

WATERSHED MANAGEMENT PLAN FINAL Murray/Sequalitchew Watershed

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Prepared for
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and
U.S. Army, Fort Lewis Garrison
Directorate of Public Works
Environmental and Natural Resources Division
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Murray/Sequalitchew Watershed

Submitted to

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Executive Summary

Purpose

This watershed management plan addresses the portions of the watersheds of Murray and Sequalitchew creeks that are under the jurisdiction of Fort Lewis. It includes Murray Creek, American Lake, Sequalitchew Lake, and Sequalitchew Creek. These watershed features are located entirely or partially within the boundaries of Fort Lewis and adjacent military installations, including Camp Murray and McChord Air Force Base.

The purpose of this watershed management plan is to consolidate existing information in the Murray/Sequalitchew watershed and assist Fort Lewis in developing an implementation plan for protecting the quality of the water resources in the watershed in a manner that is consistent with federal requirements, regional efforts, and the military mission of Fort Lewis. Information was obtained through review of existing reports and studies, meetings and conversations with Fort Lewis and other agency personnel, and limited site reconnaissance.

The Murray/Sequalitchew watershed has been divided into five subbasins for planning purposes in this document. These subbasins were delineated based on surface topography, piped stormwater systems, general direction of ground water flow, and land use. The subbasins are as follows:

- Upper Murray subbasin
- Middle Murray subbasin
- Lower Murray subbasin
- American Lake subbasin
- Sequalitchew subbasin

Key Issues and Potential Solutions

Watershed issues and potential solutions have been analyzed and summarized in sections that focus on specific environmental components. The 11 environmental categories evaluated as part of this watershed management plan are listed below, followed by a brief summary of key issues and potential solutions identified from the corresponding analysis.

Topography, Geology, and Soils

Site conditions identified in the geology and soils analysis include the fairly flat topography and highly permeable soils of the study area. A key issue is the ability of Murray and Sequalitchew creeks to recruit and transport sediment, which is limited by the flat topography, resulting in low stream velocities. The watershed's permeable soils result in close connections between ground water and surface water, causing some stream reaches to gain flow and others to lose flow. A number of potential solutions make use of the high soil permeability, such as identifying and

enhancing cold water refugia for fish within Murray Creek. This potential solution, like many others, considers impacts on other parts of the ecosystem, such as aquatic habitat and fisheries, surface water, and ground water.

Climate

Climate is a key factor influencing flow in Murray Creek. The creek reportedly ran dry in 1994, and low flows have reportedly been a problem since then. The climate section of this report includes an analysis of historical rainfall data collected from several sites near Fort Lewis to evaluate whether 1994 and subsequent years have exhibited significantly lower than average amounts of rainfall, which caused the channel-drying effect. Interestingly, there was flow in Murray Creek at the end of August 2005 despite precipitation that was approximately 20 percent below normal for the 2004–2005 water year.

Land Use and Land Cover

The assessment of land use found practices include encouraging infiltration of stormwater runoff; maintaining 50-meter buffers around Murray Creek, wetlands, and other sensitive areas; and encouraging various low impact development techniques. Low-impact development techniques are a set of decentralized stormwater controls that emphasize natural processes such as infiltration and vegetated treatment over direct discharge to surface water or piping to water treatment facilities. The key land use issue identified in this plan is the need to formalize, track, and monitor these practices to increase their effectiveness. Potential solutions for land use planning focus on formalizing these practices and increasing the implementation of low impact development.

Surface Water Resources

Key issues that were identified in the surface water analysis include maintenance concerns associated with the installation's stormwater infrastructure and water quality problems in American Lake, Sequalitchew Lake, Sequalitchew Creek, and Murray Creek. Potential solutions include implementing water conservation measures; inventorying, analyzing, and improving, or replacing culverts where necessary; implementing best management practices to reduce nutrient loading in stormwater runoff in the American Lake subbasin; and promoting stormwater infiltration potentially to improve stream base flows during the summer.

Ground Water Quantity and Quality

Key issues identified in the ground water analysis include the reduction in base flow of Murray Creek, potentially due to ground water extraction; migration of a trichloroethylene (TCE) plume from the Logistics Center to the southwest; and potentially inadequate wellhead protection areas around the installation's potable ground water supply wells. Fort Lewis is already addressing TCE contamination. Potential solutions related to ground water include potential review and redelineation of designated wellhead protection areas, and long-term reduction in ground water pumping rates.

Upland Habitat

The analysis of upland habitat in the watershed identified several issues, including the lack of late-successional forest, native prairie affected by training exercises and encroachment of Douglas-fir (*Pseudotsuga menziesii*), and the increase in nonnative invasive vegetation. These issues may affect ground water recharge as well as habitat for a number of important species present within the Fort Lewis boundaries. Potential solutions include increased efforts towards controlling invasive species and replanting disturbed areas.

Wetlands

Key issues identified in the analysis of wetlands include the presence of weeds and animal pests in wetlands and the loss of bog hydrology in McKay Marsh. Potential solutions include expanding the invasive weed control program and rerouting stormwater outfalls discharging to McKay Marsh to reduce water level fluctuation and nutrient enrichment of this system.

Riparian Habitat

Key issues identified in the riparian habitat analysis include reduced canopy cover along Murray Creek, replacement of native vegetation with lawns and gravel surfaces along the banks of American Lake and Sequalitchew Lake, and limited near-term large woody debris recruitment potential along Murray Creek and American Lake. Potential solutions include removing invasive vegetation and planting native trees on stream banks.

Aquatic Habitat and Fisheries

Key issues identified in the analysis of aquatic habitat and fisheries include restricted fish access to Murray and Sequalitchew creeks due to low flows in the channels during the summer months; the lack of suitable habitat such as overhanging native vegetation, submerged root systems, emergent vegetation, woody debris, and substrate, along the shoreline of American Lake; degraded water quality in Sequalitchew Lake; water withdrawals in the Sequalitchew subbasin; and beaver activity in upper Sequalitchew Creek. Potential solutions include identifying cold-water refugia locations in Murray and Sequalitchew creeks that will serve as target areas for fish habitat improvements, developing a streambed protection plan, improving the shoreline habitat in American Lake, introducing large woody debris and other habitat features at appropriate locations in Murray Creek, and removing invasive weeds and restoring stream processes and morphology to upper Sequalitchew Creek.

Recommendations

To assist in prioritization and categorization of potential solutions, a recommendations section is presented that compiles all the potential solutions identified during preparation of this plan. Compiling the recommendations in one section ensures that recommendations to improve a problem related to one environmental component do not contradict or interfere with recommendations for other components.

The table of recommendations also includes a column for prioritizing recommendations. At the time of this draft report, priorities are yet to be assigned, so they are not yet included in the tabulation of recommendations. Each recommendation is assigned an alpha-numeric code for reference, with the letter indicating the category of the recommendation. Affected subbasins are indicated, along with relative implementation costs (low, medium, or high). Recommendations are divided into five categories based on the nature of the recommended action:

- Data collection and monitoring
- Analysis
- Structural measures (e.g., capital improvement projects)
- Operational measures
- Communication outreach

1.0 Introduction

Fort Lewis is an 86,176-acre military installation located in the Puget Sound lowlands of western Washington. The installation lies in Pierce and Thurston counties, and is located 35 miles south of the City of Seattle, 14 miles south of the City of Tacoma, and 7 miles northeast of the City of Olympia. Fort Lewis is crossed by Interstate 5, which is the main transportation corridor in the Puget Sound region. The installation is bordered on the north by McChord Air Force Base, and suburban and commercial development; on the east and south by rural areas, forested land, and several small communities; and on the west by Puget Sound, the Nisqually Indian Reservation, and the rural areas that surround Olympia.

The study area for this watershed management plan is a portion of Fort Lewis covering over 18,000 acres along the north edge of Fort Lewis. Major surface water features within the watershed include Murray Creek, American Lake, Sequalitchew Lake, and Sequalitchew Creek. These watershed features are located entirely or partially within the boundaries of Fort Lewis and the two adjacent military installations, Camp Murray and McChord Air Force Base (Figure 1-1). The Murray/Sequalitchew watershed is bounded on the west by Puget Sound. The north boundary runs through North Fort Lewis and the City of Lakewood, including Gravelly Lake. The eastern watershed boundary is on McChord Air Force Base, and near the BNSF Railway Company tracks. The south watershed encompasses Gray Army Airfield. Gravelly Lake occurs within the watershed, but is within an adjacent city and not part of the study area. An area to the southwest that drains directly to Sequalitchew Creek below the study area was also excluded from this plan.

Over the years, numerous activities have occurred within and adjacent to the study area that have affected flow patterns, water quality, and habitat conditions in the watershed. Studies have focused on specific, isolated activities with the potential to impact specific receiving waters or small portions of the watershed. Prior to development of this watershed management plan, there was no all-encompassing document for the entire watershed that identified issues and made management recommendations.

The purpose of this watershed management plan is to assist Fort Lewis in developing an implementation plan for maintaining and improving the quality of the water resources in the Murray/Sequalitchew watershed in a manner that is consistent with federal requirements, regional efforts, and the military mission. Objectives of the watershed management plan include the following:

- Identify the key goals of the military mission and their relation to watershed management objectives
- Provide a comprehensive, multidisciplinary description of historical and existing watershed conditions
- Identify key watershed problems

- Identify potential solutions to address key watershed problems and to help meet regional and federal requirements for water quality and habitat
- Recommend management actions and an implementation plan to address environmental concerns while supporting the military mission

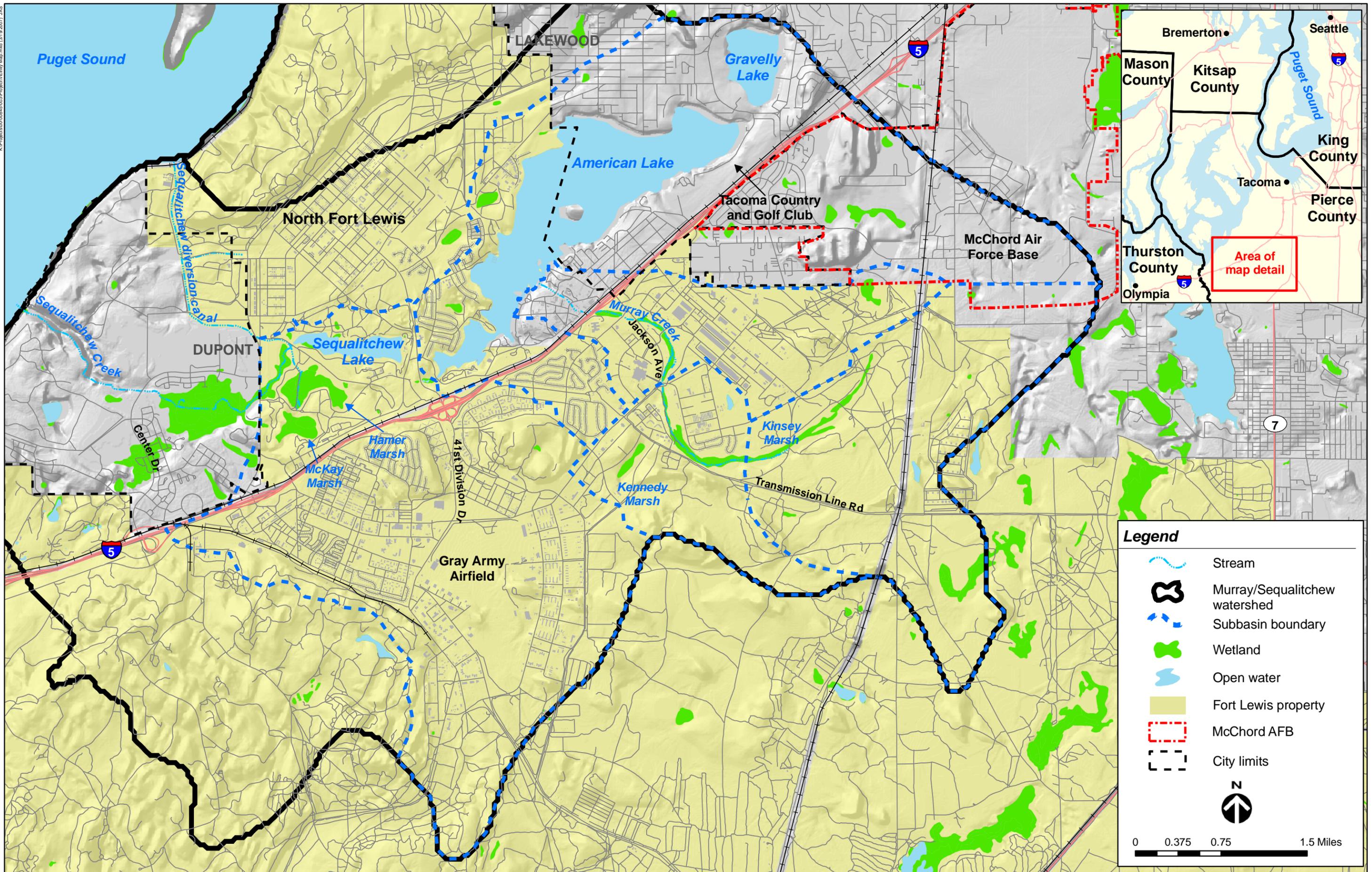


Figure 1-1 Project Vicinity and Location Map Showing Murray/Sequalitchew Watershed and Study Subbasins.

2.0 Study Area, Methods, and Assumptions

This section summarizes the methods, data sources, assumptions, and limitations of this plan.

2.1 Study Area

The Murray/Sequalitchew watershed is located within Township 19 North, Ranges 1, 2, and 3 East, as well as Township 18 North, Ranges 1 and 2 East within the state of Washington (Washington Department of Natural Resources [WDNR] 1998b). This watershed plan investigates those portions of the Murray/Sequalitchew watershed located within the boundaries of Fort Lewis and adjacent military installations.

Murray Creek originates at Kinsey Marsh on Fort Lewis and runs to the west for about three miles before crossing under Interstate 5 and discharging to American Lake at Camp Murray. The outlet to American Lake is at its south end, where a short channel runs westward to the east end of Sequalitchew Lake. Sequalitchew Creek begins at the west end of Sequalitchew Lake and flows westward approximately 3 miles through the City of DuPont before it discharges into Puget Sound. However, given the high ground water table and permeable soils, much of the water flow in the area is through ground water rather than surface water.

2.2 Methods

2.2.1 Fort Lewis Mission and Goals

Preparation of this watershed management plan required gaining an understanding of the Army's training objectives and the overall military mission, since environmental protection measures must be consistent with the mission. A preliminary step of preparing this plan was learning the key goals of the military mission at Fort Lewis through discussions with Fort Lewis personnel and review of planning documents.

The Fort Lewis mission is summarized in the *Fort Lewis Installation Sustainability Implementation Plan for FY05–10* (U.S. Army 2005a) as follows:

Fort Lewis' proximity to interconnected road, rail, sea, and air facilities makes it the premier power projection platform for mobilization and deployments on the West Coast of the United States. Its military mission under Army Transformation is to train, mobilize, and quickly deploy forces that are highly versatile, adaptive, agile, mobile, sustainable, and capable of quicker transport and combat readiness in order to fight and win throughout the world. Inherent in this mission is the requirement to care for soldiers, their families, and the work force, and to sustain a quality installation.

Fulfilling this mission requires that Fort Lewis have adequate land and water resources to meet its training needs. Combat training at Fort Lewis is diverse and includes for example land

maneuvers (armor and infantry); numerous types of artillery training, including a variety target practices; combat deployment; and amphibious training. Land in the cantonment area contains infrastructure and facilities that support the soldiers who train at Fort Lewis. The cantonment is the developed portion of the installation that supports residential, administrative, commercial, medical, recreational, and industrial land uses.

Watershed management is essential to comply with federal environmental regulations such as the Clean Water Act and the Endangered Species Act, while supporting the military mission of Fort Lewis. Not only do the many training activities on the installation have the potential to affect the streams, wetlands, and lakes of the watershed, but the infrastructure associated with support functions has impacts on the functioning of the watershed as well.

2.2.2 Describe Historical and Existing Watershed Conditions

To effectively describe historical and existing watershed conditions, information from existing reports was reviewed and then updated based on information from additional data sources and input from Fort Lewis staff and natural resource agencies. Input from other stakeholders in the watershed will be solicited for inclusion in the final version of this watershed management plan.

One goal of this plan is to compile information from the large number of studies that pertain to the Murray/Sequalitchew watershed. To provide the reader with a background on previous research along with ongoing data collection and study efforts, both historical and existing watershed conditions are described. There is no arbitrary date that defines “existing” or “historical” conditions. If information is still relevant and reflects conditions as they exist today, it is included under existing conditions. If conditions have changed or there is insufficient information to determine whether the data are still valid, they are included under historical conditions.

2.2.3 Integrate Existing Information

In view of the large number of previous studies associated with Fort Lewis facilities, this watershed management plan utilizes these past studies wherever feasible, rather than developing new information. Data from existing reports have been integrated and summarized according to the following environmental components:

- Topography, geology and soils
- Climate
- Land use and land cover
- Surface water resources
- Ground water quantity and quality
- Upland habitat
- Wetlands
- Riparian habitat
- Aquatic habitat and fisheries

Organizing the data by environmental component allowed the project team to build a comprehensive description of the existing data. It also facilitated evaluation of the data by disciplinary approach, which aided in assessing data quality and resolving conflicting information. For each environmental component, experts in the discipline evaluated pertinent data from various reports, and incorporated additional, specialized knowledge as part of the evaluation.

The existing studies are often delimited both by environmental component and geographic area. For example, the *Lake-Level Management Plan for Sequalitchew Lake* (Shapiro 1997a) deals only with flows entering or leaving this lake. The report contains little or no mention of water quality, climate, or aquatic habitat; nor does it contain discussions of factors affecting flows in upstream basins.

2.2.4 Delineate Subbasins

The study area was divided into five geographic subbasins to describe watershed conditions and formulate multidisciplinary solutions: Upper Murray, Middle Murray, Lower Murray, American Lake, and Sequalitchew (see Figure 1-1).

The subbasins were delineated based on land use, surface topography, piped stormwater systems, and general direction of ground water flow. Grouping by homogeneous or similar land uses made it easier to discuss the impacts of Fort Lewis activities within each subbasin. Although ground water is the primary transport pathway for water within the study area, surface and piped flows play an important role in environmental processes, and were considered when delineating the subbasins. Although the boundaries of the subbasins are somewhat arbitrary, due to conflicts between the delineation factors described above, they are useful for the discussion of watershed issues.

The **Upper Murray subbasin** includes over 3,200 acres in the eastern portion of the study area. This largely undeveloped area contains Kinsey Marsh, the headwaters of Murray Creek. Most of this subbasin is used for military training exercises and open space recreation. A small portion of this subbasin lies outside of the Fort Lewis boundary to the northeast. The reach of Murray Creek within the subbasin tends to gain flow from ground water (Shapiro 1996).

The **Middle Murray subbasin** receives its flows from the Upper Murray Creek subbasin, which abuts it to the east. This entire 1,300-acre subbasin is located within the Fort Lewis boundary, and a significant portion of the subbasin is developed. Murray Creek runs through the Fort Lewis cantonment area and the Old Madigan Hospital complex is located along the north bank of Murray Creek. A number of firing ranges occupy most of the undeveloped portion of this subbasin. The reach of Murray Creek within this subbasin gains flow from ground water in the winter and loses flow to ground water in the summer (Shapiro 1996).

The **Lower Murray subbasin** includes the Logistics Center, Madigan Army Medical Center (MAMC) complex, and Camp Murray in its more than 1,700 acres. Both the MAMC and the Logistics Center influence the ground water level through their pumping activities. The MAMC

pumps ground water for cooling purposes and the Logistics Center extracts ground water with a pump-and-treat system to treat contamination. Murray Creek loses flow to ground water in this lower reach (Shapiro 1996).

The **American Lake subbasin** encompasses a large drainage area of almost 6,200 acres to the east of and along the shores of American Lake. This subbasin includes large areas outside the Fort Lewis boundaries as well as smaller areas west and south of the lake that lie within installation. With the exception of the Tacoma Country and Golf Club and some parks along the lakeshore, this subbasin is almost completely developed, with mostly residential land use.

The **Sequalitchew subbasin** includes about 5,970 acres within Fort Lewis and contains Sequalitchew Lake, developed areas to the southeast of Sequalitchew Lake, and the headwaters of Sequalitchew Creek. There is little surface water drainage in this subbasin; most of the flow occurs as ground water. (A large portion of the drinking water supply for Fort Lewis, however, comes from Sequalitchew Springs, where the groundwater flows to the surface.) Housing and office complexes, along with Gray Army Airfield, are located in this subbasin. For the purposes of this plan, the downstream extent of this subbasin has been set at the Fort Lewis boundary.

2.2.5 Identify Key Watershed Problems

Based on the evaluations of historical and existing conditions, a list of known problems was developed for each environmental component. In some cases, these issues were specifically identified in existing studies, and in others the problems were identified based on input from Fort Lewis staff, site observations, and additional data sources.

2.2.6 Develop Potential Solutions

Based on the identified watershed problems for each environmental component, potential solutions were developed. Some of the identified solutions were taken from existing reports, while others were developed during the course of this study.

2.2.7 Recommend Actions and Develop an Implementation Strategy

The team that developed the various portions of this watershed management plan evaluated all of the identified potential solutions as a group to ensure that specific solutions do not conflict with goals for other environmental components. Where possible, potential solutions for one environmental component were expanded upon to address other environmental components. A list of recommended watershed management actions was then developed from the potential solutions and evaluated with respect to potential cost and urgency. A rough prioritization scheme was developed to provide a starting point for working with Fort Lewis staff on an implementation plan.

When complete, the watershed implementation plan will incorporate a list of recommended watershed management actions along with the following information:

- Nature of the action (capital improvement, operational measure, monitoring study, or routine coordination action)
- Schedule of implementation (within 5 years, 5–10 years, 10+ years)
- Personnel responsible for implementation

2.3 Data Sources

The studies that were reviewed during the preparation of this management plan include a historical account of Sequalitchew Creek, environmental impact statements, environmental assessments, site-specific studies (e.g., a hydrologic evaluation of Murray Creek and a water quality evaluation of American Lake), and other management plans (e.g., *Integrated Natural Resources Management Plan*, *American Lake Phosphorus Management Plan*). Within this watershed management plan, a list of data sources is provided for each environmental component discussed. Appendix A provides a brief summary of each of the documents referenced.

One of the more comprehensive studies within the Murray/Sequalitchew watershed was conducted by Shapiro and Associates, Inc (1996; Shapiro study). The study investigated geology, precipitation, land cover, land use, streamflow, geomorphology, and ground water pumping rates to identify potential factors contributing to the observed loss of base flow in Murray Creek during the summers of 1994 and 1995. Because that study consolidated much of the information on Murray Creek and its watershed available prior to 1995, it is cited extensively in this watershed management plan. In addition, the current plan presents information from the past 10 years, as well as supplemental information pertaining to American Lake, Sequalitchew Lake, and Sequalitchew Creek, which were not addressed in the Shapiro and Associates report.

Information gathered from the existing studies was updated using the additional sources described below.

2.3.1 Meetings with Fort Lewis Personnel

Fort Lewis staff members have a substantial amount of knowledge about the study area. Much of that knowledge is not contained in existing publications. The following meetings were held to interview staff prior to creation of the draft plan report (see Appendix B for complete meeting notes):

- A kickoff meeting was held on May 26, 2005. The consultant team discussed the project schedule, available resources, and expectations with the Fort Lewis staff. The boundaries of the study area were refined during this meeting.
- A deconfliction meeting was held on June 16, 2005. This meeting brought together staff from Fort Lewis departments likely to be affected by the management plan. The project scope was discussed and aspects of the scope clarified. A follow-up meeting occurred on July 11, 2005 to meet

with other installation stakeholders not present at the deconfliction meeting. This meeting was followed by a guided tour of selected sites within the study area.

- A series of short interviews were held on August 2, 2005, to discuss specific items with Fort Lewis personnel who had not attended previous meetings, including MAMC, Planning Division, and the Sustainability Program personnel.

2.3.2 Stakeholder Meeting

A stakeholder meeting was held on September 7, 2005, to solicit input from nearby municipalities, agencies, and other interested groups.

2.3.3 Coordination with Washington Department of Fish and Wildlife

The Washington Department of Fish and Wildlife (WDFW) was contacted regarding juvenile fish releases in American Lake and Sequalitchew Lake (Jenkins 2005).

2.3.4 Coordination with Pierce County

Elevation contour lines for the study area were derived from Pierce County light detection and ranging (lidar) data.

2.3.5 Climate Data

Climate data were obtained from the Washington State Climatologist (2005) website.

2.3.6 STORET Search

The U.S. Environmental Protection Agency (USEPA) storage and retrieval (STORET) databases, which are repositories for water quality, biological, and physical data (both pre-1999 and current) were searched for water quality information that has been collected within the study area.

2.3.7 Geographic Information System Information

Geographic information system (GIS) information was obtained from current Fort Lewis databases. The information was enhanced with lidar data to improve elevation resolution to ± 1 foot.

2.3.8 Scope of Study

This study will provide Fort Lewis with a valuable tool for prioritizing further data collection efforts and management practices to protect the Murray/Sequalitchew watershed. In view of the large number of previous studies of Fort Lewis facilities, this watershed management plan relies

largely on those studies. The only independent field investigation conducted for this study was a half-day tour led by several Fort Lewis staff members.

Needs for new data are described in Section 3.0 – Watershed Conditions.