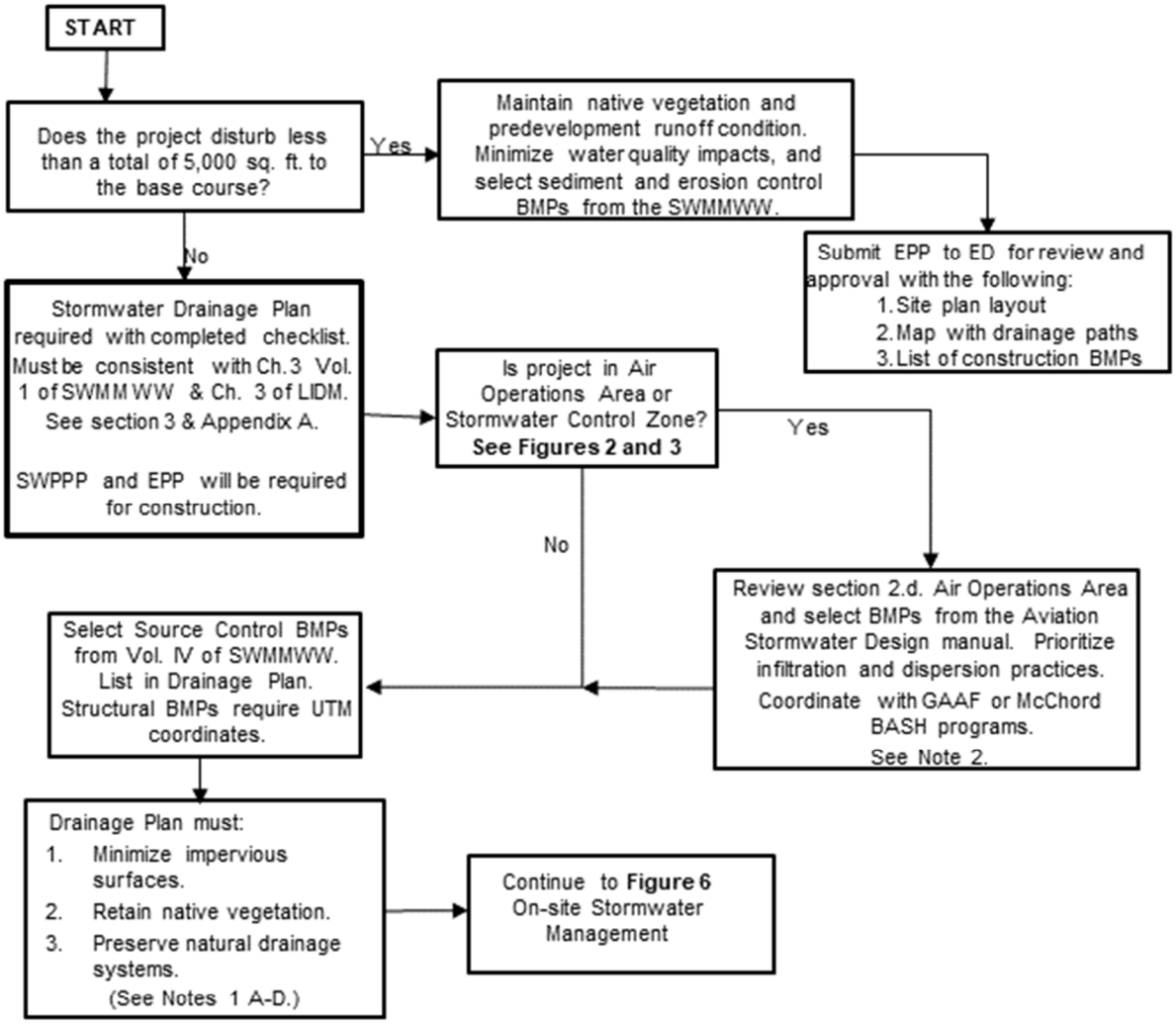
(2) Downstream of Detention Facilities: The water quality design flow rate must be the full 2-year release rate from the detention facility.

e. TREATMENT FACILITY SELECTION, DESIGN, AND MAINTENANCE. Stormwater treatment facilities must be selected, designed, and maintained in accordance with the SWMMWW. Refer to Vol. I Ch. 4, Vol. V Ch. 2, and Vol. V of the SWMMWW. Proposed facilities that are not selected from the SWMMWW must be submitted for review with justifications and infeasibility assessments for SWMMWW facilities.

(1) If treatment BMPs from the SWMMWW are infeasible for the site, refer to Ecology's emerging stormwater treatment technologies website to select from options certified by the Washington state Technology Assessment Protocol – Ecology (TAPE) program.[3] Include a written justification in the design analysis and include supportive documentation from the TAPE website in the drainage plan submittal.

f. ADDITIONAL REQUIREMENTS. The discharge of untreated stormwater from pollution-generating hard surfaces to ground water will not be authorized by JBLM except for the discharge achieved by infiltration or dispersion of runoff through use of On-site Stormwater Management BMPs in accordance with Volume V Ch. 5 and Ch. 7 of the SWMMWW, or by infiltration through soils meeting the soil suitability criteria in Volume III Ch. 3 of Volume III of the SWMMWW.

Figure 5. Source Control Requirements



NOTE 1.

A. Site design must minimize the project's roadway surfaces and parking areas, incorporates clustered development, and ensures that vegetated areas are designed to receive stormwater dispersion from all developed project areas;

B. Natural drainage patterns of the project site shall be maintained, and discharge from the new development or redevelopment project site shall occur at the natural location;

C. The manner by which runoff is discharged from the new development project site shall not cause a significant adverse impact to downstream receiving waters and/or down gradient properties; and

D. All outfalls shall use dissipation devices.

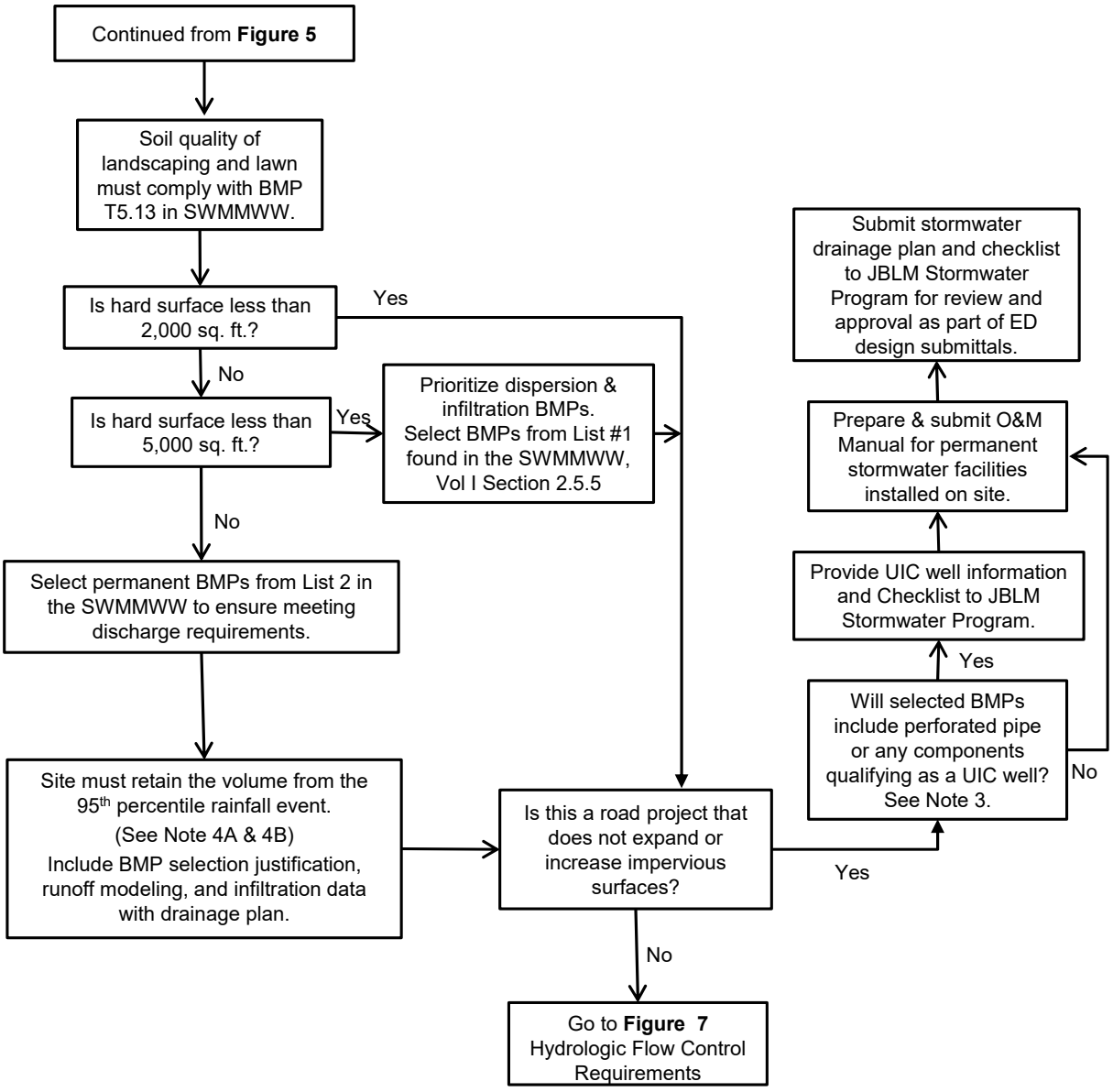
NOTE 2.

The Aviation Manual contains all components of the stormwater drainage plan except the Construction SWPPP. See the Construction Site Stormwater Runoff Control Plan.

NOTE 3.

Examples of UIC wells include french drains and bioretention or infiltration systems using perforated pipe to distribute water to the subsurface. See section 3.c.(10) for the UIC definition and Appendix D for checklist.

Figure 6. On-Site Stormwater Management

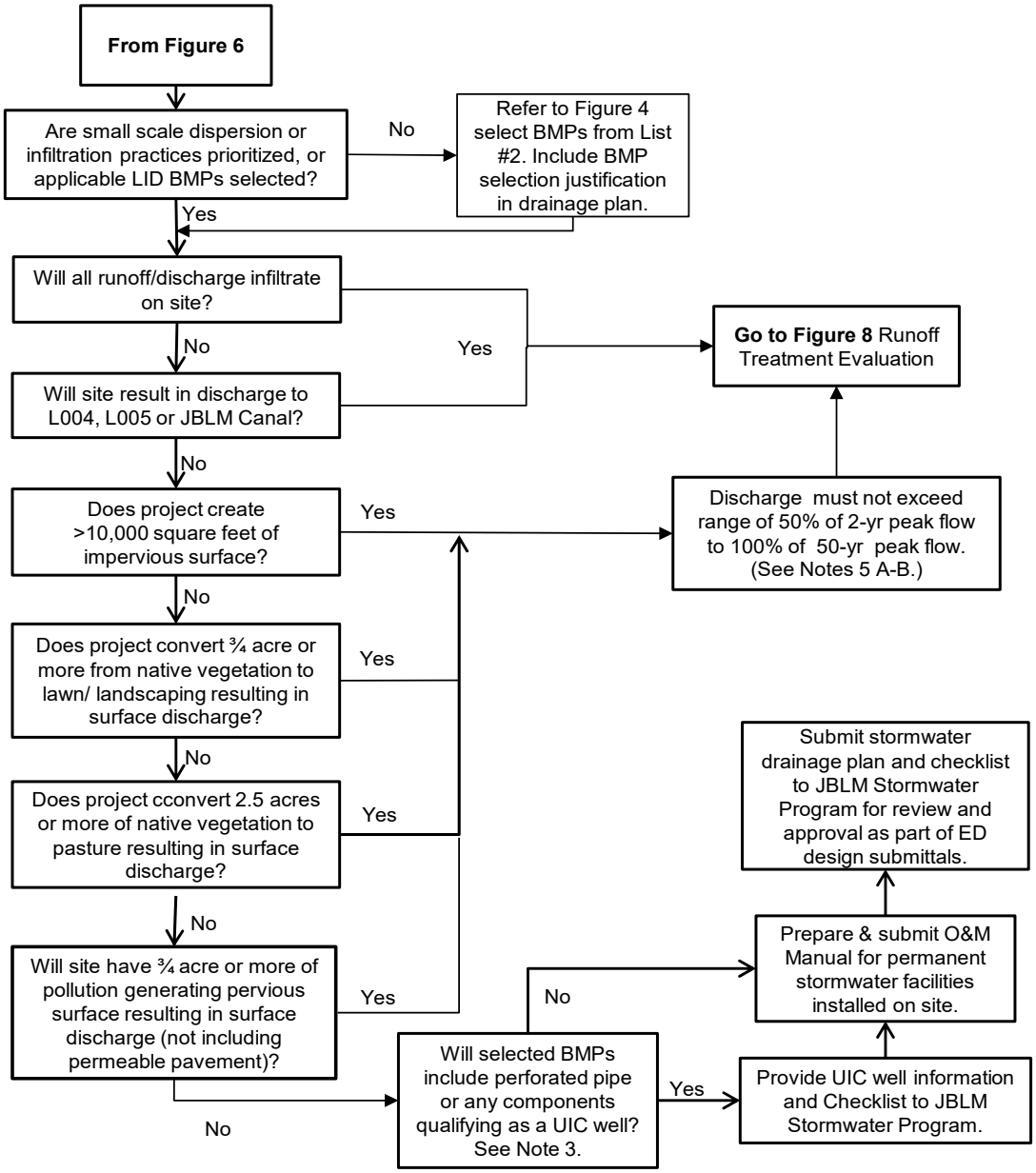


NOTE 4.

A. JBLM may exempt a project site from retaining the total runoff from the 95% rainfall event, provided compliance is documented. Feasibility must be determined by evaluating design criteria, limitations and infeasibility for each BMP in section 2.5.5. of the SWMMWW using List #2. The following information must be provided: Name, location and project description; reasons and documentation why full retention is not possible; and the estimated annual runoff volume that can and cannot be managed onsite.

B. The pre-development conditions for all new development or redevelopment projects must be "forested land cover" with applicable soil and soil grade, unless reasonable historic information indicates the site was prairie prior to settlement and may be modeled as "pasture" when using the Western Washington Hydrology Model (WWHM).

Figure 7 Hydrologic Flow Control Requirements

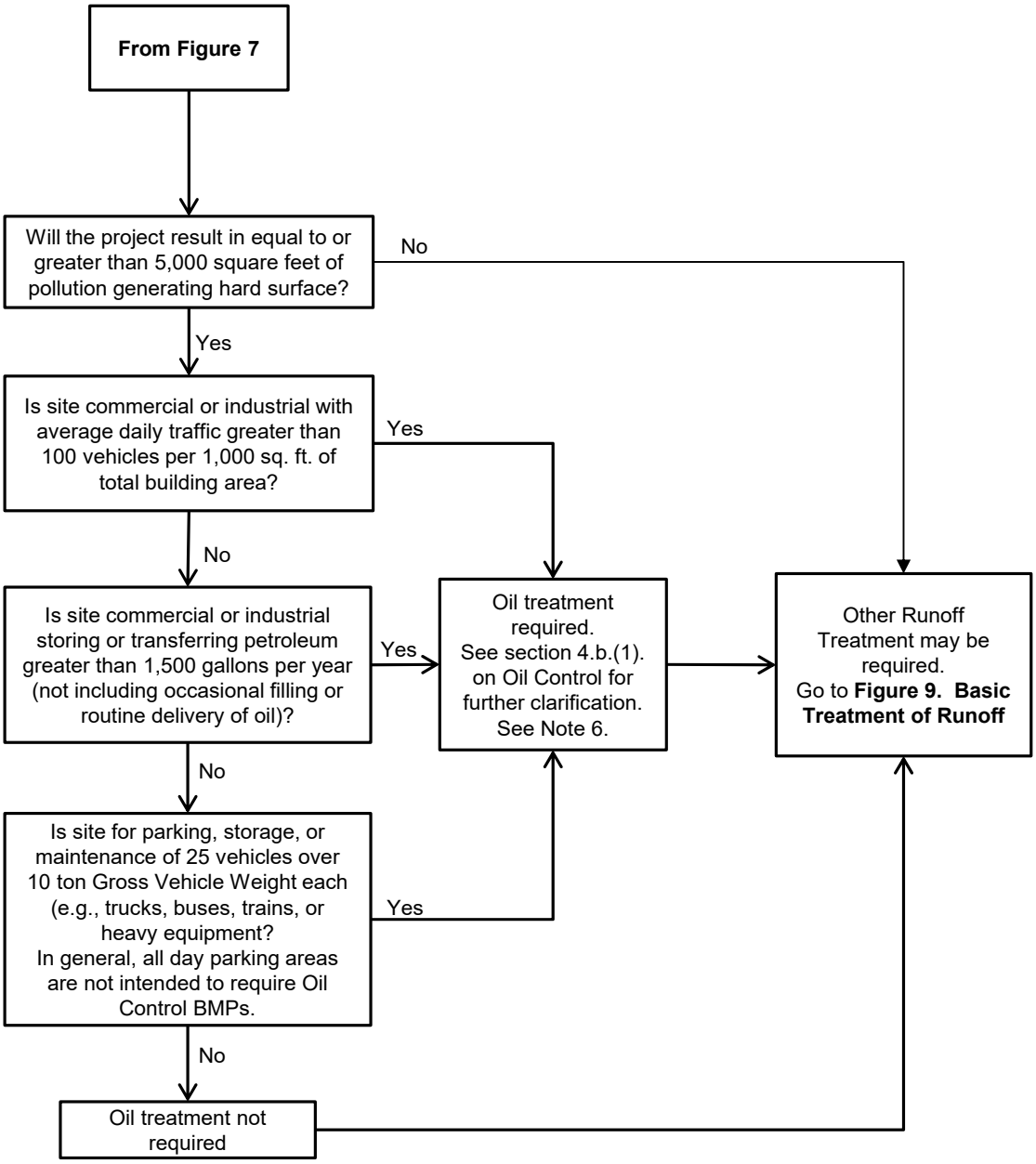


NOTE 5.

A. For the WWHM, pre-development condition for all new development and redevelopment project sites must be "forested land cover" (with applicable soil and soil grade), unless reasonable historic information indicates the site was prairie prior to settlement. May be then modeled as "pasture".

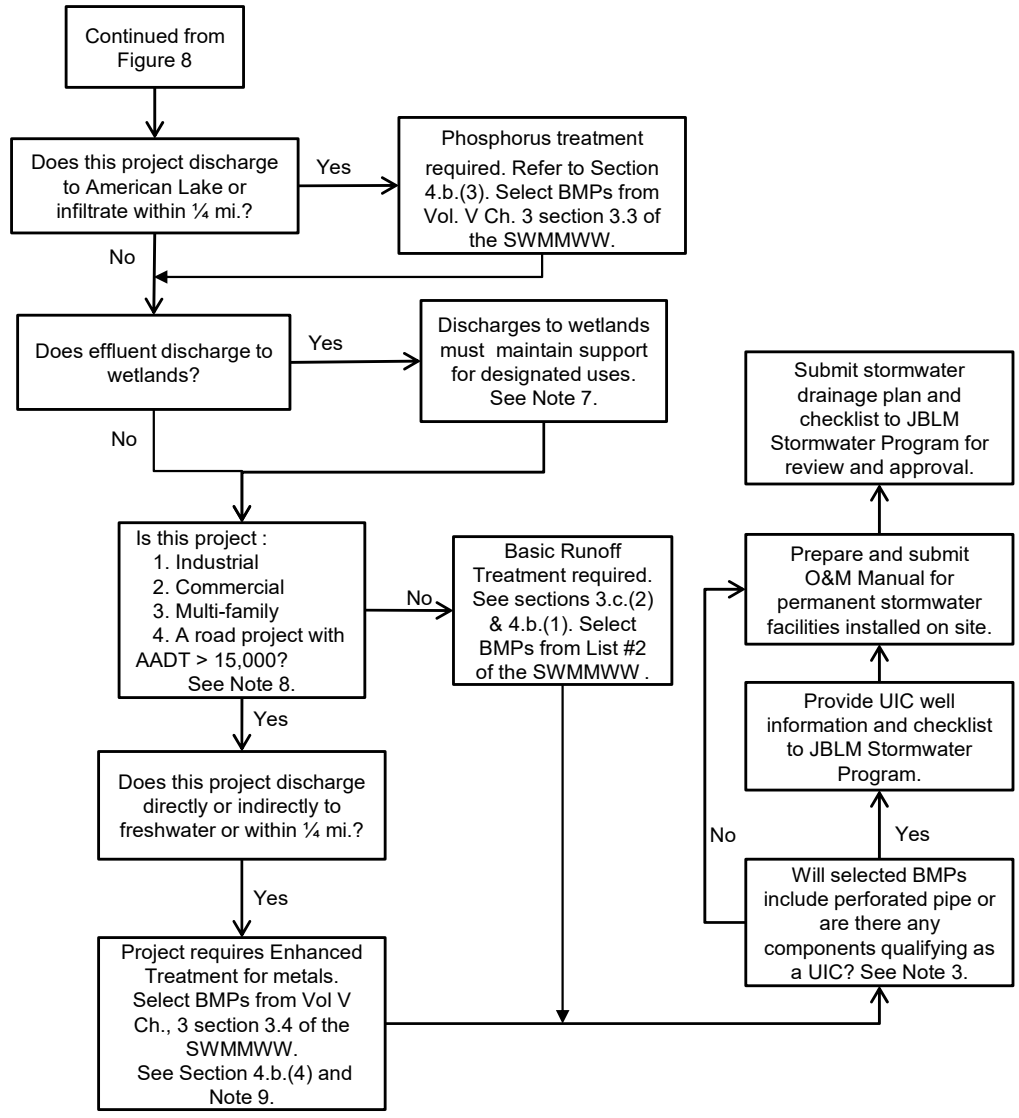
B. The designer must prioritize the use of small scale dispersion or infiltration practices, or other appropriate LID practices to meet this flow control requirement. The designer may not design new development or redevelopment sites to meet this hydrologic performance requirement for flow control solely through the use of large scale retention or detention practices.

Figure 8 Runoff Treatment Evaluation



NOTE 6. If treatment BMPs from the SWMMWW are infeasible for the site, refer to Ecology's emerging stormwater treatment technologies website to select from options certified by the Washington state Technology Assessment Protocol – Ecology (TAPE) program. Include a written justification in the design analysis and include supportive documentation from the TAPE website in the drainage plan submittal.

Figure 9. Enhanced Treatment of Runoff



NOTE 7. Wetlands must maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics. The hydrologic analysis must use the existing land cover condition to determine the existing hydrologic conditions, unless directed otherwise by JBLM. See Appendix D of Vol 1 of the SWMMWW for guidance.

NOTE 8. As of 2014, the following roads have AADT's greater than 15,000:
41st Division between the Liberty Gate and Pendleton,
Jackson Ave between the Madigan Gate and Wilson Ave; or
41st Division between the Lewis-North Gate and A St.

NOTE 9. Enhanced treatment shall be used throughout mixed land use areas where 50% of runoff is from areas requiring enhanced treatment . Also, refer to Note 6.

APPENDIX A

Drainage Plan Checklist

JBLM Stormwater Drainage Plan Checklist

Purpose: To guide the designer/project manager in developing the Stormwater Drainage Plan as required by NPDES MS4 Permit WAS-026638 for JBLM. This checklist is to be completed by projects with ground disturbance, and used in concert with the 2012 Stormwater Management Manual for Western Washington (SWMMWW).

Submit completed form with submittals for the Environmental Division or directly to the JBLM Stormwater Program via email: usarmy.jblm.id-readiness.list.dpw-stormwater1@mail.mil

Project Name: _____ **Date:** _____

IJO/USACE Project /Contract No.: _____

Package No./JBLM Planning No.: _____

Project Designer/Organization: _____

Phone: _____ **Email** _____

JBLM PM/Organization: _____

Phone: _____ **E-mail** _____

☐ Less than 5,000 ft^2: Include in the EPP Submission to the Environmental Division for review and approval by the Stormwater Program:

1. A site plan layout.
2. Site map showing area of disturbance and drainage paths for runoff.
3. A list of BMPs for sediment and erosion control.

☐ More than 5,000 ft^2: Subject to MS4 requirements & must submit complete Drainage Plan. All components must be included in design submissions to the Environmental Division for review and approval by the Stormwater Program.

☐ Project is in Airport Operations Area (on McChord or within GAAF AOA area): Refer to **Figures 2 & 3**. Submit Drainage Plan with BMPs selected from the Aviation Stormwater Design Manual. All components must be included in design submissions to the Environmental Division for review and approval by the Stormwater Program.

☐ Project is exempt (See Appendix B). Attach signed documentation, and submit above 3 items. *Requests for exemptions must be coordinated with the Stormwater Program Manager.*

Drainage Plan (Section 3 of JBLM Stormwater Guidance Document)

Instructions: Label with the appropriate referenced page and section number from the design narrative, appendix, or drawing sheet. Refer to primary document, JBLM Stormwater Design Guidance, for more details on each point.

a) ____Highlight decision process on flow charts (**Figures 5 through 9)** and include with Drainage Plan submissions.

b) A preliminary layout that includes justification/summary in the design narrative:

____Minimizes land disturbance
____Preserves natural vegetation
____Locates impervious areas over less permeable soils
____Clusters buildings
____Utilizes natural drainage areas

c) Project Description (3.c.(1)(a)):

____Short paragraph in design narrative (project name, number, location, amount of disturbed area, and amount of new impervious surface)
____Vicinity map (i.e., where on JBLM)
____Site map with the following components:
  ____Contours (2 ft. up to 10% slope, 5 ft. at 10-20%, 10ft at >20%)
  ____Existing stormwater drainage features (e.g., catch basins, swales, outfalls)
  ____Hydrologic features (e.g., streams, ponds, wetlands, ditches)
  ____Layout with bldg., roads/pavement, limits of disturbance
  ____Flow paths for drainage areas contributing runoff to site
  ____Proposed BMP locations in UTM WGS 1984 in meters
  ____Flood hazard areas (if applicable)
  ____Well head protection areas (if applicable)

d) Geotechnical soils report/Infiltration data (3.c.(1)(b)):

____Logs for test pits or borings at locations for permanent BMPs
____Soil type (grain size, texture, stratification)
____Infiltration test results & analysis
____Cation exchange capacity (for UIC and Bioretention projects)

e) Source Control Requirements (3.c.(3) & Figure 5):

____Select Source Control BMPs and list in Drainage Plan
____List in Stormwater LID Form permanent BMPs with the following:
  1. BMP type
  2. BMP Location on Site
  3. State Plane Coordinates
  4. Drainage area served by BMP (sq. ft.)

5. Estimated cost including installation

____List efforts to minimize impervious surfaces, retain native vegetation, and preserve natural drainage systems. Site design must comply with section 3.c.(4).

____Implement dissipation devices at outfalls

f) On-site Stormwater Management (3.c.(5) & Figure 6):

____Include Project Report (summary) of runoff calculations & modeling (3.c.(5)(i))
____Evaluate alternatives for discharge in Drainage Plan
____Document soil quality of lawn and landscaping complies with BMP T5.13 in SWMMWW

g) Hydraulic Flow Control Requirements (3.c.(6) & Figure 7)

____Indicate method of discharge calculation. Include a summary of calculations or the summary pages and graph(s) from the continuous runoff model used.
____List dispersion or infiltration BMPs. Prioritize the use of small scale dispersion or infiltration practices (3.c.(6)(d).

h) Runoff Treatment (3.c.(7), section 4, and Figures 8 & 9):
____List Basic Runoff Treatment BMPs

____List Oil Treatment BMPs (if applicable)

____List Enhanced Treatment (phosphorus and/or metals removal) BMPs (if applicable)

i) Underground Injection Control (UIC) Wells (3.c.(10))
____Fill out checklist and submit with all information needed for registration with Ecology

Submittals (Section 2.b.)

____Drainage Plan (draft at 35%, complete at 65%) to ED for review and approval (2 weeks)
____Stormwater LID Form
____Highlighted Flow Charts
____Prepare and submit Operation and Maintenance Manual for permanent BMP's (3.c.(9)) with 100%

Supplemental Requirements for Airport Operations Areas.

Washington State Department of Transportation *Aviation Stormwater Design Manual* (document M0341.00) dated December 2008 (ASDM). Additional considerations to the *Stormwater Drainage Plan Checklist* are described below.

Drainage Plans - Additional areas to consider include:

_____Address stormwater facility restrictions due to clearways, object-free areas, runway protection zones, runway safety areas, stopways, and taxiway safety areas. A description of these areas and their associated restrictions are in Section 2-1 of the ASDM.

_____Designer may determine infiltration rates using the detailed approach described in Section 5-3 of the ASDM.

_____**Document that risks associated with wild-life-aircraft interactions are minimized** e.g. selective use of vegetation that provides wildlife habitat (Ch. 3 of ASDM).

Hydraulic Flow Control Requirements

_____ Follow design guide from Section 4.4 of ASDM and select Infiltration/Dispersion BMP's from Ch. 6 of ASDM. **List BMPs in Drainage Plan and LID Form**.

Runoff Treatment Evaluation

_____ If area is used for refueling or maintenance oil treatment is required. Applicable BMPs in Section 4-5.7 of ASDM shall be listed in Drainage Plan

_____ Areas with high traffic such as aircraft service and fueling areas, and touchdown areas of runways may require enhanced treatment and should be evaluated for metals concentrations. **Document in Drainage Plan if enhanced treatment is or is not required.**

APPENDIX B

Exemptions from Stormwater Requirements

Appendix B

Exemptions from Stormwater Requirements. The practices described in this section may be exempt from some or all stormwater requirements. *Coordination with the Stormwater Program for review and approval is required*.

a. **Forest Practices, Commercial Agriculture, and Oil and Gas Field Activities or Operations.** Refer to Appendix C of the JBLM MS4 Permit regarding these exemptions.

b. **Pavement Maintenance.**

(1) The following maintenance practices are exempt:

(a) Sealing cracks and patching potholes or square cuts

(b) Overlaying existing asphalt or concrete pavement without expanding the area of coverage

(c) Grading unpaved shoulders

(d) Reshaping/regrading unpaved drainage systems

(e) Resurfacing with in-kind material without expanding the road prism (except for repaving to the base course)

(f) Pavement preservation activities that do not expand the road prism

(g) Maintaining vegetation

(2) Repaving projects that include disturbing the base course or repairing the pavement base may be exempt from flow control and runoff treatment requirements if impervious surfaces are not expanded. Exemption requests must include a complete drainage plan with selected on-site stormwater management BMPs. *Coordination with the Stormwater Program is required.*

c. **Underground Utility Projects.** Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are exempt from design requirements. This exemption is only applicable to projects involving underground utilities alone. These projects are typically minor repairs or replacement of existing utility lines. In accordance with the JBLM Construction Runoff Control Program, include runoff control BMPs and a site map in EPP submittals. *Coordination with the Stormwater Program is required.*

d. **Hydrologic Performance Requirement for Flow Control.** Exemption from flow control requirements may be requested due to severe economic costs. Exemption is not guaranteed and does not include runoff treatment requirements. Runoff treatment requirements will NOT be exempt. *Review by the Stormwater Program Manager, approval by the JBLM Director of Public Works, and written notification submitted to the EPA Region 10 is required and must be coordinated through the Stormwater Program*. Flow control exemption requests must include:

(1) Name, location, and project description with a brief synopsis of the project purpose and a detailed description of the underlying facts supporting the request for the exemption.

(2) Written documentation and quantification of the stormwater control strategies proposed to manage as much of the calculated flow volume as possible, the marginal cost of full attainment, and the justification on why flow control for the full runoff volume would result in severe economic costs.

APPENDIX C

JBLM Vegetation and Plant Selection Tables

Table 2. Recommended Groundcover Plants

Native?	Genus	Species var.	Common Name	Plant Category and Type	Moisture Regime	Height (ft)	Spread (ft)	Notes
N	*Alisma*	*plantago-aquatica*	Water Plantain	Groundcover	Wet-Saturated	2.5-4	N/A	Wetland associate
	Alopecurus	*geniculatus*	Water Foxtail	Groundcover	Moist-Wet	1	1.5	Wetland associate
N	*Aster*	*subspicatus*	Douglas' Aster	Groundcover	Moist-Dry	0.6-2.5	N/A	
N	*Bromus*	*sitchensis*	Alaska Brome	Groundcover	Moist-Dry	1.5-6	N/A	
N	*Bromus*	*vulgaris*	Columbia Brome Grass	Groundcover	Moist-Dry	1.5-6	N/A	
N	*Carex*	*densa*	Dense Sedge	Groundcover	Moist	1–2	N/A	
N	*Carex*	*hendersonii*	Henderson Sedge	Groundcover	Moist	1–2	N/A	
N	*Carex*	*vesicaria*	Inflated Sedge	Groundcover	Moist	1–2	N/A	
N	*Carex*	*aperta*	Columbia Sedge	Groundcover	Moist-Wet	1–2	N/A	Wetland associate
N	*Carex*	*deweyana*	Dewey Sedge	Groundcover	Moist-Wet	0.7-4	N/A	Wetland associate
N	*Deschampsia*	*caespitosa*	Tufted Hairgrass	Groundcover	Moist-Dry	1–2	2	
N	*Eleocharis*	*acicularis*	Needle Spike-Rush	Groundcover	Moist	1–2	N/A	
N	*Eleocharis*	*ovata*	Ovate Spike Rush	Groundcover	Wet-Saturated	0.2-1.6	N/A	Wetland associate
N	*Eleocharis*	*palustris*	Creeping Spike Rush	Groundcover	Wet-Saturated	0.3-3.3	N/A	Wetland associate
	Epimedium x	*rubrum*	Bishop's Hat	Groundcover	Dry	2	1	
	Heuchera	*sanguinea*	Coral Bells	Groundcover	Dry	2	2	
N	*Iris*	*tenax*	Oregon Iris	Groundcover	Moist-Dry	1.3	N/A	
N	*Juncus*	*effusus*	Common/Soft Rush	Groundcover	Moist-Wet	2.5	2.5	Wetland associate
N	*Juncus*	*ensifolius*	Dagger-leaf Rush	Groundcover	Moist-Wet	0.5-2	N/A	Wetland associate
N	*Juncus*	*oxymeris*	Pointed Rush	Groundcover	Moist-Wet	1-2.5	N/A	Wetland associate
N	*Juncus*	*patens*	Grooved Rush; Spreading Rush	Groundcover	Moist-Wet	2	2	Wetland associate
N	*Juncus*	*tenuis*	Slender Rush	Groundcover	Moist-Saturated	0.5-2.3	N/A	Wetland associate

Native?	Genus	Species var.	Common Name	Plant Category and Type	Moisture Regime	Height (ft)	Spread (ft)	Notes
	Lavandula	*angustifolia*	Jean Davis; English Lavender	Groundcover	Dry	5	3	
N	*Lupinus*	*micranthus/polycarpus*	Small Flowered Lupine	Groundcover	Moist-Dry	0.3-1.5	N/A	
N	*Lupinus*	*polyphyllus*	Large-leaved Lupine	Groundcover	Moist-Wet	1.5-4	1-2.5	Wetland associate
	Ophiopogon	*planiscapus*	Nigrescens; Black Mondo Grass	Groundcover	Moist	1	1	Evergreen
N	*Scirpus*	*americanus*	Three-square or American Bulrush	Groundcover	Wet-Saturated	0.5-3.3	N/A	Wetland associate
N	*Scirpus*	*microcarpus*	Small-fruited Bulrush	Groundcover	Wet-Saturated	5	N/A	Wetland associate
N	*Scirpus*	*acutus*	Hardstem Bulrush	Groundcover	Wet-Saturated	3–9	N/A	Wetland associate
N	*Sisyrinchium*	*idahoense*	Blue-eyed Grass	Groundcover	Moist	0.5-2	0.5-2	

Table 3. Recommended Shrubs

Native?	Genus	Species var.	Common Name	Plant Category and Type	Moisture Regime	Height (ft)	Spread (ft)	Notes
	Abeilia	*grandiflora*	Edward Goucher Abelia	Shrub	Dry	5	5	Evergreen
N	*Athyrium*	*felix-femina*	Lady Fern	Shrub	Moist	4	2–3	
	Ceanothus	*prostratus*	Mahala Mat	Shrub	Dry	<1	N/A	
N	*Ceanothus*	*sanguineus*	Redstem Ceanothus	Shrub	Moist-Dry	3–10	N/A	
	Cistusx purpureus		Orchid Rock Rose; Purple Rock Rose	Shrub	Dry	10	6	
	Cistus	*corbariensis (hybridus)*	White Rock Rose	Shrub	Dry	5	5	Evergreen
	Erica	*carnea*	Pink Heather; Springwood Pink	Shrub	Moist	1	3	Low shrub
	Escallonia	*langleyensis*	Apple Blossom Escallonia	Shrub	Dry	5	6	Evergreen
	Euonymus	*alatus compactus*	Winged Euonymus; Dwarf Burning Bush	Shrub	Dry	10	8	Deciduous
	Euonymus	*fortunei coloratus*	Wintercreeper Euonymus	Shrub	Dry	2	3	Evergreen
	Hydrangea	*quercifolia*	Oakleaf Hydrangea	Shrub	Dry	10	8	Deciduous
	Leucothoe	*axillaris*	Coast Leucothoe	Shrub	Moist	4	6	Evergreen
	Osmanthus	*delavayi*	Delavay Osmanthus	Shrub	Dry	10	10	
	Osmanthus	*heterophyllus (Variegatus)*	Variegated Holly Leaf Osmanthus	Shrub	Dry	10	8	Evergreen
	Pachysandra	*terminalis*	Japanese Spurge	Shrub	Dry	2	3	Evergreen
N	*Philadelphus*	*lewisii*	Mock Orange	Shrub	Dry	20	8	Deciduous
	Phyllodoce	spp.	Mountain Heath	Shrub	Moist	1	N/A	Low shrub
N	*Physocarpus*	*capitatus*	Pacific Ninebark	Shrub	Moist-Wet	8	8	
N	*Polystichum*	*munitum*	Western Sword Fern	Shrub	Dry	5	3	
N	*Rosa*	*gymnocarpa*	Baldhip Rose	Shrub	Moist	5	N/A	
N	*Rosa*	*nutkana*	Nootka Rose	Shrub	Moist	6	4	
N	*Rosa*	*piscocarpa*	Wild Clustered Rose	Shrub	Moist	10	N/A	

Native?	Genus	Species var.	Common Name	Plant Category and Type	Moisture Regime	Height (ft)	Spread (ft)	Notes
N	*Salix*	*lucida* (or *S. lasiandra*)	Pacific Willow	Shrub	Moist-Wet	40	N/A	Arboreal Shrub
N	*Salix*	*sessilifolia*	Soft leafed Willow	Shrub	Moist-Wet	40	N/A	Arboreal Shrub
N	*Salix*	*fluviatalis*	Columbia Willow	Shrub	Moist-Saturated	N/A	N/A	
N	*Salix*	*hookeriana*	Hookers Willow	Shrub	Moist-Saturated	20	N/A	
N	*Salix*	*scouleriana*	Scouler's Willow	Shrub	Moist	6–40	N/A	
N	*Salix*	*sitchensis*	Sitka Willow	Shrub	Moist-Saturated	3–25	N/A	

Table 4. Recommended Trees

Native?	Genus	Species var.	Common Name	Plant Category and Type	Moisture Regime	Height (ft)	Spread (ft)	Notes
N	*Alnus*	*rubra*	Red Alder	Tree	Moist-Wet	45-50	20-30	Deciduous
N	*Arbutus*	*menziesii*	Madrone	Tree	Dry	20-100	N/A	Evergreen
	Betula	*jacquemontii*	Jacquemontii Birch	Tree	Moist	40+	N/A	Deciduous
N	*Betula*	*occidentalis*	Water Birch	Tree	Moist-Wet	40+	N/A	Deciduous
N	*Castanopsis*	*chrysopylla*	Chinquapin	Tree	Dry	25-45	20-25	Evergreen
	Ceanothus	*thyrisiflorus*	Victoria Ceanothus	Tree	Dry	9	12	Evergreen
	Cupressocyparis	*leylandii*	Leyland Cypress	Tree	Dry	40+	25	Evergreen
N	*Fraxinus*	*latifolia*	Oregon Ash	Tree	Moist-Wet	40-80	30-50	Deciduous
N	*Pinus*	var. *contorta*	Shore Pine	Tree	Dry	40+	N/A	Evergreen
N	*Pinus*	*monticola*	Western White Pine	Tree	Moist-Dry	60	20	Evergreen
	Thuja	*Occidentalis 'Emerald'*	Emerald Green Aborvitae	Tree	Moist	20	4	Evergreen
	Thuja	*Occidentalis 'Little Gem'*	Little Gem; Dwarf Aborvitae	Tree	Moist	5	3	Evergreen
N	*Tsuga*	*heterophylla*	Western Hemlock	Tree	Moist	70-130	20-30	Evergreen

APPENDIX D

Underground Injection Control (UIC) Well Registration Checklist

Underground Injection Control Well Registration Checklist

If a proposed stormwater structure meets the Washington State Department of Ecology definition and/or examples of a UIC Well, the following information must be submitted for review to the Joint Base Lewis McChord Public Works Stormwater Program with the 65% Design and Drainage Plan.

Submissions must be emailed to usarmy.jblm.id-readiness.list.dpw-stormwater1@mail.mil

- □ Facility/Site Information
  Facility Name: _____

  Address: _____

  Description of area draining to UIC well (e.g., parking lot, driveway, and sidewalk):
  _____
  _____

- □ Contact Information For Designs and Construction of the UIC Well
  Name(s): _____

  Phone: _____ Email: _____

- □ Estimated Construction Date of Well: _____

- □ Construction type (e.g., bioswale w/ perf pipe underdrain): _____
  _____

- □ Well Coordinates

Well Description/BMP	Longitude	Latitude

- □ UIC well distance to nearest surface water: _____

- □ Soil Type(s): _____

- □ Infiltration Rate: _____

- □ Cation exchange capacity: _____

- □ Stormwater structure and UIC Well proposed designs must be attached/included with email.
  - Does the design meet the Stormwater Management Manual for Western Washington requirements? Yes ___ No ___

For further information please contact the Stormwater Program

Email: usarmy.jblm.id-readiness.list.dpw-stormwater1@mail.mil

APPENDIX E

References

REFERENCES

1. Department of Ecology State of Washington. (2012). *Stormwater Management Manual for Western Washington.* Publications Home. https://fortress.wa.gov/ecy/publications/summarypages/1210030.html

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