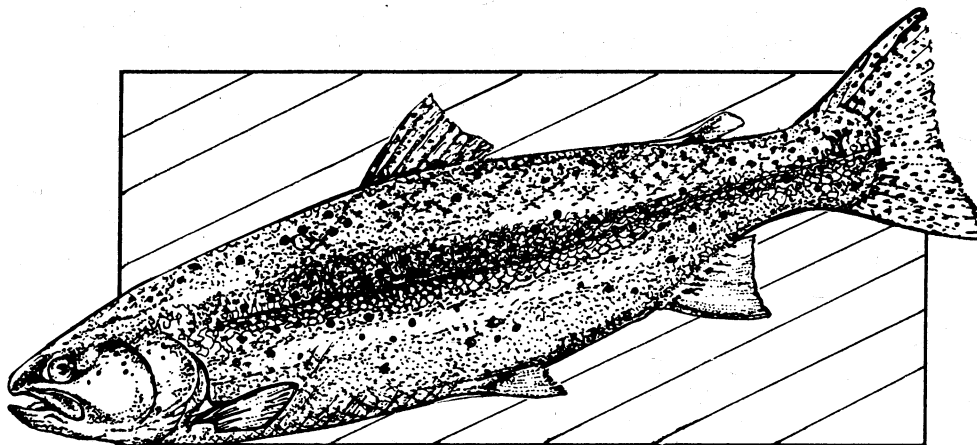


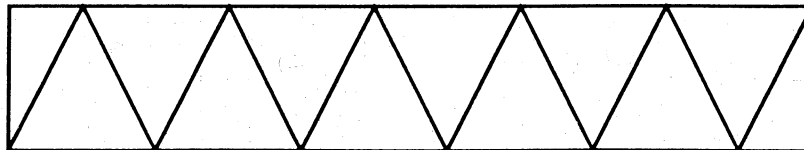
# INDIAN MOXLIE CREEK



## COMPREHENSIVE DRAINAGE BASIN PLAN

MAY 1993

CITY OF OLYMPIA    THURSTON COUNTY    DEPT. OF ECOLOGY



# **Indian/Moxlie Creek Comprehensive Drainage Basin Plan**

**May 1993**

Prepared by the City of Olympia Public Works Department in conjunction with the Thurston County Public Works Department. Financial support provided by Washington State Department of Ecology Centennial Clean Water Grants TAX 90110/91188.



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## 1.0 INTRODUCTION

The Indian/Moxlie Creek Comprehensive Drainage Basin Plan has been developed in response to growing concerns over the impacts of urbanization on surface waters within the basin. The plan provides a means to resolve current and potential surface water problems in the creek system and surrounding drainage area. These problems include flooding, erosion, degraded water quality, and diminishing aquatic and wildlife habitat.

The Indian/Moxlie Creek basin planning effort was initiated in early 1990 with funding from a Washington State Department of Ecology (WDOE) Centennial Clean Water Grant (TAX 90110/91188). A basin plan has also been completed for the Percival basin in Olympia, Tumwater, and Thurston County. Plans are underway for the Woodland/Woodard basin in Lacey, Thurston County, and Olympia; the Chambers/Ward/Hewitt Lakes basin in Lacey, Olympia, Thurston County, and the Green Cove Basin in Thurston County and Olympia.

The 4.5-square-mile Indian/Moxlie Creek drainage basin includes a portion of downtown Olympia as well as residential and commercial neighborhoods on the east side of Olympia. The Indian Creek basin includes semi-rural, but developing areas of Thurston County. Map 1 in Appendix 1 illustrates the location of the basin in the north Thurston County area.

Indian Creek flows south from its headwaters at Bigelow Lake, under Interstate 5, and into downtown Olympia. Moxlie Creek flows northerly from its headwaters at the springs in Watershed Park. The two creeks have been combined and piped under Olympia's central business district to the eastern portion of Budd Inlet.

The basin planning effort has identified both basin specific and regional solutions to a variety of problems within the basins. Basin specific projects are primarily capital improvements needed to solve or prevent problems. The regional surface water management program is aimed at preventing problems common to all basins in the north Thurston County area. This program has also been included in the Percival Creek and Woodard/Woodland Creek basin plans.

Comprehensive Public Involvement and Education (PIE) activities have been offered during the planning process. Activities include a citizen advisory committee, public workshops, and Steam Team training and field activities. Public involvement is a continuing aspect of plan implementation.

This plan is arranged into 14 chapters:

1. Introduction
2. Goals and Objectives
3. Authority of the Basin Plan
4. Basin Characterization
5. Indian/Moxlie Creek Systems
6. Basin Problem Analysis
7. Management Alternatives
8. Evaluation of Alternatives
9. Preferred Alternative and Recommendations
10. Optimum Alternative and Recommendations
11. Nonstructural Surface Water Management Program
12. Implementation Costs
13. Funding Alternatives
14. Implementation Strategy

The content of the chapters is as follows:

- The goals and objectives established by the jurisdictions for north Thurston County basin plans are presented in Chapter 2.
- Chapter 3, "Authority of the Basin Plan" examines the various legislation and plans that support or direct surface water planning and management.
- "Basin Characterization," Chapter 4, provides a description of the topography, soils, critical areas, land cover, and other physical traits of the basin. A discussion of existing stormwater systems within the basin is presented in this chapter.
- A detailed discussion of the physical traits of Indian/Moxlie Creeks, their wildlife habitat, and water quality are discussed in Chapter 5.
- Problems identified during the basin planning process are described and analyzed in Chapter 6, "Basin Problem Analysis."
- Three levels of service, existing, enhanced, and optimal are discussed in Chapter 7, "Management Alternatives."
- A description of the evaluation criteria and the results are included in Chapter 8, "Evaluation of Alternatives." The management alternatives have been evaluated according to five criteria: effectiveness, sustainability, cost, feasibility, and goals and objectives.

- Chapter 9, "Preferred Alternative and Recommendations" presents a detailed description of Alternative II recommendations, benefits, and costs. The optimal level of service, Alternative III, is described in Chapter 10.
- Chapter 11 contains a collection of nonstructural surface water management recommendations intended for implementation throughout the north Thurston region.
- Implementation costs, funding alternatives, and an implementation strategy are discussed in Chapters 12 through 14.



## **2.0 GOALS AND OBJECTIVES**

At the outset of the planning process, a set of goals and objectives was established for all basin plans undertaken in Thurston County. These were developed by the Storm and Surface Water Technical Advisory Committee which consists of staff representatives from Olympia, Tumwater, Lacey, and Thurston County.

### **2.1 Goals**

The Technical Advisory Committee established the following goals for comprehensive drainage basin plans:

- Preserve and/or enhance water quality, stream morphology, wetlands, groundwater, fisheries/wildlife habitat, and aesthetic amenities.
- Promote environmentally sustainable development within each basin.
- Promote public interest and involvement in water resource management.
- Establish long-term solutions to existing and future stormwater quality and quantity problems.
- Promote a regional approach for financing, ownership, and operation/maintenance of regional facilities and programs.

### **2.2 Objectives**

The Technical Advisory Committee established that drainage basin plans will provide:

1. A basis for making decisions about capital expenditures, financing options, land use regulation, source reductions, and stormwater facility location, design, and maintenance. Decision-making information and tools generated by each basin plan will include:
  - A data base on water quality, hydrology, and habitat.
  - A data base on existing and potential pollution sources.
  - A predictive model for testing effects of alternate decisions.
  - Recommended development controls (regulations/incentives).
  - Recommended programs for continued monitoring of facility performance and resource conditions.

2. Ongoing public involvement in stream restoration, enhancement, and education activities addressing problems identified in the plan.
3. Understanding and support of the basin plan recommendations by the public.
4. A common implementation and financing strategy by jurisdictions responsible for the drainage basin including:
  - Schedules for implementing recommended projects.
  - Revenue sources and methods of financing.
  - Cost allocations.
  - Responsibility for owning and operating capital facilities.
  - Enforcement of development controls and other regulations.
  - Ongoing coordination of plan implementation.
  - Ongoing coordination of public involvement and education activities.

### **2.3 Use of the Plan**

Government entities are expected to use the Indian/Moxlie Creek Drainage Basin Plan through:

- Administration of city and county programs and services that affect the Indian/Moxlie Creek basin.
- Review of other plans and policies that affect Indian/Moxlie Creek basin.
- Coordination with other governments and groups interested in the Indian/Moxlie Creek basin.
- Preparation of city and county capital improvement project lists and annual operation and maintenance budgets.
- Response to development proposals in Indian/Moxlie Creek basin.
- Planning and development of future public involvement and education opportunities in Indian/Moxlie Creek basin.

Others interested in the plan or proposing new development in the basin are anticipated to use the plan by:

- Understanding the community's vision and hopes for the Indian/Moxlie Creek basin.

- Designing projects so that they are consistent with the recommendations and visions outlined in the plan.
- Initiating projects and activities that protect or enhance Indian/Moxlie Creek basin's natural and developed systems.



### 3.0 AUTHORITY OF THE BASIN PLAN

Each jurisdiction in Washington is required by the Revised Code of Washington (RCW) to prepare a comprehensive plan. These plans are intended to facilitate orderly development and include a broad spectrum of planning issues. Comprehensive plans are required to contain a land use element which provides for:

- Review of drainage, flooding, and stormwater runoff in the area and nearby jurisdictions (RCW 36.70.330).
- Guidance for corrective actions to mitigate or cleanse those discharges that pollute Puget Sound or waters entering Puget Sound (RCW 36.70.330).
- Protection of the quality and quantity of groundwater used for public water supplies (RCW 36.70.330).

The RCW allows key aspects of the comprehensive plan to be "amplified and augmented in scope by progressively including more completely planned areas consisting of distinctive geographic areas or other types of districts having unified interests within the total area of the county" (RCW 36.70.340).

Further authority for basin planning is encouraged by a comprehensive planning option to include "a conservation element for the conservation, development, and utilization of natural resources, including water and its hydraulic force, forests, watersheds, soils, rivers and other waters, harbors, fisheries, wildlife, and other natural resources" (RCW 36.70.350).

The comprehensive plans for jurisdictions within the Indian/Moxlie Creek Basin support stormwater management and therefore the development of basin plans.

- City of Olympia Comprehensive Plan: The City of Olympia updated its comprehensive plan in 1988 through the Planning Enabling Act (Chapter 36.70 RCW). The comprehensive plan provides a legally recognized framework for making decisions about land use in the city. The Indian/Moxlie Creek basin includes a large portion of the developed and developing east side of Olympia. The City of Olympia Comprehensive Plan (Chapter 4, Goals 5, 6, and 7; Chapter 7, Goal 13) establishes the following goals related to stormwater management:
  - Local jurisdictions should join in planning, funding, and implementing a stormwater utility.
  - New development should not increase peak runoff and should minimize total runoff and erosion.

- Lakes, ponds, wetlands, and stream corridors should be retained substantially in their natural condition.
  - New development should meet the requirements of the City of Olympia Flood Plain Management Ordinance.
  - Shoreline development should be managed at a level beyond that provided by the Shoreline Master Program.
  - Fish-bearing streams must be protected from high flows and water quality degradation.
  - Development should preserve the natural vegetation of the site.
- Thurston County Comprehensive Plan: The comprehensive plan for Thurston County was updated in 1988. Many of the concerns expressed in the City of Olympia Comprehensive Plan are also emphasized in the county's plan. Thurston County has jurisdiction in the northern and central portion of the Indian Creek basin. Basin planning is an integral part of Thurston County's stormwater management program.

According to the Thurston County Comprehensive Plan (Chapter 2, Objective B), the protection of water resources within the County's jurisdiction is to be accomplished by:

- Viewing wetlands, streams, lakes, and ponds as systems rather than isolated units.
- Requiring that development does not degrade fish-bearing streams or result in the loss of natural functions. Efforts to accomplish this goal include avoiding excessive flows, protection of riparian habitat and streambank integrity, and avoiding water quality degradation.
- Restoring degraded systems when possible.
- Retaining water systems in their natural condition.
- Managing water resources for multiple uses.
- Increasing evaluation of the natural resources within the county and enacting programs or updating existing programs to correct existing and potential degradation.

Adoption of the Indian/Moxlie Creek Drainage Basin Plan by the Olympia City Council and the Board of County Commissioners would initiate the appropriate changes to the comprehensive plans, ordinances, and policies of the jurisdictions.

Basin planning is also supported by the requirements included in the State Growth Management Act. The Washington State Legislature passed the Growth Management Act in 1990 in order to promote comprehensive land use planning. This act addresses:

- Protection of the environment.
- Enhancement of economic development.
- Protection of quality of life in Washington State.

The Growth Management Act comprises new chapters in the RCW. This act requires all jurisdictions to adopt regulations to protect critical areas including:

- Wetlands.
- Frequently flooded areas.
- Critical aquifer recharge areas.
- Fish and wildlife habitat.

The central focus of the Growth Management Act is on the interjurisdictional character of natural resources. A number of the requirements placed upon jurisdictions by the Growth Management Act can be effectively met through the basin planning process. These requirements include, but are not limited to:

- Working cooperatively to achieve cohesive land use policies on issues such as stormwater that do not recognize jurisdictional boundaries.
- Identifying capital stormwater facilities and planning for future capital improvements.
- Identifying innovative land use solutions for land management problems.

Other programs, both federal and state, have guidelines and requirements specific to the kinds of information and recommendations generated by basin plans.

- The National Pollutant Discharge Elimination System (NPDES): In 1987 the Federal Clean Water Act and associated NPDES program was amended to address stormwater discharges. Administered by the Washington Department of Ecology, NPDES has begun to regulate large- and medium-sized municipal storm sewer systems that discharge stormwater to receiving waters of the state. Requirements for permitting include prohibition of non-stormwater discharges into the storm system and controls to reduce discharge of pollutants to the maximum extent practicable. Although local jurisdictions in Thurston County currently have populations under the permitting requirements, EPA will be determining

how to regulate smaller municipalities in the near future. The potential water quality improvements gained from basin plan recommendations will be instrumental in the future permitting process.

- Washington Department of Ecology (WDOE) Stormwater Management Guidelines: Minimum stormwater management guidelines have been developed by WDOE with the aim of protecting the Puget Sound basin from stormwater contamination. The stormwater programs required for local governments include measures to address stormwater treatment and volume control, maintenance, development regulations, and erosion control.

A stormwater management manual presenting minimum guidelines is available to local entities for adoption. The manual establishes requirements for the components of urban stormwater programs within the Puget Sound basin. It is expected that jurisdictions will adopt the WDOE manual or develop a similar one.

- Washington Department of Fisheries (WDF): Guidelines for the protection of streams and fish habitat have been developed by WDF. A specific set of guidelines focusing on stormwater issues and fisheries protection was developed in 1990.
- Drainage Design and Erosion Control Manual for the Thurston Region, Washington: Basin plan recommendations addressing stormwater management requirements would supersede any overlapping regulations included in the regional drainage manual.

In addition, various grant and loan programs require the completion of a basin plan or flood management plan before a jurisdiction is eligible for funding assistance. The programs include the following:

- WDOE Flood Control Assistance Account Program (FCAAP).
- Centennial Clean Water Program.
- Department of Community Development's Public Works Trust Fund Loan Program.
- Washington State Revolving Fund.

The grant program requirements lend authority to the plan by enabling the City of Olympia and Thurston County to pursue additional outside funding sources. Further descriptions of established regulations, policies, and plans are summarized in Appendix 6.

Upcoming and past studies and plans also support the issues addressed by the Indian/Moxlie Creek Basin plan. These studies include:

- North Thurston County Groundwater Management Plan (GWMP): The GWMP provides a mechanism for comprehensive management of groundwater in north Thurston County. The plan recognizes the potential impacts of stormwater on groundwater and supports the current management efforts of the jurisdictions. However, because of the importance of stormwater management on groundwater quality, the plan includes numerous recommendations in support of existing programs as well as for additional work. Specific recommendations address public education, technical assistance, increased enforcement, facility maintenance, modification of the regional drainage manual, and other recommendations that have been addressed within this plan.
- Critical Areas Ordinances (CAO): Both Olympia and Thurston County are currently revising their critical areas ordinances in order to comply with the *Puget Sound Water Quality Management Plan* and the Growth Management Act. These regulations apply to developments within or near wetlands, unstable slopes, streams, flood plains, significant wildlife habitat areas, and special management areas. Basin plan recommendations address the protection of some of the same types of areas addressed by the CAOs.
- Budd Inlet Urban Bay Action Program: 1991 Action Plan: In 1985 agencies with regulatory, resource management, and research responsibilities initiated the Puget Sound Estuary Program to address broad based concern over the health of Puget Sound. This program developed the Urban Bay Action Program is intended to address contamination problems near urban areas. The Budd Inlet Action Plan focuses on pollutant source control as the principal means to improve water quality in southern Budd Inlet. Priority problem areas have been identified by the plan and include microbial contamination from Indian/Moxlie Creek.
- Comprehensive Circulation and Water Quality Study at Budd Inlet: The URS Company conducted a study in conjunction with WDOE to identify the cause of the low dissolved oxygen concentrations in Budd Inlet (which occur in the late summer and early fall) and to identify possible corrective action. During the bacteriological survey Indian/Moxlie Creek was found to be a major contributor of fecal coliform to Budd Inlet. A thorough investigation of the creek and its tributaries was recommended by the study.



## 4.0 BASIN CHARACTERIZATION

The history of development in Indian/Moxlie Creek basin dates to the initial settlement of the Olympia area. As development spread from the urbanizing core, the hydrologic nature of the drainage area as well as the creek system was altered.

When Burlington Northern Railroad was developed along a sizable segment of Indian Creek in the 1890s, the creek was channelized to flow parallel to the railroad grade. Indian Creek was further channelized when Interstate 5 was constructed in the early 1950s. Indian Creek now flows under Interstate 5 at two locations.

The headwaters of Moxlie Creek were protected from development through its designation as a municipal water supply in the 1920s. Although the basin is highly developed, the area established to protect the springs is now contained within the City of Olympia's Watershed Park.

Prior to development of the downtown area, Indian and Moxlie Creeks discharged independently to a large estuarine wetland in Budd Inlet. As downtown Olympia developed, the estuary was filled and the creeks combined in a 3,200-foot pipe that discharges at the southern end of the East Bay of Budd Inlet.

The natural hydrology of the basins has been highly influenced by urban development. Because development in the Indian/Moxlie Creek basin has been established for a long period of time, the basins are experiencing a slower growth rate than many nearby, lesser developed basins. Maps 2 and 4 in Appendix 1 present the basin's boundaries and land use, respectively.

### 4.1 Climate

The South Puget Sound region has a marine climate typical of the West Coast. Summers are relatively dry and cool; winters are mild, wet, and cloudy. Annual precipitation averages approximately 53 inches. During the wet season, rainfall is usually of light to moderate intensity and continuous over a long period of time. Snow occasionally falls within the basins.

Typical seasonal rainfall is as follows:

	<u>Approximate Seasonal Rainfall (inches)</u>
Fall	10
Winter	29
Spring	10
Summer	4

Major storm events in the Olympia area have been evaluated for the purpose of characterizing stormwater runoff quantities. This evaluation generates theoretical design storms that are defined as the precipitation expected in a 24-hour time period from a storm of a given recurrence interval. Although precipitation varies with the specific geographic location, the 24-hour rainfall values are used for stormwater facility design in northern Thurston County (*Drainage Design and Erosion Control Manual for the Thurston Region, Washington, 1991*).

<u>Storm Recurrence (years)</u>	<u>Precipitation (inches/24 hours)</u>
2	2.80
5	3.75
10	4.35
25	5.10
50	5.65
100	6.15

The prolonged wet season in the Puget Sound area presents unique problems for estimating the quantity of runoff generated by a storm of a specific intensity and duration. Often the level of moisture in the soil profile immediately preceding a storm event is high. Given a saturated soil, only minimal amounts of precipitation can be infiltrated. This likelihood of high antecedent moisture levels in the soil requires extra care when predicting the amount of runoff that can be expected from a storm event.

## 4.2 Topography

Indian and Moxlie Creeks have low to medium channel gradients and are located in areas of rolling terraces and numerous small depressions. The upper portion of Indian Creek flows in a wide flood plain with extensive streamside wetlands. Downstream reaches of the stream are confined by steeper upper banks. Numerous year-round and seasonal tributaries, springs, and seeps enter the creek.

Moxlie Creek has formed deeply incised upper banks with slopes that commonly exceed 30 percent. The adjacent upland terrace in the southern portion of the basin has numerous glacial depressions commonly called kettles or potholes. Surface water in this portion of the basin typically drains to the kettles rather than to Moxlie Creek.

The Indian/Moxlie Creek basin has been divided into 11 subbasins based upon topography. Subbasin boundaries have been modified where necessary to reflect the redirecting of stormwater flows by man-made conveyance systems. Map 3 in Appendix 1 displays the subbasin boundaries within the two basins. The topographic traits of the subbasins are included on Table A-1 of Appendix 2.

#### **4.3 Soil Characteristics**

The glacial history of the Olympia area has strongly influenced local soil characteristics. Glacial ice from the north entered the Puget Sound region at least several times in geologic history. As the glaciers advanced and then retreated, several types of material were formed and deposited in both river channels and uplands. Within Thurston County there are deposits representing three of the four major glacial advances. All deposits in the Indian/Moxlie Creek basin were formed by the most recent glaciation.

Glacial advancement deposited and compacted sand, silt, clay, and gravel. The resulting concrete-like soil, known as till, has low permeability and therefore generates considerable stormwater runoff. The tills are fairly stable in slopes. Conversely, the material deposited ahead of advancing glaciers by melting ice, known as advance outwash, is composed of highly porous sands and gravels. A second type of outwash, recessional, was formed by retreating glaciers. The outwash soils are deeper and much better drained than the till soils. Outwash materials with a high content of silt and sand are prone to erosion; those that are more sorted and contain larger material are more resistant to erosion.

The dominant soil type found within the Indian/Moxlie Creek basin is Yelm fine sandy loam generated by the recession of the Vashon glacier. Water percolates through this type of soil relatively poorly. Layers of gravels are also common.

In addition, several poorly drained soils are found in the low areas and depressions of the basin. These soils are typically saturated or nearly saturated due to high water tables. For example, the wetland adjacent to Bigelow Lake is largely underlain by peat.

#### **4.4 Critical Areas**

Critical areas within the basins include wetlands, floodplains, aquifer sensitive areas, steep slopes, and kettles. Many of these areas are delineated on local zoning maps and necessitate development restrictions. Map 5 in Appendix 1 illustrates the location of wetlands, steep slopes, and flood hazard areas within the two basins. Map 6 in Appendix 1 presents the land use zoning within the basins.

#### 4.4.1 Wetlands

Wetlands offer some of the most productive and diverse habitat within the basin. These areas support a variety of scrub/shrub vegetation, and are seasonally flooded in association with the creeks and lakes of the basin. Extensive wetlands surround Bigelow Lake and range downstream from the lake to approximately Boulevard Street.

The wetlands have, in many cases, been altered by draining and replacement of water tolerant species with agricultural plants. Some of the wetlands still maintain a high degree of biological integrity.

The 140-acre peat bog wetland adjacent to Bigelow Lake at the headwaters of Indian Creek is a unique basin amenity. The wetland contains several vegetation types including scrub/shrub, emergent, and forest vegetation. Approximately 80 percent of the wetland is underlain by peat soils. The area offers excellent terrestrial and aquatic wildlife habitat, as well as water storage capacity.

A comparison of the occurrence of hydric soils and known wetlands within the basin indicates that current U.S. Fish and Wildlife Service wetland maps (National Wetland Inventory, 1989) may underestimate the total wetland acreage in the Indian/Moxlie Creek basin. A description of the basin's wetlands is presented in Table A-2 of Appendix 2.

#### 4.4.2 Floodplains

The Federal Emergency Management Agency (FEMA) has identified and mapped the floodplains within the basins. In many cases the floodplains are also wetlands. Most of the floodplains within the basins are associated with the upstream portions of Indian Creek and in kettles of the Moxlie basin.

#### 4.4.3 Aquifer Sensitive Areas

Aquifer sensitive areas encompass a relatively large portion of the basin. These areas have soil types which may allow contaminated surface waters to reach underlying aquifers (Thurston County, 1991).

The largest aquifer within the basin is located in the vicinity of Bigelow Lake. During much of the wet season this aquifer is located at surface level and is critical to the formation of the large wetland area surrounding Bigelow Lake. This aquifer is considered moderately vulnerable to contamination (Thurston County, 1991).

#### 4.4.4 Steep Slopes

Steep and unstable slopes do not constitute a formidable management problem in the Indian/Moxlie basin. For the most part, the riparian zone associated with Indian Creek is modestly sloped. The hillslopes bounding Moxlie Creek within Watershed Park are steep but stable. The protected status of Moxlie Creek also helps maintain the integrity of the hillslopes.

#### 4.4.5 Kettles

The Moxlie Creek basin contains numerous glacial depressions commonly called kettles. A majority of the kettles are bounded by development and receive stormwater from piped conveyance systems. As the basin becomes increasingly developed, the wooded kettles will become more and more valuable as wildlife habitat and urban open space areas. Table A-3 in Appendix 2 lists kettles in the basins.

### 4.5 Land Cover and Use

#### 4.5.1 Historical Land Cover

Historically, land within the basins was dominated by forests, extensive wetlands, and agricultural pastures. Forests were composed of Douglas fir, western red cedar, big leaf maple, western hemlock, and red alder with an understory of shrubs and herbs.

#### 4.5.2 Existing Land Cover

As Olympia developed, Indian/Moxlie Creek basin experienced considerable urban growth. The western portion of the basin has been heavily urbanized for many years. In contrast, the northern portion of Indian Creek basin contains small farms and maintains a semi-rural flavor. Moxlie Creek basin encompasses the majority of downtown Olympia, numerous suburban residential neighborhoods with scattered woodlots, and the heavily forested Watershed Park.

### 4.5.3 Existing Land Use

The land area within the basins is developed at varying levels of intensity from sparse residential to commercial. Areas of Indian Creek basin within Thurston County are relatively rural with sparse- to moderate-density residential development and intermixed businesses. The land area within Olympia is more heavily developed with moderate-to high-density residential and commercial zones. Existing land use is presented on Map 4 of Appendix 1. Neighborhood traits are summarized in Table 1 as follows:

**Table 1: Neighborhood Traits  
Indian/Moxlie Creek Basin**

Subbasin*	Neighborhood Designation	Dominant Land Use	Estimated Undeveloped Land	Growth Potential	Sewer Service
I-1, I-2	North Olympia	Older and new residential	10%	Moderate	Partial
M-4	Bigelow	Older single-family residential	10%	Low	Yes
I-3	Northeast	Highly varied	10%	Low	Yes
M-2, M-3	South Capitol	Single-family residential, duplex, professional	5%	Low	Yes
M-1, M-2	South Olympia	Older and new residential, duplex	Watershed Park only	Low	Yes
I-3, I-4, I-5, I-6	Southeast	Single-family residential	20%	Moderate	Partial
M-4, I-7	Eastside	Older single-family residential	10%	Low	Partial

\* Refer to Map 3 In Appendix 1

### 4.5.4 Potential Development

The vast majority of Indian/Moxlie Creek basin falls within the boundary of the current Urban Growth Management Area (UGMA) delineated by the Cities of Lacey, Tumwater, Olympia, and Thurston County. Land use policies and infrastructure development in this area are designed to encourage high-density housing and commercial development. Regions in north Thurston County that are outside the UGMA area are

intended to maintain their rural attributes. The current UGMA boundary is expected to be maintained until 1998 at which time it will be expanded to a proposed long-term boundary. The boundary is identified on Map 6 in Appendix 1.

As a result of its proximity to one of Olympia's largest and most highly developed business districts, Indian/Moxlie Creek basin has already been extensively developed. Large portions of both basins are approximately 95 percent developed.

The majority of future growth within the basins will focus on the filling of undeveloped areas within existing neighborhoods and commercial districts. Additionally, residential areas on the periphery of the business district can be expected to convert to business and professional development. Land use zoning is presented on Map 6 in Appendix 1.

The portion of Indian Creek basin north of Bigelow Lake is an exception to the generally moderate level of development expected in the basins. This area is outside the existing short-term boundary, but inside the long-term UGMA boundary. The land area located between the two boundaries is currently zoned one residential unit per five acres. Implementation of the long-term boundary would encourage high-density development in this area.

## **4.6 Recreational Resources**

### **4.6.1 Existing Resources**

Numerous parks are located within the Indian/Moxlie Creek basin. Moxlie Creek basin contains five parks of various sizes (Bigelow Park, Governor Stevens Park, Olympia's Yashiro Japanese Garden, Stevens Field, and Watershed Park). Indian Creek basin contains three small parks (Lions Park, Harry Fain's Legion Park, and Madison Scenic Park).

Watershed Park is the largest recreational facility within the basins. The park encompasses 171 acres of an undeveloped forested ravine and offers 1.5 miles of walking trails. The park offers protection to the headwaters of Moxlie Creek and maintains high-quality habitat for both aquatic and terrestrial wildlife.

Although privately owned, the abandoned Burlington Northern Railroad grade parallels an appreciable portion of Indian Creek and offers excellent recreational access to the creek and associated riparian areas.

#### 4.6.2 Potential Recreational Improvements

The Olympia Parks Department has identified the need for 10 acres of additional park facilities and approximately 50 acres of open space within the Indian/Moxlie Creek basin. Improvements for existing parks within the basins are also planned. These areas would accommodate the needs of increasing urban populations.

Recreational opportunities within the Indian/Moxlie Creek basin would be further enhanced by implementing the Thurston Regional Planning Council's Urban Trails Plan. Although still in draft form, the plan is intended to guide future trail development within the UGMA. The Urban Trails Plan is compatible with the local jurisdictions' park plans and would enable the cities and Thurston County to proceed with trail development as outlined in their respective comprehensive plans. The main trail proposed within the basins links Priest Point Park with Bigelow Lake and the upper reaches of Indian Creek. The abandoned Burlington Northern Railroad grade that parallels Indian Creek offers an optimal greenbelt and trail location. Recently, several neighborhood associations have been active in efforts to obtain the railroad corridor as an urban greenbelt and public trail. Because of its location and the protection it offers to one of Indian Creek's most viable fish and wildlife habitat areas, both the City of Olympia Parks Department and Water Resources Program are pursuing creative methods of acquiring this property.

#### 4.7 Stormwater Conveyance, Storage, and Treatment Systems

Stormwater runoff generated by impervious surfaces associated with urbanization strongly influences, and in many cases impairs, the surface waters of the basins.

##### 4.7.1 Existing Systems

The basins are served by an extensive stormwater collection system in downtown Olympia and the surrounding residential/commercial areas. In most cases, these systems discharge directly to the creeks. In outlying areas, the systems become increasingly intermittent.

Indian and Moxlie Creeks, their tributaries, and wetlands are important natural components of the basin's surface water conveyance system. At current levels of stormwater management, discharges to the creek create unnaturally high flood flows that threaten the integrity of the creek system and associated critical areas. Stormwater runoff is also a source of nonpoint pollution. These problems are addressed in detail in Chapter 6.

A simplified schematic of the piped conveyance system within the basin is shown on Map 7 in Appendix 1. The map illustrates major pipe systems, outfalls to the creeks, and stormwater storage facilities. Detailed, computerized stormwater maps for the basin have also been developed as part of the basin planning effort. The total public piped system in the basin is summarized as follows:

<u>Pipe Diameter (inches)</u>	<u>Total Length (miles)</u>
4 - 10	19.2
12 - 24	8.3
> 24	2.2

Thirty-six public and private storage facilities have been identified and inventoried within the basin. A database including facility location, condition, and approximately capacity is available from the City of Olympia. The inventory provides an indication of maintenance needs and the potential for design upgrades. These facilities are listed in Appendix 3.

Indian and Moxlie Creeks pass through 20 and 5 instream pipes, respectively. Analysis of these pipes using the U.S. Environmental Protection Agency Surface Water Management Model (EPA SWMM) indicates that many of the culverts are undersized for current flows. Without better management, the impoundment of water behind these pipes during high flow conditions will increase as development continues. Table A-4 in Appendix 2 characterizes these pipes.

The characteristics of the stormwater systems in each of the basin's jurisdictions are presented in the following discussions. Specific problems associated with the stormwater system are addressed in Chapter 6.

### Olympia

The City of Olympia's stormwater system discharges to Indian and Moxlie Creeks at 22 locations. Thirteen of these outfalls discharge to the creeks as they flow under downtown Olympia. Major municipal stormwater systems also discharge to the middle segments of Indian Creek and the headwaters and midstream segments of Moxlie Creek. Flows to the creeks are typically not detained or treated by private or public facilities prior to discharge. No public stormwater storage facilities are located in the basins.

An additional 16 systems discharge to glacial depressions (kettles) in the basins. The majority of these systems serve adjacent residential neighborhoods.

### Thurston County

Small systems comprised of roadside ditches and culverts serve the many discontinuous residential drainage systems within the Thurston County jurisdiction. The County has not constructed public pipe and stormwater management facilities in the basins.

### Washington State Department of Transportation

The Washington State Department of Transportation (WSDOT) manages the runoff generated by the 43 acres of Interstate 5 located within the basins. Nine WSDOT outfalls discharge to Indian Creek; four outfalls discharge to Moxlie Creek.

The flows to Moxlie Creek are slightly regulated by a man-made wetland, Moss Lake, and a hazardous spill containment pond located on Henderson Boulevard. With the exception of one detention pond, the flows from Interstate 5 to Indian Creek are not managed.

#### 4.7.2 Effectiveness of Existing Facilities

The present level of stormwater management in the Indian/Moxlie Creek basin is based on the construction and maintenance of public and private infrastructure, and the regulation of potential developments.

Historically, stormwater systems were maintained only in reaction to a flooding problem. Maintenance has improved for some of the systems. The City of Olympia began an aggressive long-term maintenance program for municipal systems in 1990. Additionally, new developments within Olympia's jurisdiction are required to implement maintenance programs; existing developments are being encouraged to develop maintenance programs. In the event of inadequate private maintenance, the City has the authority to maintain private systems and charge the owner for the service.

Street sweeping in the city occurs every one to six weeks depending upon the level of traffic associated with the particular street. Thurston County currently maintains roadside ditches on an as-needed basis and has a limited pipe, culvert, and pond maintenance program. Streets in the county are swept every 3 to 12 months.

In general, public conveyance systems in the basin are adequately maintained and of sufficient capacity to convey current flows to receiving waters. However, the vast majority of these systems fail to meet current stormwater management expectations for stormwater storage and water quality treatment. Additionally, flooding is a major problem at several locations.

Existing inadequacies in the public systems include:

- Flooding of private property and roadways in the extreme southern portion of Moxlie basin, the Plum Street/Union Avenue intersection area, and on Indian Creek at Fredrick Street.
- Runoff from residential developments is managed by approximately 1 acre-foot of storage. Based on the level of development in the basin and current regulations these developments should provide considerable additional storage.
- Approximately 91 percent of the nonresidential developments in Indian/Moxlie Creek basin do not provide any level of stormwater storage and treatment.
- Contamination of water quality via numerous stormwater discharges.
- Deteriorating physical and biological conditions in the creek system. Computer modeling indicates that flood flows have increased dramatically compared to predevelopment land cover conditions (EPA SWMM, 1991). A detailed discussion of creek hydrology is presented in Section 5.3.

#### 4.7.3 Ongoing System Improvements

Several stormwater management projects are either recently completed, currently underway, or expected to be completed in the near future. These basin projects are presented in the following discussion.

#### Olympia

Stormwater projects currently underway by the City of Olympia in the basins are as follows:

- Improving the conveyance system at Plum Street and Union Avenue was initiated in early 1991 by piping a 230-foot open channel segment of Indian Creek. This project was conducted with approval from Washington Department of Fisheries and relies upon the subsequent rerouting of the Indian Creek in a habitat-oriented open channel. In addition to correcting the flooding problem, the reroute provides salmon passage to upstream

sections of the creek. Initial work on the reroute was conducted in the autumn of 1991 with completion in October 1992. Funding for the reroute project will be provided by the City of Olympia, WSDOT, and WDOE's FCAAP program.

- Improvements to the conveyance system serving several subdivisions in the Log Cabin/Cain Road area. Minor, low-costs efforts have been pursued to relieve the flooding impacts. An engineering report addressing the Log Cabin/Cain Road problem is scheduled for completion in early 1993.
- Minor conveyance system improvements in the Governor Stevens neighborhood located adjacent to Watershed Park.

#### Washington State Department of Transportation

Interstate 5 related improvements are as follows:

- An existing stormwater storage pond located north of the Plum Street off-ramp was retrofitted in 1992. Improvements were limited due to the topographic constraints of the site.