Miami River Watershed Assessment
and
Analysis of ODF Lands

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TABLE OF CONTENTS

List of Figures

List of Tables

1.0 INTRODUCTION

1.1 Purpose and Context

The Miami River Watershed Assessment and Analysis was developed in response to the Northwest Oregon State Forests Management Plan (ODF 2001, [FMP]). The project area, including the Miami River watershed and an adjoining frontal hydrologic unit was selected by ODF as one of a number of priority watersheds in western Oregon where analysis is to be conducted in support of objectives set forth in the FMP, and in support of Oregon Plan for Salmon and Watersheds (OPSW).

The FMP directs and guides management on State Forest lands administered by the Oregon Department of Forestry (ODF) in northwestern Oregon. One of the many objectives of the FMP is the conservation of aquatic and riparian resources, and the upland areas that directly influence them, as a means of assuring the long-term persistence of properly functioning habitat for riparian dependent species, particularly anadromous salmonids. Watershed analysis is a component strategy of that objective, and its overall goal is to determine if properly functioning conditions exist along streams that flow through lands administered by ODF (ODF 2004).

This study was prepared specifically for the ODF and is intended primarily for their use. Its purpose is to support ODF staff in their development of management strategies and implementation plans that promotes the attainment of a properly functioning aquatic and riparian network on Tillamook State Forest lands within the project area.

The processes, functions, and mechanisms integral to the aquatic and riparian systems that exist on ODF lands in the project area are the primary focus of this analysis. Conditions on ODF lands are emphasized because: 1) ODF is mandated by the FMP to analyze conditions on State Forest lands, 2), the FMP only applies to ODF managed lands, and 3) prior studies of the area did not address in sufficient detail information specifically useful for resource management and planning on ODF lands in the project area. However, watershed concerns often transcend ownership boundaries. Although the management of non-state lands is outside the scope of ODF's administrative authority, information about conditions on other ownerships is evaluated to discern if it is relevant to the conditions and management on ODF lands.

1.2 Methodology

This analysis follows the process outlined in subsection 7, Section 2 of the ODF's State Forest Program Watershed Analysis Manual (ODF 2004). In the manual, two distinct phases are identified, an assessment phase and an analysis phase. The former addresses historic and current conditions, inherent physical processes, and land use trends, while the latter addresses the relationships between existing conditions, select ecosystem functions, management goals, and desired conditions. The manual stipulates that the methodologies to be used should be compatible with those outlined in the Oregon Watershed Assessment Manual (OWEB 1999).

The ODF manual lists three sets of questions that are to be answered in each of the phases. Determining the answers to these questions provide the foundation and framework of the ODF analysis process. For the assessment phase, "OWEB Critical Questions" are to be answered. For both phases "ODF Supplemental Questions" are to be answered. For the analysis phase "Key Analysis Questions are to be answered. These questions along with their individual answers are listed in Section 5.0 of this document.

1.3 Prior Studies Relevant to this Project Area

In 1992 Tillamook Bay was officially nominated to EPA's National Estuary Program. Since then a number of studies and analyses similar or parallel to this effort have been conducted. Several have been broad-scale studies that address conditions across the entire Tillamook Bay watershed, which the Miami project area is tributary to. These are comprehensive studies that address a wide variety of resources, and provide an excellent and informative interpretation of intrinsic processes, existing conditions, and land use trends across the landscape. These studies include: An Environmental History of Tillamook Bay Estuary and Watershed (TBNEP 1996), Landscape Change in the Tillamook Bay Watershed (TBNEP 1997), and the Tillamook Bay Environmental Characterization (TBNEP 1998).

Similar but smaller scale assessments have also been conducted for some of the individual watersheds that are tributary to the Tillamook Bay Watershed, such as the Kilchis, Trask, and Wilson River watersheds which neighbor the Miami. One report in particular addressed conditions specific to the Miami River Watershed, and is titled the "Miami River Watershed Assessment" (E&S 2001). It was prepared for the Tillamook Bay Performance Partnership, which is a non-profit group dedicated to enhancing the estuaries and watersheds of Tillamook County. Using the methodologies outlined in the OWEB manual, the Miami River Watershed Assessment (E&S 2001) analyzed conditions relevant to aquatic and riparian resources, and concluded with a set of suggested restoration strategies. The assessment and analysis that follows however, is intended to be separate, even though it is similar and uses much of the information presented in the E&S study.

The assessment presented here differs from previous studies in several ways. First, the title of this document, "The Miami Watershed Assessment and Analysis," reflects the two-phase process directed by ODF's State Forest Program Watershed Analysis Manual. Secondly, the project area that study addresses includes not only the Miami River watershed, but also an adjoining hydrologic unit which contains the drainages of several small streams which flow directly into Tillamook Bay, but which are separate from any of the other primary tributary watersheds that have been studied previously.

Another notable difference between this effort and the previous work is the availability of several updated base data layers and newer aerial photo imagery. The streams layer database used for this effort is a smaller, finer scale than that used prior; thereby resulting in a stream network with significantly more stream miles, especially headwater tributaries. The division of hydrologic units is also different. This project recognizes fewer distinct hydrologic units compared to the E&S study (2001), resulting in a more uniform subwatershed size. Aerial imagery used for this iteration is also more recent, and included 2002 and 2003 high-resolution photos, which enabled a more refined mapping of vegetative cover that is more closely representative of locally recognizable patch characteristics.

Numerous other studies have also been conducted over the last twenty years in the Tillamook Bay area. They have addressed in detail a variety of select resources integral to Tillamook Bay, such as fisheries, shell fish, salt marshes, wetlands, and tide gates, to name a few. Many of these documents are housed in the Tillamook Estuary Partnership library.

In an attempt to minimize redundancy with previous studies of like kind, this project will incorporate and build upon the results of earlier efforts. New findings will be explicitly oriented to select conditions on specified lands.

2.0 PROJECT AREA OVERVIEW

Much of the general information in this chapter has been described previously in numerous other studies, and has been analyzed in detail before. The intended audience of this document, ODF staff, has a close familiarity with and prior knowledge of the project area. They are relatively well read about the basic physical and intrinsic characteristics of the Tillamook Bay and Northern Oregon Coast Region. Thus, for the sake of brevity and to limit redundancy, this section primarily addresses details considered essential to a general overview of the project area.

2.1 Setting and Physiography

The 28,037-acre project area is located approximately 60 air miles west of Portland on the northern portion of Oregon’s coast (Figure 1). It is situated along the northeastern shore of Tillamook Bay between the towns of Tillamook and Garibaldi on U.S. Highway 101; within it is contained the town of Bay City and the small unincorporated community known as Idaville. Its shape is roughly 12 miles long and 4 miles wide (Figure 2).

Situated within the Coast Range Physiographic Province described by Franklin and Dyrness (1973), the landscape in the project area exhibits both mountainous and nearly level terrain. Three distinct “ecoregions,” as described by OWEB (1999) are represented, volcanic uplands, coastal uplands, and coastal lowlands. The two upland ecoregions comprise most (93%) of the project area. They primarily consist of densely forested, heavily dissected, steep and rugged mountains that are separated by narrow confined valleys. The elevation rises from sea level on the western margin to a maximum of 2,778 feet on the ridge that defines the far eastern boundary. The lowlands that comprise the remaining 7 percent of the project area, are located in the far southwestern corner, and are typified as a fertile, broad, low elevation (<100 feet), gently sloping alluvial coastal plain.

The Miami River watershed is the smallest and northern most of the five primary watersheds that flow into Tillamook Bay. To the south are the Kilchis, Wilson, Trask, and Tillamook rivers. The Miami River valley is a major feature that bisects the project area. Its southwest to northeast trending axis between Garibaldi and the far eastern divide is about 11 miles long. The main valley is about 0.3 miles wide at its mouth, narrowing to several hundred feet far upstream. The portion of the coastal plain in the southwest corner of the project area is roughly three square miles in size, but extends outside the boundary to the south and east. Along the Bay, locally recognized landmarks include, from south to north: Kilchis Point, Goose Point, Sandstone Point, and Hobsonville Point. Most of the ridges and mountaintops in the project area are unnamed, but common labels on topographic maps include Doty Hill on the southeastern divide, and Crag Mountain and Foley Peak along a portion of the northern divide.

2.2 Basic Geology and Soils

The coastal lowlands consist primarily of fluvial and estuarine deposits. Soils that formed on these alluvial sediments are generally deep, and may be well drained or poorly drained. Textures vary from sand to silty clay loam, and surface horizons are relatively thick, dark, and rich. Near the bay, there are notable areas of organic peat soils associated with tidal marshes. The floor of the Miami River valley also consists of alluvium (OWEB 1999).

To the north and east, the low coastal plain transitions into the coastal uplands that occupy most of the western portion of the project area. These are underlain primarily by bedded sedimentary rock formations of relatively weak and highly weathered sandstone siltstone, and mudstone. Soils mantling the coastal uplands are generally moderately deep colluvium, and are well drained. Textures range from fine sandy loams and silt loams to silty clay loams. The volcanic uplands comprise the greatest proportion (64%) of the project area. They are underlain by thick basaltic igneous rock formations that locally are associated with the Tillamook Volcanics formations described by Wells et al (1994) and others. Soils that have developed are generally moderately deep to shallow, well-drained colluvium. Textures range from gravely to very rocky silt loams and loams. Rock outcrops are abundant (OWEB 1999).

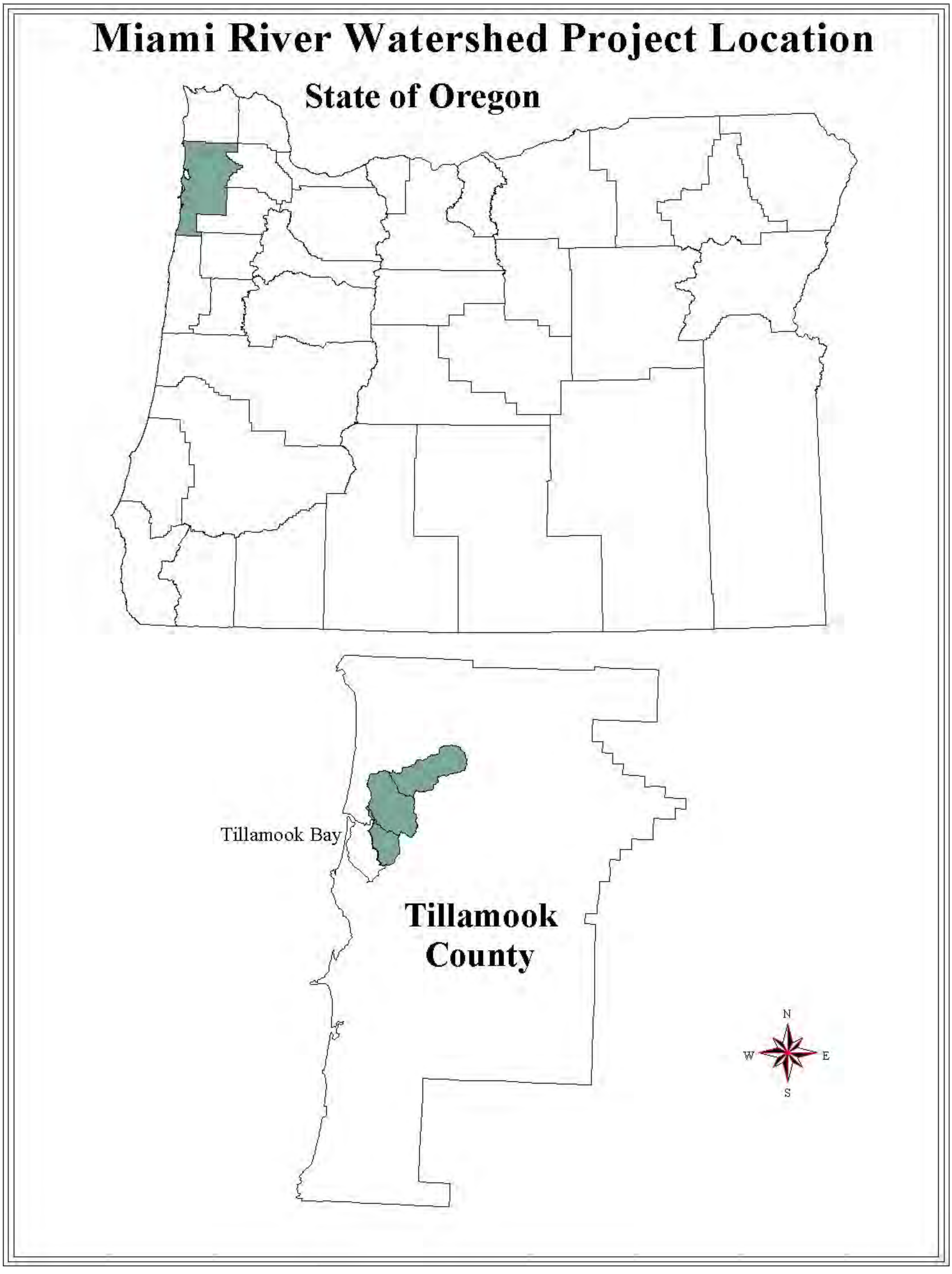

Figure 1. Miami River Watershed Location Map.

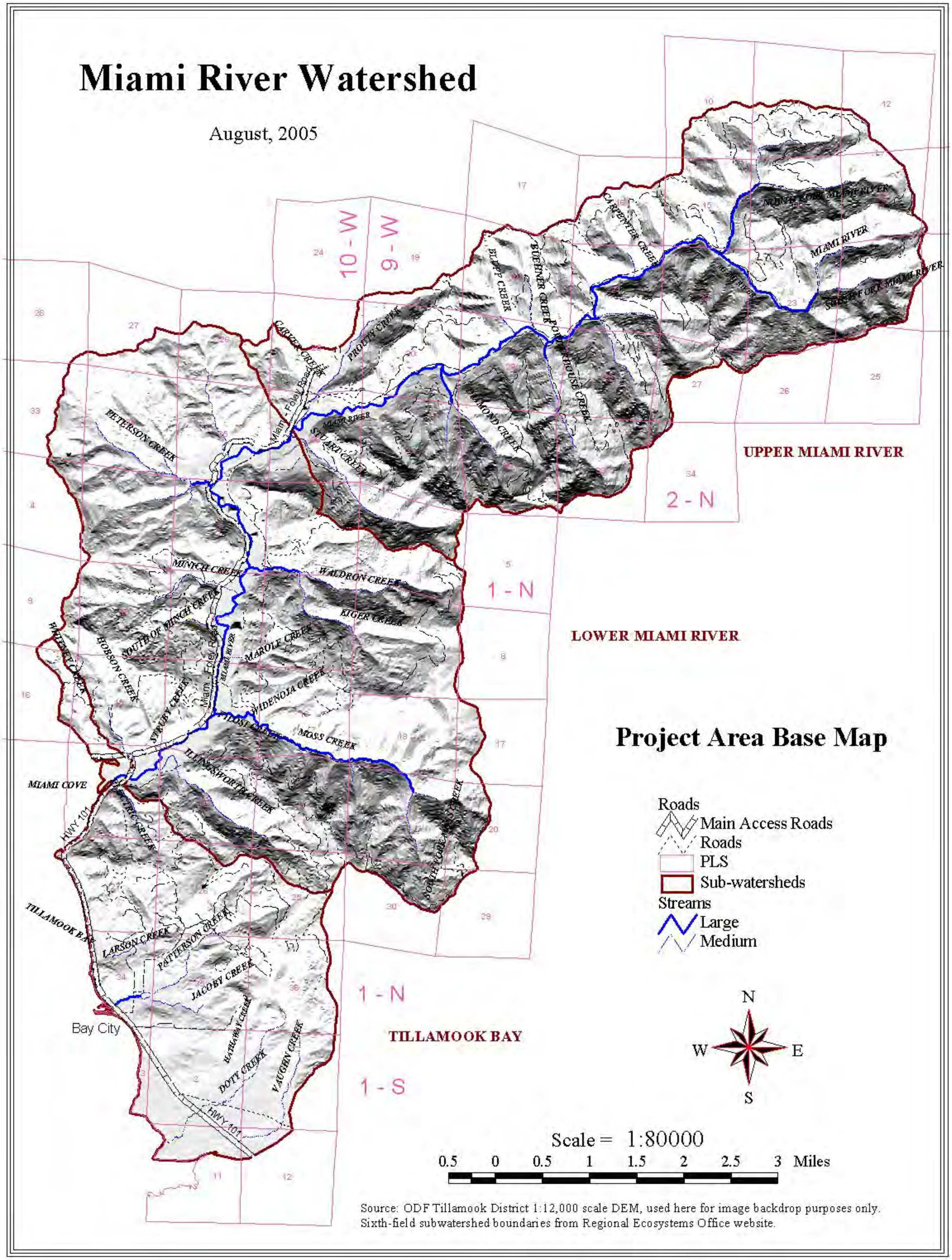

Figure 2. Miami River Watershed Project Area base map.

2.3 General Climate

The project area is typified as having a moderate climate. Marine effects from the Pacific Ocean greatly influence and tempers seasonal weather patterns that dominate the region. Winter is usually cool and wet; snow and freezing temperatures are only common at the highest elevations. Summer is fairly cool and moist. Relative humidity is nearly always high. The warmest, clearest days along the coast are generally in autumn. Every few years, abnormal temperatures occur, and even at the lower elevations there are several consecutive days with freezing temperatures in winter; while in summer a week or longer may become hotter than normal. Daily mean temperatures are cooler at the higher elevations (OCS 2005).

Average precipitation ranges between about 90 and 120 inches annually, increasing toward the eastern divide of the Miami Watershed to more than 140 inches (TBNEP 1998a). Most of the precipitation falls in winter, about 57 percent from November through February. Less than 10 percent falls in the summer months, although fog and drizzle are not infrequent (OCS 2005).

Since the majority (96%) of the project area lies below an elevation of 2,000 feet, average seasonal snowfall across most of the project area is usually only a trace or less. On average, less than one day per year has at least 1 inch of snow on the ground at elevations below 1,000 feet. Snow is more abundant at elevations of about 2,000 feet and above, where several inches accumulate occasionally (ODF/BLM 2003).

During the winter months, the storm track moves south from the Gulf of Alaska, usually bringing repeated strong, low-pressure weather systems to the Pacific Northwest. These storms, as well as those characterized as a “pineapple express”, often deliver periodic heavy rains to the region. During many years there are one or two storms that bring exceptionally heavy rains and damaging winds during the wet season. Resultant flooding often inundates low-lying areas. Thunderstorms are uncommon in the basin, although they are more frequent inland and primarily occur in the summer time (ODF/BLM 2003).

The direction of the prevailing wind is highly dependent upon season and location. In general, winds affecting the planning area are usually prevailing from the north during the summer and from the south and southwest in the wintertime, particularly during periods of stormy weather. Average annual wind speed is the greatest during winter along the coast. The strongest winds are nearly always from the south or southwest as a result of strong, cyclonic frontal systems that move across the coast from the Pacific. In most winters, one or two large-scale storms bring strong and sometimes damaging winds. Wind gusts of 70 to 80 mph are nearly an annual occurrence at exposed locations along the coast and ridgetops. Winds during the summer along the coast can become brisk and generate rough ocean conditions, but seldom attains speeds great enough to be damaging (USDA 1997).

2.4 Watersheds and Streams

A hierarchy of hydrologic units delineated by the USGS is recognized in the project area, which is comprised of two distinct and separate 5th-field hydrologic units (Figure 3). The largest is the Miami River watershed (USGS hydrologic unit code 1710020307), which accounts for about 82 percent of the entire project area, and drains approximately

23,034 acres. It is divided further into two similar sized 6th-field subdivisions identified as the Lower and Upper Miami subwatersheds (hydrologic unit codes 171002030702 and 171002030703 respectively). These divisions are different than those recognized in the existing Miami River Watershed Assessment prepared by E&S (2001).

The Miami River hydrologic unit exhibits a classic dendritic branching pattern. Numerous tributary streams flow into the mainstem river along its entire length. Each being fed by many smaller headwater, first- and second-order streams that originate above from the steep mountains. Names of some of the major streams include (listed in clockwise order from the mouth): Hobson, Struby, Minich, Peterson, Prouty, North Fork, South Fork, Powderhouse, Diamond, Stuart, Waldron, Moss, and Illingsworth. Based upon a stream map that was prepared for ODF at a scale of 1:12,000, about 83 percent of the total stream miles in the project area occur in the Miami River watershed (Table 1). Of these about 63 percent and 32 percent respectively flow through ODF and private industrial owned lands. The remaining 6 percent flow across lands designated as private non-industrial owners.

Table 1. Estimated Stream Miles by Owner Class in the Project Area.

Owner Class	Lower Miami	Upper Miami	Tillamook Bay	Total
Private Industrial	134	13	3	150
Private Non Industrial	23	4	56	83
State	62	232	36	330
Total	219	249	95	563

Source: ODF 2004

The other 5th-field hydrologic unit, which makes up the remaining 18 percent (5,003 ac.) of the project area, is distinctly separate from any of these primary rivers. It is situated between the mouths of the Miami and Kilchis watersheds. All of the streams within it flow directly to Tillamook Bay; none are tributary to any other stream. These streams originate from the low, steep mountains of the coastal highland and, in general flow parallel to each other individually to the bay. In this report, this “frontal” hydrologic unit is named the Tillamook Bay frontal subwatershed (USGS hydrologic unit code 171002030603), names of the major streams within its bounds include (listed north to south): Whitney, Electric Larson, Patterson, Doty, and Vaughn. About 17 percent of the total stream miles in the project area are located in the frontal hydrologic unit. Of these about 59 percent and 38 percent respectively flow through private non-industrial and ODF designated lands, only about 3 percent flow across lands identified as private industrial owners.

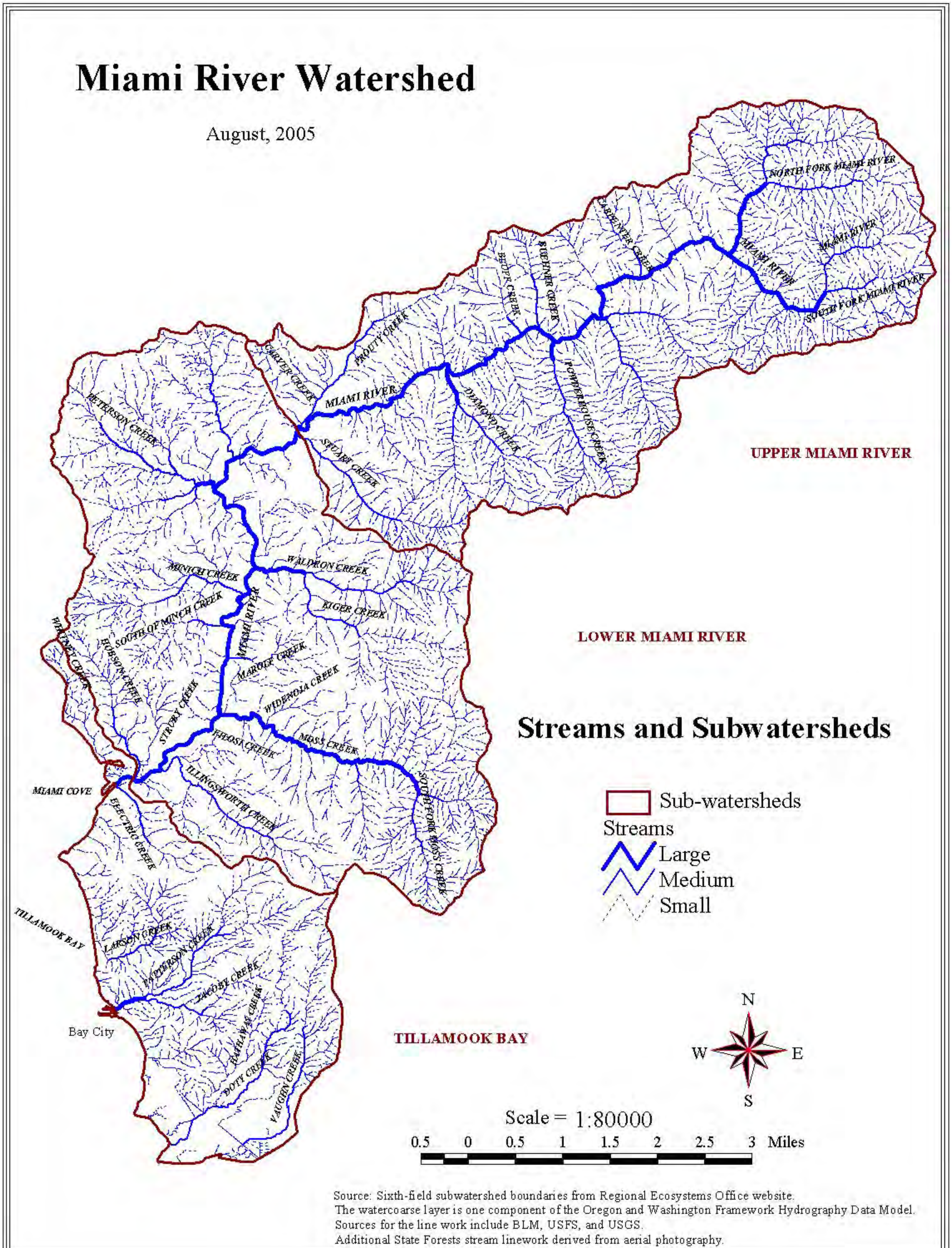

Figure 3. Streams and subwatershed boundaries for the Miami River Watershed Project Area.

2.5 General Ownership and Land Cover

Three owner classes recognized in the project area by this report include private industrial timberlands (PI), private non-industrial lands (PNI), and State lands. State lands comprise the largest (57%) owner class in the project area. All but 28 acres of these lands are within the officially designated Tillamook State Forest, the remainder is county land administered by the ODF. The majority (88%) of State lands in the project area are located within the Miami hydrologic unit, particularly within the Upper Miami where they comprise 92 percent of the subwatershed (Table 2). In comparison, private industrial timberlands amount to about 58 percent of the lower Miami subwatershed, while state lands account for about 32 percent. Within the Tillamook Bay frontal subwatershed, where urban, rural residential, and agricultural land uses are dominant; private non-industrial owners account for the greatest percentage of area (57%). State lands amount to nearly 40 percent of the Tillamook Bay frontal subwatershed.

Table 2. Acres by Ownership Category and Subwatershed

Owner Category	Lower Miami	Upper Miami	Tillamook Bay	Total
Private Industrial	6,979	616	165	7,760
Private Non Industrial	1,288	233	2,862	4,382
State Admin. Lands	3,788	10,181	1,976	15,894
Total	12,004	11,030	5,003	28,037

Source ODF 2004a.

Natural resource management and timber production are the dominant land uses across the majority of the project area (92%). Agricultural, rural residential, and urban land use account for slightly less than 8 percent of the entire project area, and represent most of the non forest areas. Most non-forest areas are privately owned, and are located in the southwest half of the Tillamook Bay frontal subwatershed and the floor of the Miami River Valley. It is estimated that roughly one percent of State lands are non-forest (i.e., rock outcrops, brush in right-of-way corridors).

The majority (91%) of the project area consists of a forested cover; the remaining nine percent is non-forest. Two major potential vegetation zones, as described by Franklin and Dyrness (1973) comprise the forested portion: the Sitka spruce zone and the western hemlock zone. The portion of the project area that is within the coastal lowland ecoregion is dominated by the Sitka Spruce zone, while both zones are represented in the coastal uplands ecoregion. The volcanic uplands ecoregion that occurs in the project area is dominated by the western hemlock zone.

The Sitka spruce zone occupies the lowlands, drainage bottoms, and lower hillslopes in the project area below about 450 feet (about 20% of the total area). More than half of the zone is in private ownership, and includes significant areas converted to a non forest status where agricultural, rural residential, and urban land uses prevail, particularly across the low coastal plain in the southwestern corner of the project area and in the main Miami River valley. Within the low coastal plain, there are also notable patches of naturally occurring non-forest, such as grass meadows, wetlands, and tidal marshes along the margin of the bay.

The Sitka spruce zone transitions into the western hemlock zone, which locally occupies higher ground and accounts for roughly 80 percent of the project area, mostly in the Miami subwatersheds. About 95 percent of this zone is on ODF administered lands or privately owned industrial timberlands where natural resource and timber management are the predominant land uses.

3.0 HISTORICAL CONDITIONS

Much has been documented and reiterated portraying the environment in its pre-settlement context in the Tillamook Basin and its tributaries (E&S 2001, E&S 2001a, ODF/BLM 2003, TBNEP 1998, TBNEP 1998a, TBNEP 1997, TBNEP 1996). Indigenous local populations and cultures have been comprehensively addressed in these previous studies, as have patterns of Euro-American settlement and land use, and the historical condition of natural resources. However, much of this information is more regional in context, so there is little that pertains specifically to ODF lands in the project area. To minimize redundancy, this section incorporates by reference the previous cited studies and omits reiterating too much of that which is not specific to local aspects of the project area. It is intended to be a brief section, so narrative is minimal and the salient points are presented as simple bullet statements for quick review.

3.1 Historical Vegetative Cover

- The dominant stand-age class for the Miami watershed in 1850 is estimated to have been older than two hundred years. Early landscape maps of 1856/1857 indicate that the uplands in the project area were heavily timbered. (TBNEP 1996). Early surveyor notes make repeated references to the abundance of hemlock and spruce in the understory, potentially indicating late-seral conditions (ODF 2004c). It is inferred that these conditions prevailed across most of the present day ODF lands.

- The 1856/1857 landscape maps indicate that the Miami valley bottom was comprised of “first rate” stands of timber with dominant conifers being spruce, hemlock, cedar, and yellow fir (i.e., Douglas-fir). A similar patch of forest cover was mapped in an area proximally located between Doty and Hathaway Creeks in the frontal subwatershed (TBNEP 1996).

- On the coastal lowland in the proximity of Bay City and in the Larsen Creek drainage, as well as the area between Doty and Vaughn Creeks, the 1856/1857 map depicts broad meadows, prairies, and wetlands. Along the margin of the bay between Bay City and the mouth of Vaughn Creek, patches of dense scrub and shrub were mapped that were interspersed with wet meadows, tidelands, and sloughs (TBNEP 1996). It is documented that the local culture in the area commonly used fire as a “land management tool” to create and maintain meadows on the coastal lowlands in the area.

- By 1890, large patches on both the lowlands and uplands in the frontal subwatershed had been logged. Much of the lowlands had been converted to pasture for rural and agricultural land use. Lower reaches of the Miami valley had also been logged. By 1920, cleared forestland patches had expanded somewhat, extending across most of the frontal subwatershed and up the lower half of the Miami valley to Prouty Creek. However, much of the upper half and interior portions (present-day ODF land) of the Miami watershed were not extensively cut over, and the eastern two-thirds of the project area was still generally intact (TBNEP 1996).

- The eastern half of the Miami watershed burns in the 1933 fire, and again in the 1939 fire (Fick and Martin 1992). By 1940, the majority of the project area, including present-day ODF land, had been burned or cutover, and the predominant forest stand age-class was less than 50 years old (TBNEP 1996). There are very few large, contiguous, remnant patches of old forest structure on ODF lands in the project area. Most remnant trees in the project area are located on ODF land, and occur as small isolated stands within larger patch types along the valley bottom margins of the upper Miami River and its tributaries. It's estimated that about 2% of ODF lands are comprised of patches greater than 130 years old in the project area. All are located in the portions of the upper Miami that didn't burn.

3.2 Inherent Disturbance

- It is well documented that large storms and intense precipitation events are a frequent occurrence in the Coast Range. They are the primary disturbance mechanism that causes flooding and heavy runoff, which often leads to landslide and stream channel (fluvial) erosion. Landslide and fluvial erosion are considered to be the dominant inherent erosion processes in Coast Range basins such as the Miami project area (TBNEP 1998).

- The preponderance of steep slopes, shallow soils, highly weathered rock formations, along with the seasonally wet climate combine to make unstable slopes a common naturally occurring condition in the project area. Shallow, rapidly moving landslides are the dominant hillslope erosion process. Their occurrence is nearly always associated with winter storms when soil moisture is greatest (Harr and Yee 1975). The steep and very steep slopes that are prominent in the drainages of the upper Miami subwatershed, and those in the Moss, Illingsworth, Stewart, and Kiger drainages are notably susceptible.

- Inherent rates of erosion and sedimentation in the Coast Range are well documented to be relatively high naturally, and the background rate of sedimentation is highly variable. Post-fire increases in the rate of inherent surface and landslide erosion in western Oregon can be significant after large, intense fires. In the portion of the upper Miami subwatershed that was burned over by the Tillamook fire of 1933, and again in 1939, it is inferred that for a time sediment inputs increased substantially above background rates. Logging practices and road construction customary for that time period were not expressly intent on minimizing sedimentation compared to current day standards, so subsequent salvage of fire killed timber likely exacerbated accelerated erosion further, particularly in the South Fork.

- For the 22-year period of record between 1973 and 1995 on the Miami River, the five largest peak events occurred in 1977, 1983, 1986, 1990, and1994. For

Patterson Creek in the frontal subwatershed, the five highest peaks for the 17-year period of record between 1952 and 1968 occurred in 1953, 1955, 1961, 1964, and 1965. The flood of 1996 was another event of significance that affected the Miami watershed. It spawned heavy runoff and a number of landslides that caused considerable damage, particularly to roads (per. comm. K. Mills 2005).

- High winds are another frequent, natural disturbance agent in the Coast Range. Wind gusts approaching 100 miles per hour occur in most years, usually during winter. Extreme damaging winds have been recorded in nearly every decade since 1900 (TBNEP 1998). While specific records of localized wind damage on ODF lands in the project area are not known to have been assembled, the most recent and damaging wind storms that are likely to have affected the project area occurred in 1962, 1963, 1967, 1971, 1981,1995, and 2002 (NOAA 2005).

- There is evidence of large fires in the northern Coast Range as long ago as the 1600s. Some of the earliest documented landscape-scale fires that occurred in 1845 and 1868 originated in the Willamette Valley and Clatsop County respectively. The 1868 fire is believed to have burned into the northwestern portion of the watershed in the headwater areas of Minich and Peterson Creeks. While the cause of those fires is uncertain, it is believed that historic fires in the northwest Coast Range may be as equally associated with starts from lightning or humans (TBNEP 1996 and 1998). Much of the frontal subwatershed and the majority of the eastern half of the Miami watershed have been affected by human caused wildfire.

- There are a variety of forest pathogens that are disturbance agents in the Coast Range. In particular, a high incidence of Swiss Needle Cast became prevalent in the early 1980’s in the Tillamook Burn. The infection continues to spread. As a result, the majority of Douglas-fir dominated stands on ODF lands in the upper Miami subwatershed have become infected to various degrees (ODF 2001 and 2003).

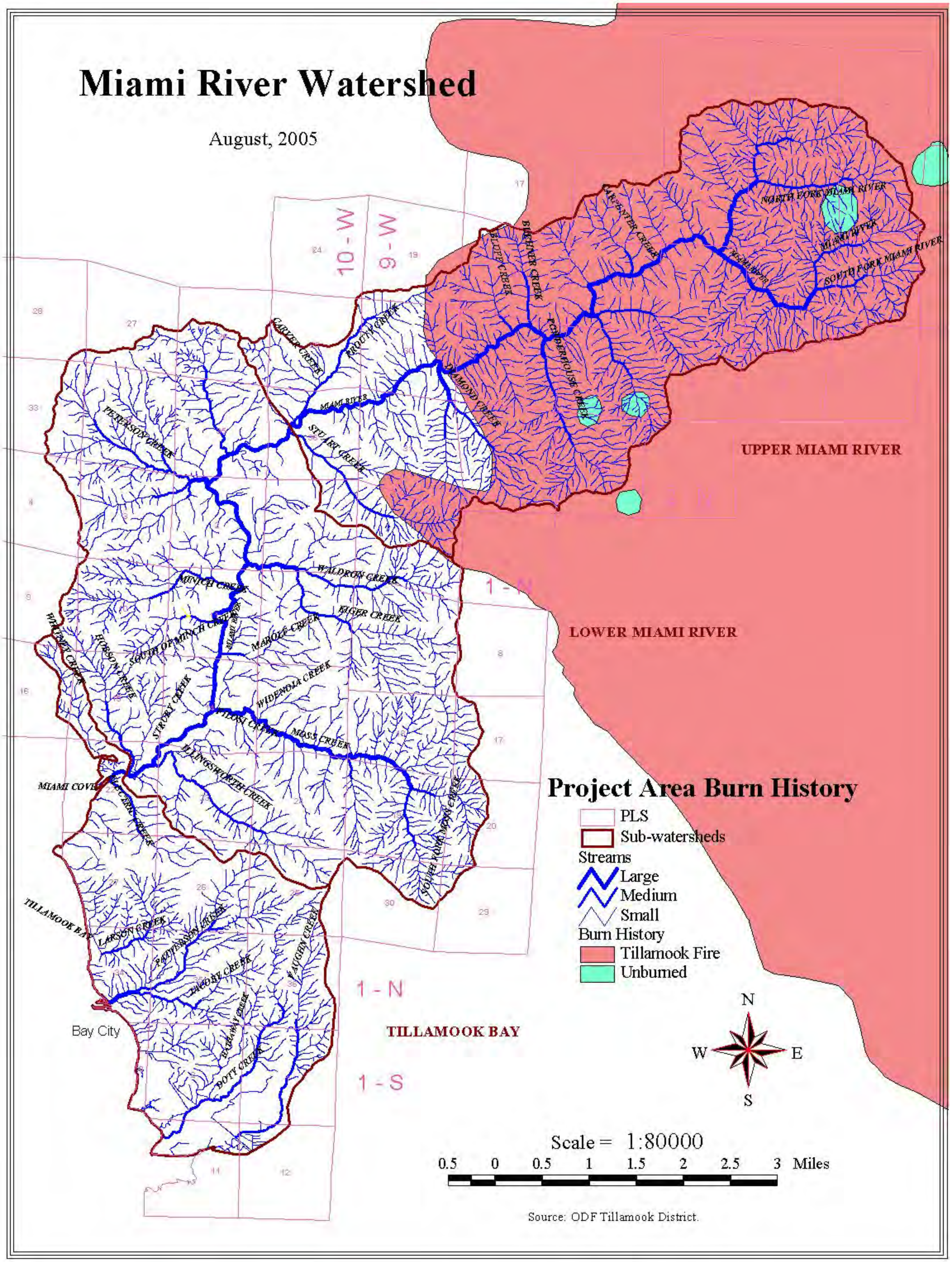

Figure 4. Burn history of the Miami River Watershed Project Area.

3.3 Historical Land Use and Human Disturbance

- Early landscape maps and anecdotal accounts make reference to semi permanent villages near the mouth of Patterson and Vaughn Creeks, and along the Miami estuary, suggesting that local indigenous peoples inhabited the coastal lowlands of the project area year-round prior to Euro-American settlement (TBNEP 1996). Meander survey notes from 1856 stated that the Miami valley was uninhabited.

- Early explorers made documented visits to Tillamook Bay in the 1780's. By the early 1850's Euro-Americans began settling on the coastal lowlands. By 1900, donation land claim settlements resulted in nearly all the shore adjacent lands on the coastal lowlands to become privately owned (TBNEP 1996).

- Surveyor notes from 1873 and 1884 noted fire-killed trees in the vicinity of the middle reaches of Patterson and Jacoby Creeks and near the project area boundary south along the middle reaches of Vaughn Creek. Small-scale human-caused fires in the frontal subwatershed where population centers were concentrated were likely somewhat frequent in both pre- and post-settlement times (ODF 2004c).

- Commercial logging to supply local mills started in the early 1860s, when sawmills began to operate at the mouths of the major rivers and in the primary valleys in the basin. A mill was located at Hobsonville Point near the mouth of the Miami, and operated from about 1883 to 1907 under various ownerships. Another mill operated in Bay City between 1879 and 1900 (pers. comm. D. Clough 2005, TBNEP 1996).

- Log transport down rivers via log drives and splash dams is documented in neighboring watersheds during the early days of logging, however, none is known to have occurred on the Miami River (TBNEP 1996).

- Farming and logging are the primary industries by 1900, and the conversion of land for urban, rural, and agricultural uses becomes widespread. The first water districts become established and wetlands are drained. In the early 1900s, roads are constructed up the major river valleys (such as the Miami), which are the easiest routes into the interior reaches (TBNEP 1997).

- The development of dikes, levees, and tide gates become common practice in the early 1900's. Affected streams in the project area include the lower reaches of Doty, Hathaway, Patterson and Vaughn Creeks, as well as the Miami River estuary. The construction of tide gates continued into the 1960s, and dike construction continued into the 1980's (TBNEP 1996).

- In 1911 the railroad between Tillamook and Portland was completed. It is located along the shore of the frontal subwatershed and crosses every major tributary in the project area including the mouth of the Miami River. In a related anecdote, railroad logging is known to have occurred in the Larsen Creek drainage (pers. comm. D. Clough 2005).

- Between 1900 and 1933, it is estimated that roughly 9% of those lands currently administered by the ODF had been harvested in the project area (ODF 2005). While there are no known records of harvest on non-ODF lands during this time period, private industrial owners had moved into the watershed. By the end of this period, the main Miami River road extended to about Diamond Creek. During WW I, harvest of Sitka spruce for military aircraft was a primary focus.

- Acquisition by the State and County of private timberlands in the project area occurs between 1925 and 1949. In 1973 these lands are included in the newly established Tillamook State Forest. Early management emphasis was focused toward fire control, salvage logging, and reforestation objectives (Fick and Martin 1992, ODF 2001).

- An estimated 75% of the Miami watershed burned in the 1933 Tillamook Burn (ODF 2004a). Portions burned again in the 1939 fires (Fick and Martin 1992, TBNEP 1996). The upper half of the Miami from the eastern divide to Diamond Creek was affected (Figure 4).

- Post Tillamook burn salvage logging in the Miami watershed started in 1937 and continued at a high-level until 1941. Nearly all of the post-fire salvage was completed by 1959 (Fick and Martin 1992, TBNEP 1996).

- Most roads on ODF lands in the upper Miami subwatershed were constructed during the period between 1937 and 1960. The main Miami River road extending up into the North Fork and the South Fork road were constructed in the 1940's to access fire-killed timber; and the Foley Peak and Fire Break 3 roads were constructed in the 1940's and 1950's for timber salvage and fire control. Most of the road system on ODF lands in the project area is in place by 1950. Seeding and reforestation programs were ongoing between 1949 and1970 and included the eastern portion of the Miami watershed (Fick and Martin 1992, TBNEP 1996).

- Between 1933 and 1960, it is estimated that roughly 50% of those lands currently administered by the ODF had experienced some form of timber harvest (including post-burn salvage). Most occurred in the upper Miami subwatershed (ODF 2005).

- Dams for municipal water use for the town of Garibaldi were constructed up Electric Creek in 1953 and Struby Creek in 1955. Both reaches were considered to be too steep for salmon spawning (ODF 2004b).

- To protect the main Miami River haul route, dikes were constructed to close off several side channels of the river near the confluence with Powderhouse Creek in 1958. Channelization of the mainstem river between Diamond and Powderhouse Creeks is also carried out as a measure to protect the road from high water (ODF 2004b).

- A cat road was routed up a lower reach of Stuart Creek. In places it was directly in the channel, or immediately next to it. A considerable degree of channel disturbance was noted (ODF 2004b). Bridge construction work on the Miami River that occurred in the early 1950's between Prouty Creek and the confluence of the North and South Forks, resulted in heavy equipment operating directly in the main channel of the Miami River (pers. comm. D. Clough).

- Stream cleanout was a common practice to protect fish until 1976. Anecdotal evidence from biologist notes in the early 1950's suggests that logging debris as well as any other remnant LWD such as log jams was removed from reaches of No Name Creek, Peterson Creek, the upper Miami mainstem, the South Fork, and the North Fork (ODF 2004b).

- A comparatively minor degree of gravel mining occurred periodically during the 1960's and 1970's, primarily along the mainstem of the Miami River near the mouths of Peterson and Stuart Creeks (pers. comm. D. Clough 2005, ODF 2004b).

- Between 1960 and 1980, roughly 43% of those lands currently administered by the ODF underwent some form of timber harvest. Most occurred in the upper Miami, but harvest in the lower Miami was also prevalent (ODF 2005).

- Since 1980, it is estimated that about 9% of ODF lands in the project area have undergone some form of harvest. Most has occurred in the lower Miami subwatershed. The first commercial thinning harvests in the Miami began in the mid 1980's (ODF 2001 and 2005).

3.4 Historical Fish Populations and Distribution

There is little known data specific to the project area that characterizes the abundance and distribution of fish. However, a summary of basin-wide study findings for Tillamook Bay conclude some general historical trends that are inferred to have affected populations in the project area:

- Commercial gillnetting to support commercial canneries began in the late 1800's in the bay (TBNEP 1998).
- The first fish hatcheries in the basin appeared in the early 1900's (TBNEP 1998).
- Hatchery releases peaked between the mid 1920's and late 1940's (TBNEP 1998).
- General declines in the salmon catch were noticed in the1930's (TBNEP 1996).
- Significant declines in the salmon catch were first observed in the1940's, and poor returns were recorded throughout the1950's (TBNEP 1998).
- Tillamook Bay was closed to commercial fishing in 1961 (TBNEP 1998).
- With the exception of fall Chinook salmon, populations of all other anadromous salmonids in the Tillamook basin have declined significantly over the last 100 years (TBNEP 1998).

Current fish distribution in the project area is estimated to be similar to historic distribution (ODFW 2005). Historical habitat conditions are not well documented. However, there are anecdotal notes from stream survey reports that were conducted in the Miami watershed in the early 1950's that provide a snapshot glimpse of relative conditions at that time (ODF 2004b). Some of the more salient items specific to reaches in the project area are listed below.

- Sightings of coho fry, fingerlings, and trout were observed in the lower reaches of Diamond, Illingsworth, Minich, South Minich, Moss, No Name, Prouty, Stuart, and Stewart Creeks; as well as the mainstem Miami between Stuart Creek and the confluence of the North and South Forks. Steelhead and Coho had been observed spawning by a local resident in Stuart Creek. Local workers observed adult "dog" (chum salmon) and Coho migrating up Prouty Creek. Stocking of hatchery fish was conducted in the upper Miami subwatershed in 1952. A culvert barrier on Illingsworth Creek was observed just upstream from its mouth.

- Descriptions and locations of in-stream woody debris in survey notes:
  - A large log jam packed with gravel is observed in the middle reach of Diamond Creek.
  - Several small woody debris jams are observed in Stuart Creek.
  - A small jam was located in the middle reach of Stewart Creek.
  - One of the main tributaries to Peterson Creek has a large jam in its lower reach.
  - There were seven very large, dense jams packed with gravel in the middle and upper-middle reaches of Moss Creek.
  - A number of beaver dams were observed in Moss and Peterson Creeks.
  - A small jam was noted in the middle reach of Minich Creek.
  - Two large jams in No Name creek were removed during stream cleanout activities.

- Select substrate descriptions by reach in the survey include:
  - Of the surveyed tributaries to the Miami, fines were observed in lower Stuart Creek, the lowest reaches of Illingsworth and Peterson Creeks, and in lower South Minich Creek.
  - Quality spawning substrate was observed in Prouty Creek, in the lower-middle reach of Illingsworth Creek, the lower-middle reach of Moss Creek, and the main tributaries to Peterson Creek.

- Survey notes pertaining to the mainstem Miami between Prouty Creek and the confluence of the North and South Forks:
  - Lower reach between Prouty and Powderhouse Creeks comprised of excellent spawning gravels.
  - There are two very large jams in the lower reach, one of which has a spillway cut into the middle for fish passage.
  - The upper reach from Powderhouse to the main forks has an estimated 20% of fines in the substrate. The fines are attributed to active logging operations near the confluence of the main forks.
  - There are two very large jams in the upper reach. One is a large deposit of logging-related debris, which is noted as muddying the water; the other is noted as being an “old” jam.

- Survey notes and observations of the South Fork:
  - The surrounding hillslopes have been burned-over and logged. The only trees noted are a few widely spaced, small alders.
  - Fine sediment is estimated to comprise 10% of the substrate in all reaches.
  - There are several large deposits of logging-related debris, loose dirt, and rock in the main channel of the South Fork and its main contributing forks. The water is turbid immediately below these deposits
  - No fish were observed while surveying the South Fork.

- Survey notes and observations of the North Fork:
  - Hill sides are not as heavily burned or logged as the S. Fork, alder, maple, and fir abundant.
  - Substrate is comprised of an estimated 5-10% fine sediment in all reaches. Good spawning gravel is noted in the lower reaches, but the middle and upper reaches are dominated by large, coarse substrate.

- Six large jams with lots of logs and stored gravels were observed in the main channel and its two primary contributing forks.
- Coho fry, fingerlings, and trout are observed in lower and middle reaches where flow is perennial.

4.0 CURRENT CONDITIONS

Current information and relevant data have been compiled and summarized for Tillamook Bay and in the Miami River watershed, specifically (TBNEP 1998, TBNEP 1996, E&S 2001). This assessment incorporates these documents by reference. This assessment differs from the E&S study (2001) in that stratification of the data was performed at different subwatershed divisions. Therefore, similar data items presented in both documents may differ. This assessment focuses on summarizing information in preparation for the subsequent "analysis" phase, which will provide the rationale for basing management recommendations, and identifying restoration opportunities on ODF administered lands in the Miami River Watershed and adjacent frontal subwatershed.

4.1 Streams and Channel Types

Using a 1:12,000 scale GIS coverage obtained from ODF (2004), it is estimated that there are 563 miles of stream in the project area. All three Forest Practices Act (FPA) stream size categories are present. Large category streams such as the upper middle reaches of the Miami River (Table 3) account for about 3 percent of the total stream miles. Medium size category streams such as the lower reaches of Doty Creek account for about 5 percent. Typical of the highly dissected terrain and drainage of the Coast Range, the remaining 91 percent of total miles are categorized as small streams; all are small first- and second-order headwater streams. The "duration" attribute item in the GIS coverage designates about three-fourths of the small stream segments as intermittent (seasonally flowing).

Table 1. Percent of Total Stream Miles Stratified by Forest Practice Act Size Category and Flow Duration Descriptor.

FPA Stream Size	Intermittent	Perennial	Total
Large	0%	3%	3%
Medium	0%	5%	5%
Small	75%	17%	91%
Total	75%	25%	100%

Source: ODF 2004a

Using the methodology described in the Oregon Watershed Assessment Manual (OWAM), mapped streams in the project area have been further categorized into Channel Habitat Types (CHTs) as a means of characterizing stream morphology. CHTs were originally identified for the Miami hydrologic unit in the E&S 2001 Miami Watershed Assessment. Since then, a more detailed stream network has been mapped, leading to an extension of the original channel typing (Figure 5).

Table 4 lists the eleven distinct CHTs that have been mapped in the project area and describes their general characteristics. They differ primarily by size, channel gradient, and valley confinement. These factors relate to the general responsiveness of a stream to adjust to changes or alterations in the supply of sediment, wood, and high flows as a consequence of natural disturbance or human influences (OWEB 1999).

Analogous with the FPA size categories previously discussed, the majority (90%) of CHTs recognized are small, steep, and confined channels indicative of the mountainous terrain, the steepest of which are prone to shallow, fast moving debris slides and flows. The majority (63%) of these channel types is located on ODF lands. In comparison, low and moderate gradient, unconfined, and moderately confined sensitive channel types comprise only about 9 percent of the miles mapped. Most (86%) are located on non-ODF lands, only 14 percent occur on ODF lands. Table 5 displays the distribution of mapped CHTs in the project area.

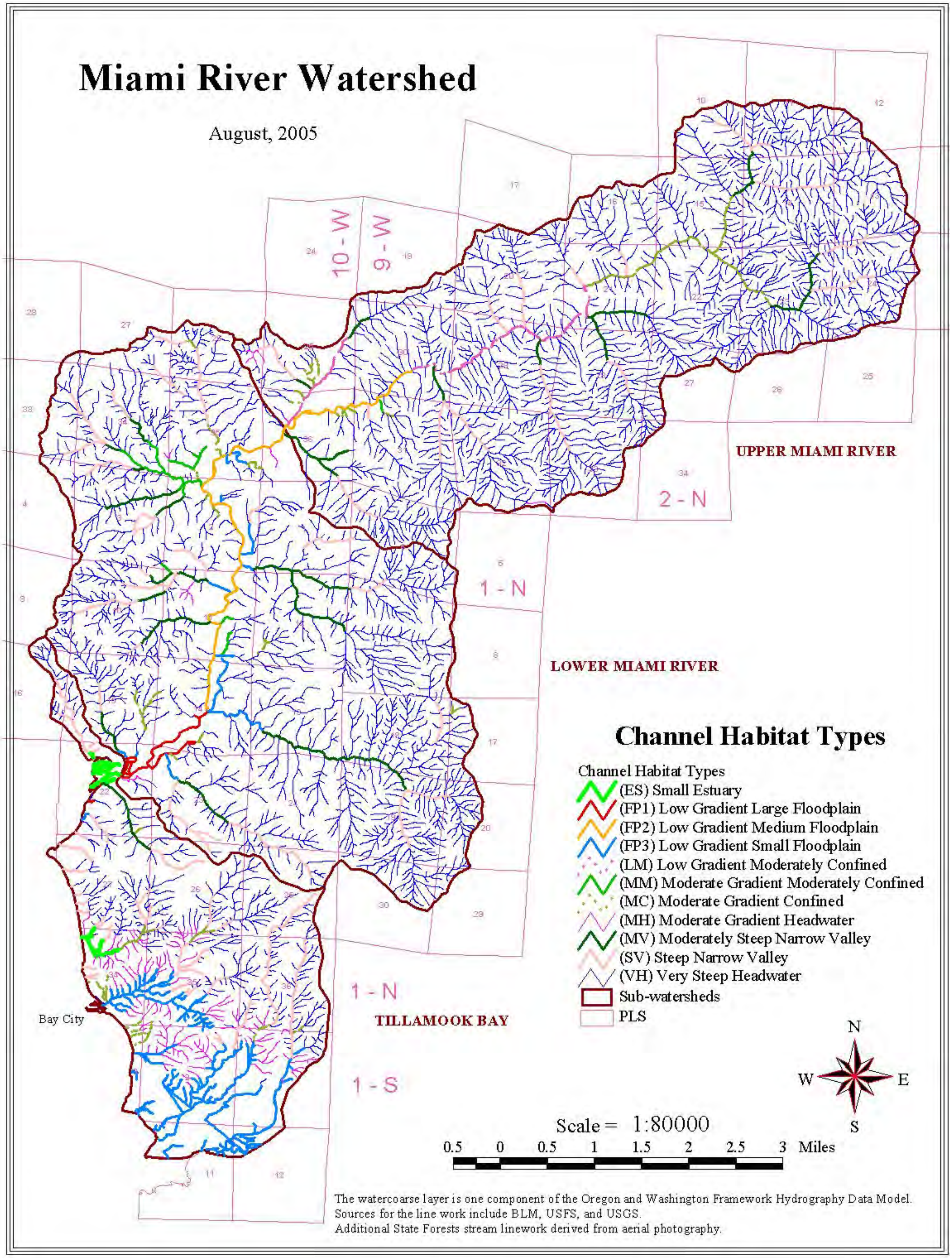

Figure 1. Channel habitat types for the Miami River Watershed Project Area.

Table 2. List of OWAM Channel Habitat Types Identified in the Project Area.

OWAM CHT Code	Description of Characteristics in Project Area	Disturbance Sensitivity
ES	Small Estuary – large sized stream, small river, low gradient (<2%), unconfined, and tidally influenced (ex. Mouth of Miami River).	Moderate
FP1	Large sized stream, small river – large, wide floodplain ($\geq$4x bankfull width), low gradient (<2%), unconfined (ex. lower Miami River).	High
FP2	Medium to large size stream – flood plain width 2x bankfull width, low gradient (<2%), unconfined (ex. middle reaches of Miami River).	High
FP3	Small to Medium sized stream with narrow floodplain, low gradient (<2%), unconfined (ex. lower reaches of Doty Creek).	High
LM	Small to large size stream - low gradient (<2%), moderately confined (ex. mid-upper reaches of Miami River).	Mod. to High
MM	Small to large size stream – moderate gradient (2-4%), moderately confined (ex. lower and mid reaches of Peterson Creek).	Moderate
MC	Small to large size stream – moderate gradient (2-6%), confined (ex. mid-upper reaches of Miami River).	Moderate
MV	Small to medium size stream – moderately steep (3-10%), confined narrow valley (ex. middle reach of Moss Creek).	Moderate
MH	Small streams – moderate gradient (2-6%), confined (ex. headwater tributaries to Jacoby and Patterson Creeks).	Low
SV	Small stream – steep gradient (8-16%), confined narrow valley (ex. upper Vaughn Creek).	Low
VH	Small stream – very steep gradient (>16%), confined narrow headwater valley (ex. upper most tributaries to middle reach of Moss Creek).	Low

Source: OWEB 1999

Table 3. Distribution of Channel Habitat Types in the Project Area

CHT Code	Total Stream Miles	Channel Miles by Subwatershed and Owner Class (nearest mile)								
		Lower Miami			Upper Miami			Tillamook Bay		
		PI	PNI	State	PI	PNI	State	PI	PNI	State
ES	2	0	0	0	0	0	0	0	2	0
FP1	3	0	3	0	0	0	0	0	<1	0
FP2	7	<1	5	<1	0	<1	1	0	0	0
FP3	22	0	4	0	0	0	0	0	18	0
LM	5	0	0	0	0	1	3	0	1	0
MC	10	1	1	<1	0	<1	4	0	2	1
MH	19	<1	<1	<1	<1	<1	<1	<1	15	2
MM	3	2	1	<1	0	0	<1	0	0	0
MV	15	5	1	3	0	<1	5	0	<1	1
SV	32	9	<1	2	<1	<1	8	<1	6	5
VH	443	116	8	56	12	1	211	3	11	27
Total	563	134	23	62	13	4	232	3	56	36

Key: PI = Private Industrial, PNI = Private Non Industrial, ES Small Estuary, FP1=Low Gradient Large Floodplain, FP2=Low Gradient Medium Floodplain, FP3=Low Gradient Small Floodplain, LM=Low Gradient Moderately Confined, MM=Moderate Gradient Moderately Confined, MC=Moderate Gradient Confined, MH=Moderate Gradient Headwater, MV=Moderately Steep Narrow Valley, SV=Steep Narrow Valley, VH=Very Steep Headwater

Sensitivity ratings in Table 4 are an indicator of the relative sensitivity of a particular channel type to disturbance. The ratings are useful for predicting the location, type, and magnitude of effects to channels that could be expected in response to land use activities; and for identifying where potential restoration opportunities might prove most beneficial. Channel habitat types with a disturbance sensitivity rating of high are considered to be ”sensitive.” Sensitive stream reaches often comprise the habitat characteristics important to the presence of anadromous fish, such as quality pools, juvenile refugia, and spawning areas.

Approximately 37 miles of stream in the project area are considered to be sensitive to disturbance (Table 6). The most sensitive CHTs identified in the project area include the low gradient reaches of the main stem Miami River that extend from its mouth upstream to about Foley Peak Road. Also included are the lowest reaches of the Miami's small and medium sized tributaries in the lower subwatershed, which enter from the adjoining narrow mountain drainages onto the gentle valley floor. Eighty-four percent of the sensitive reaches in the project area are located on non-ODF land in the Lower Miami and Tillamook Bay subwatersheds. There are five miles (14%) of sensitive reaches that occur on ODF lands. They are all located in the Upper Miami subwatershed and extend from Prouty Creek up to Foley Peak Road.

In the Tillamook Bay subwatershed, sensitive reaches are located where the majority of agricultural, rural residential, and urban land use occur. These reaches include the lower portions of Patterson, Jacoby, Doty, and Vaughn Creeks that flow across the gently sloping coastal lowland.

Table 4. Distribution of Sensitive Stream Reaches in the Project Area

	Percent of Sensitive Reach Miles By Subwatershed and Owner Class (nearest mile)								
Total Stream Miles	Lower Miami			Upper Miami			Tillamook Bay		
	PI	PNI	State	PI	PNI	State	PI	PNI	State
37	<1	12	<1	0	1	4	0	19	0

Field reconnaissance was conducted to validate the accuracy of the CHT mapping and the extent and location of sensitive reaches. Approximately sixty locations in the field were sampled. At seven (about 12%) of these locations, the mapped CHT was different from what was observed. Based on these observations, the mapping was then revised to improve its accuracy.

4.1.1 Channel Modifications

The majority of distinctly prominent channel modifications in the project area are currently located in the Tillamook Bay frontal subwatershed, where the greatest degree of land conversion has occurred as a result of agricultural, rural residential, and urban development over the past 150 years (Figure 6). These include all of the low and moderate gradient reaches of Patterson, Jacoby, Doty and Vaughn Creeks. Also included are the lower and middle, low gradient reaches of the Miami River, where once forested valley-bottom has been converted to agricultural and rural residential land.

It is estimated that roughly 8 percent (43 miles) of the total stream miles in the project area have been prominently modified. Nearly all (90%) of these channels are located on non-ODF lands. Thirty-six of the thirty seven miles of sensitive stream reaches in the project area have been modified. About four and a half miles of channel are modified on ODF lands. They include portions of the sensitive reaches on the upper Miami, and the lower reach of the North Fork. One other includes the middle reach of Moss Creek. All are associated with roads that encroach upon the river's channel and have been identified in the roads condition inventory that is presented in following sections of this report.

There are many different types of channel modification in the Tillamook Bay frontal subwatershed. The wealth of information addressing the development of the low coastal plain indicates that such modifications are extensive, and have adversely affected channel form and function, as well as aquatic habitat.

Modifications to Vaughn Creek are the most severe in the project area, primarily the lower and middle reaches. A variety of modifications can be directly attributed to agriculture. Three small impoundments used for irrigation and agricultural purposes divert a proportion of its surface flow. Along the lower reaches and the mouth, a network of dikes and levees were constructed and a tide gate was installed to convert wet and poorly drained areas into land suitable for cultivation and pasture, altering the stream course from its original route. Some of the dikes divert flow, which originally flowed into Hathaway Creek, just outside the project area to Vaughn Creek. There are fourteen permitted diversions associated with Vaughn Creek, mostly groundwater wells for irrigation, rural residential use, and a golf course. Agriculture fields, pastures, rural home sites and the golf course all impinge on portions of its floodplain and banks, and there are a number of road crossings and culverts the stream passes through. Additionally, the fill foundations of Highway 101 and a spur of the old Southern Pacific railroad tracks have diverted flow from a variety of small tributaries, wet areas, and drainage ditch lines to the lowest reach of Vaughn Creek.

Doty Creek has undergone similar, but relatively less extensive alteration. Its lowest reach and a notable portion of its middle reach flow through areas with a dense cover of trees, and a lesser degree of encroachment, and it has not been subjected to extensive diking and channelization like Vaughn Creek. Many of its small tributaries however, have been affected by small town urbanization, and their original flow routes are no longer discernible.

Likewise the lower and middle reaches of Patterson and Jacoby Creeks have also been heavily modified, primarily due to the establishment of Bay City. Many of the small tributaries to these reaches no longer flow above ground, and pass through drain tiles and storm sewers. Both streams pass under many roads. The mouth of Patterson Creek passes under Highway 101 and the railroad, and has been altered further by the two jetties adjacent to the docks at Bay City.

The upper and headwater reaches of Vaughn, Doty, Patterson, and Jacoby Creeks originate from, and flow through ODF land. These currently represent the reaches of these streams that are the most intact.

Along the Miami River, channel modifications are prominent from the mouth to the confluence with Prouty Creek. The majority of these reaches are located on private non industrial land. These are primarily the sensitive low gradient channel types on the valley bottom, and include the lower reaches of the river and the lowest reaches of its connecting tributaries. As a result of the valley floor being converted from forest bottomland to agricultural fields and rural home sites; channel complexity along these reaches has been diminished significantly (ODFW 2005).

In the direct vicinity of the estuarine reaches of the Miami River, prominent channel modifications are attributable to fill grades of Highway 101 and the Port of Tillamook railroad tracks. Both cross the broad estuarine flats of the river mouth, effectively truncating the estuary into an east and west half. On the east half of the estuary, dikes and small channelized streams support agricultural use. The west half is mostly a tidal wetland.

Further up river, agricultural fields occupy the majority of the valley floor and in places impinge upon the river's banks and floodplain, as does the main Miami River Road. In places, rip rap has been emplaced along the streambank. A 1978 study of the Miami River estimated that about 25 percent of the surveyed miles were armored in this manner (TBNEP 1996). Additionally, there are half a dozen surface diversions, mostly small, that support irrigation for agricultural purposes in the valley bottom. Such features are located at the mouth of Illingsworth, Moss, and Waldron Creeks, and several other small unnamed tributaries.

Extensive disturbance in the uplands over the last hundred years has affected many reaches in the project area. For example large forest fires, subsequent salvage harvest, obsolete and less cautious harvest and road construction practices of the past, yarding through riparian corridors, and prodigious stream clean out all played various roles that either directly or indirectly affected channel morphology. Undoubtedly, channel modifications that have occurred in the past still persist along many reaches in the project area. Available data however is limited, and comprehensive surveys are available only for recently surveyed reaches of the Miami River and Moss Creek.

Notes from stream surveys conducted in the early 1950's identify several other notable channel modifications on ODF reaches in the project area where effects could be long lasting. Dams for urban and domestic water supply were constructed in Electric and Struby Creeks in 1953 and 1955 respectively, which may have reduced available water for aquatic dependent species in those streams. Additionally, channelization and diking along the Miami river between Diamond and Powderhouse Creeks was conducted in 1958 to protect the river adjacent access road from high water, diminishing channel complexity in a reach noted for quality spawning and rearing habitat (ODF 2004b).

Currently, there are certain road segments of the Miami River road on ODF land that encroach upon the floodplain and channel of the river between Prouty and Buehner Creeks. Segments also impinge upon the lower and middle reach of the North Fork upstream from its confluence with the South Fork. Other notable road segments on ODF land have resulted in modified channel conditions in the narrow drainage bottoms of Moss and Buehner Creeks (ODF 2005a).

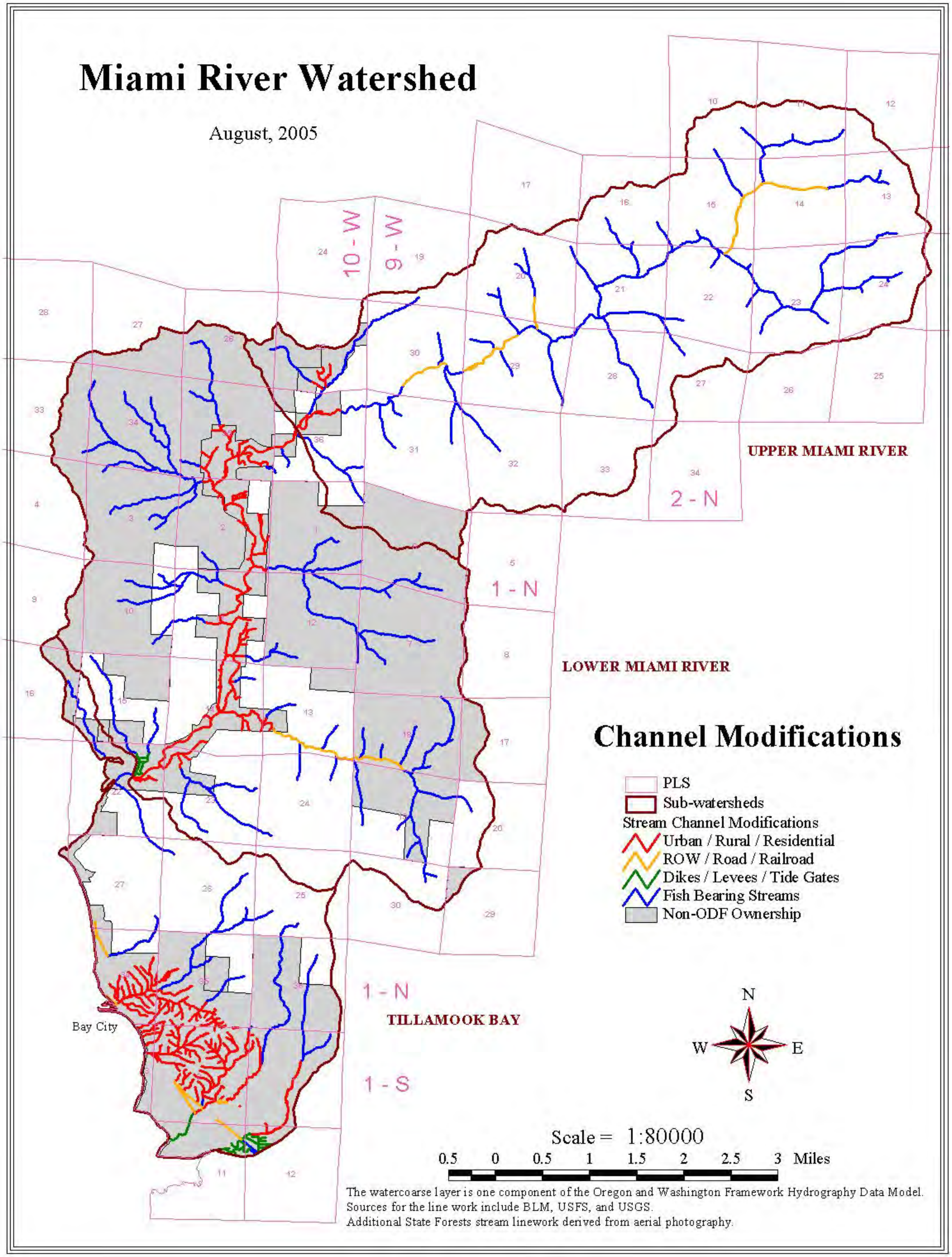

Figure 2. Map of modified channels for the Miami River Watershed Project Area.

Stream improvement projects that have occurred in the project area could also be considered channel modifications, albeit with a positive connotation converse to those previously addressed. Since 1996, nine habitat improvement projects have been completed on reaches located on ODF lands and sixteen on reaches located on non State lands (ODFW 2005). Most involved the placement of in-stream large wood, erosion control, passage access, and riparian plantings. On ODF lands these occurred mostly on the upper reaches of the mainstem Miami River, and in certain reaches of Buehner Creek, Diamond Creek, Illingsworth Creek, Minich Creek, Moss Creek, Powderhouse Creek, and Prouty Creek.

4.2 Hydrologic Conditions and Water Use

4.2.1 Hydrologic Conditions

Stream flow data specific to the project area is only known to be available for two former gauging sites no longer in service. One was located near the mouth of the Miami River (ODWR gage no. 14301300), and another was located on a lower reach of Patterson Creek (ODWR gage no. 14301400). The Miami River site was in use from 1973 to 1995, and the Patterson Creek site was in use from 1952 to 1968. Using data from the Miami River site, Figure 7 displays the representative hydrograph based upon the daily mean for the 22-year period of record. The hydrologic regime for the project area is a rain dominated system typical of the Coast Range. Stream flow increases sharply in the fall with the onset of the rainy season and peaks during the winter before steadily decreasing to a low in late summer.

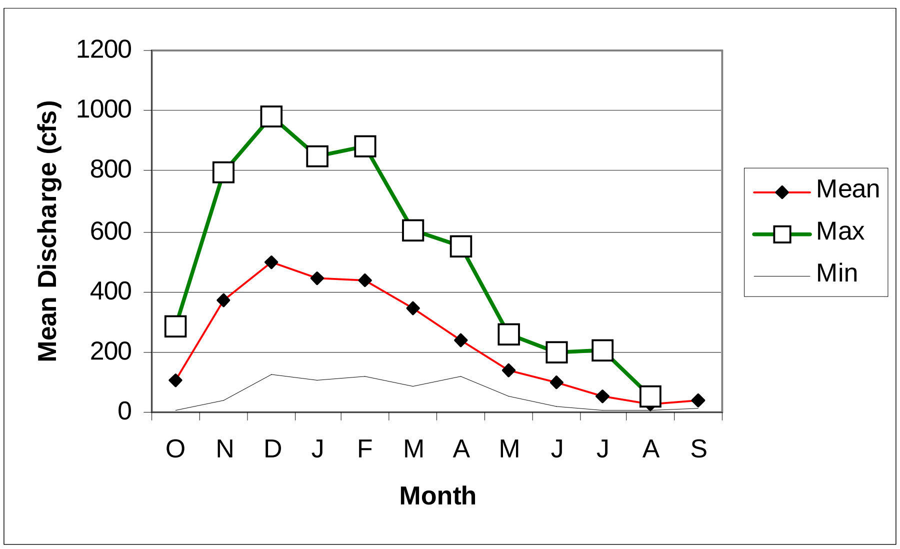

Figure 3. Hydrograph of mean daily flow for the period of record 1973-1995 for the Miami River (ODWR Gage No. 14301300) (Source: ODWR 2005).

For the period of record, daily mean flow on the Miami is 251 cubic feet per second (cfs), with a maximum of 2,813 cfs, and a minimum of 17 cfs. The greatest peak flow recorded at the Miami site was estimated at 6,480 cfs, and occurred on January 9th, 1990. For the 22 years of record, December and January accounted for six peak flow events each, February tallied three, March four, and November, April, and June each recorded one. At the Patterson Creek site all but three of the peaks in the 17-year period of record occurred Between November and March. The three greatest peaks recorded for Patterson Creek in the winter of 1955, 1964, and 1965. Another of the more notable floods in recent times was the flood of 1996; the year after the Miami River gage site was decommissioned. By some, the 1996 event is considered to have been the most significant flood of recent times that affected the region, including the Miami River watershed (K. Mills pers. comm.). For each year in the period of record, the lowest recorded flow for the Miami was always after August 14th. The lowest flow on record for the Miami of 2.4 cfs occurred on four different non-consecutive days between August 28th and September 7th 1992.

To evaluate the effects of land use status on hydrologic conditions, peak flows are commonly evaluated as an indicator. The effects of accentuated peak flows have been widely documented, and in forested watersheds they have the potential to impact channel morphology and affect riparian and aquatic resources (Beschta et al. 2000, Swanson et al. 1998, Grant and Hayes 2001). The streamflow records for the project area indicate that peak flows can vary considerably from year to year, a trait characteristic of a wide range of natural variability. Such variation can obscure the effects of disturbance on the hydrograph, so that despite extensive land use, discernible and explicit alterations to peak flows are difficult to verify. In short, there is insufficient streamflow data to determine if peak flows are within the natural range of variability in the project area. Since the data are limited, indicators of hydrologic conditions are inferred from a qualitative perspective by evaluating cover types and roads.

In the past 150 years, forest patterns across much of the project area have been altered, predominantly by catastrophic wildfire, clearcut timber harvest, urbanization, conversion to agricultural land, and rural home sites (E&S 2001, ODF/BLM 2003). Large changes in land cover patterns, and forest patches can alter the hydrologic regime by altering evapotranspiration rates (Brooks et al.1991). In general, two broad types of land use that have the potential for altering peak flows are represented in the project area: those that have resulted in a semi permanent conversion of forested cover types to non forest, and those that have caused temporary but substantial alterations to the structure of forest cover. The former includes activities, facilities, and infrastructure associated with agricultural, rural residential, and urban land use, and the latter with those associated with natural resource extraction, in this case primarily timber harvest.

In the wet forested environment of the Coast Range, changes in the forest cover (which may occur as a result of disturbance) can effectively reduce interception and transpiration thereby increasing the amount of net precipitation available for runoff (Beschta et al. 1994). Studies have shown that if the forest cover of a large enough area in a western Oregon watershed has been converted to a created opening (i.e. clearcuts, heavily burned over areas, etc.), then an increase in peak flows is likely to result (Beschta et al. 2000, Harr et al. 1975, Jones and Grant 1996, and others). Results compiled by Bosch and Hewlett (1982) of relevant watershed studies indicate that in general, if about 15 to 30 percent of the forest cover types in a drainage are comprised of created openings or young forest stands, then changes in hydrologic conditions, namely water yield or accentuated peak flows, can become detectable.

Increases in peak discharge associated with the extent of created openings or young forest stands diminish with time as stands grow and an effective canopy develops. In forested watersheds of the Pacific Northwest, a fully effective canopy is generally defined as a cover type that is at least 90 percent vegetated, with at least one-third of the stand comprised of conifers that are at least 15 feet tall or that exhibit a crown closure of about 70 percent (Bosch and Hewlett 1982, Klock 1985, WFPB 1995). In the Coast Range, created openings develop an effective canopy within approximately 25 to 40 years of disturbance depending on site class (Harr and Cundy 1992; Stednick and Kern 1992; Beschta et al. 1994).

In the project area cover types that are considered to be created openings are: 1) young conifer dominated or mixed stands with a sparse canopy closure, 2) young to medium-sized hardwood stands with a sparse canopy closure, and 3) areas converted from forest to a non forest status (i.e., agricultural, rural residential, and urban cover types). Table 7 displays the percent of area by subwatershed in created openings.

At a subwatershed scale, the Tillamook Bay subwatershed, which has the greatest extent of private non-industrial ownership, has the highest percentage (69) of area in created openings. The Lower Miami subwatershed, which has the greatest proportion of private industrial land, has the second highest percentage (32). The Upper Miami subwatershed, where the majority of ODF lands occur, exhibits the least amount of area (19) in created openings. Based solely on cover types, the greatest potential for accentuated peak flows is in the frontal and lower Miami subwatersheds.

Table 5. Estimated Percent of Subwatershed in Created Openings

Subwatershed	Non Forest Cover Types*	Forest Cover Types	Total
Lower Miami	6	26	32
Upper Miami	1	18	19
Tillamook Bay	30	39	69

* Agricultural, rural residential, and urban cover types

In the Coast Range where stream density is high, changes to the hydrologic regime caused by roads are typically the most pronounced where road densities are the greatest, increasing the susceptibility of a watershed to accentuated peak flows (Harr et al. 1975, OWEB 1999). OWEB methodology for evaluating the potential of roads to alter peak flows assigns a threshold of concern rating based upon the percent area of roads relative to the total area of a hydrologic unit. A high rating is assigned if the percent area in roads is greater than 8 percent of the total area of a subwatershed, a moderate rating is assigned if the roaded area occupies from 4 to 8 percent, and a low potential is assigned if the area is less than 4 percent.

Using the OWEB methodology the following assumptions were used to estimate the amount of area in acres of road on non-ODF lands. The average road width for: 1) Highway 101 is 40 feet, 2) all other paved roads is 25 feet, 3) roads with crushed rock surfacing is 16 feet, and 4) unsurfaced roads is 12 feet. For ODF lands RIMS data was used to estimate the amount of area in roads (an average width of 25 feet was considered to be non forest based on inventory data).

Based solely on roaded area (road area index) as an indicator, all three subwatersheds exhibit values less then the 4 percent threshold, suggesting that the potential for roads to accentuate peak flows is low at the subwatershed scale (Table 8). If the calculated road area index had been greater than 4 percent, then further analysis would have been warranted, and other road related factors such as surfacing and connection to streams would have been evaluated to determine potential effects to peak flow. But since the values for all three subwatersheds are below the 4 percent threshold, additional study was considered unnecessary.

Table 6. Estimated Percent of Subwatershed Acres in Roads by Ownership

Owner	Lower Miami	Upper Miami	Tillamook Bay	Project Area
PI	1	<1	<1	1
PNI	<1	<1	2	1
State	1	1	1	1
Total	2	1	3	3

Rounded to nearest whole percent

Based on the cover type and road indicators, the greatest potential for accentuated peak flows is associated with the Tillamook Bay frontal subwatershed, primarily as a result of the conversion of forest cover types to a non forest condition. The small, heavily modified tributaries of the Tillamook Bay frontal subwatershed have likely been affected. Stream surveys conducted by ODFW (2005) partially corroborate this conclusion. However, these streams are short and have a relatively small contributing area. Additionally, their lower and middle reaches that flow through areas converted to non-forest are little more than a mile to Tillamook Bay. Hence, the magnitude of effect of heightened runoff as a consequence of conversion to a non-forest condition is limited due to the short length of their affected channel.

At the subwatershed scale, it is not clearly evident based on the cover type and road indicators that the potential for peak flows has been accentuated above detectable levels in either the lower or upper Miami. Secondary indicators such as the extent of excessive bank erosion, accelerated downcutting, etc. that are noted in both recent and historic stream surveys of the Miami River are equally inconclusive due to extensive past disturbance (i.e. conversion to agricultural land use). Effects to peak flows attributed solely to forest practices would be very difficult to distinguish, particularly when the inherent range of peak flows is highly variable naturally. Thus, a closer look at a smaller scale is necessary.

In the rain dominated hydrologic regime of the Coast Range, enhanced peak flows that can occur as a result of created openings can be difficult to detect. Created openings and roads are more apt to affect peak flows at a small, local scale, such as a 6^{th}- or 7^{th}-field hydrologic unit (Beschta et al 2000, Thomas and Megahan 1998). Increases in peak flow resulting from disturbance, and subsequent effects to stream channels are typically most pronounced within smaller drainages, such as Moss Creek (Jones and Grant 1996, Rothacher 1970). However, smaller officially recognized hydrologic units have not been delineated for the project area, so the extent of created openings can't be determined at this time for the small drainages. But ocular estimates can provide a rough approximation.

In the lower Miami subwatershed, the Hobson, Stewart, and Kiger drainages, along with the upper reaches of Peterson and Moss Creeks are dominated by created openings and roads. Most are located on non-ODF lands. These drainages represent local areas where based on road and cover type indicators, the potential for accentuated peak flows is high. In the upper Miami subwatershed, the extent of created openings is not as evident by comparison. There are distinguishable created openings that comprise large proportions of the Buehner, Carpenter, Diamond, No Name, Powderhouse, and Prouty

Creek drainages. Nearly all are located on ODF lands. However, these and the other drainages of the upper Miami also contain large proportions of cover types that have an effective canopy, or that are no longer considered to be a created opening. These drainages represent local areas where the potential for accentuated peak flows is considered moderate to low.

Even if peaks are elevated in the upper Miami, the change would have to be significantly pronounced before downstream effects could be considered a factor that limits properly functioning conditions. The aquatic and riparian ecosystems in the project area are adapted to the inherent disturbance regime, namely heavy rain and high runoff events. Even after major disturbances species are capable of recovering and surviving (Swanson et al. 1998). This seems apparent despite extensive past disturbance in the upper Miami such as the Tillamook Burn, post-burn salvage activities, and a half-dozen intense flood events (ex. 1964 and 1996) because the presence of certain aquatic species extends far up in the drainage and in most of its major tributaries.

4.2.2 Water Use

As presented in Table 9, there are seventy four permitted withdrawals in the project area. Beneficial uses designated by DEQ that they serve include aesthetic quality, public domestic water supply, private domestic water supply, industrial water supply, and irrigation. Most are located in the Tillamook Bay Streams and Lower Miami subwatersheds (48 and 18 respectively).

Table 7. Number of Permitted Withdrawals in the Project Area

	Use	AS	DI	DN	DO	IM	IR	IS	MU	ST	Total
Lower Miami	No.			1	6		4		7		18
	Cfs			0.00	0.15		1.52		2.89		4.56
Upper Miami	No.		2		3		3				8
	Cfs		0.01		0.04		0.04				0.09
Tillamook Bay	No.	1	3	1	13	5	14	1	5	5	48
	Cfs	0.15	0.03	0.01	1.13	2.40	476.07	1.33	6.38	4.98	492.41
Total	No.	1	5	2	22	5	21	1	12	5	74
	cfs	0.15	0.04	0.01	1.32	2.4	477.63	1.33	9.27	4.98	497.14

Source: OWRD 2005.
Key: AE=aesthetics, DI=domestic irrigation, DN=domestic non commercial, DO=domestic, IM=Manufacturing, IR=irrigation, IS=supplemental irrigation, MU=municipal, ST=storage

In the Tillamook Bay frontal subwatershed seventeen of the permitted withdrawals serve domestic users, all originate from surface waters. Four of the seventeen permits are located on ODF lands (Figure 8). All are located in the vicinity of Hobsonville Point north of Bay City and serve private homeowners. Fifteen are designated for irrigation purposes, of which two draw from groundwater wells near the mouth of Vaughn Creek. The remaining that serve irrigation users draw from surface water sources, primarily Vaughn Creek, but also Doty, Patterson, and several unnamed tributaries. There are five surface water withdrawals serving municipal users, namely Bay City and Idaville. There are also five permitted surface withdrawals that serve manufacturing users. There are five permitted storage reservoirs in the subwatershed. Two are ponds that draw from Vaughn Creek, of which one is designated for aesthetic use and the other for supplemental irrigation. The three other storage permits serve municipal users. Two serve Bay City, one for the water treatment ponds, and an impoundment on Jacoby

- Six large jams with lots of logs and stored gravels were observed in the main channel and its two primary contributing forks.
- Coho fry, fingerlings, and trout are observed in lower and middle reaches where flow is perennial.

Creek. The other municipal storage site is on Electric Creek, and serves the city of Garibaldi. Based on the size of the streams, their annual discharge, and the number of surface withdrawals in the frontal subwatershed, dewatering could be a concern during summer low flow periods in terms of aquatic habitat.

In the Lower Miami subwatershed seven of the permitted withdrawals serve domestic users and draw from the Miami River, Hobson Creek and Minich Creek. All four of the permitted withdrawals serving irrigation users in the subwatershed are from surface sources associated with either the Miami River or unnamed tributaries. There are seven permitted withdrawals serving the City of Garibaldi, which is outside of the project area. Two of these are wells in the Whitney Creek drainage, one is a reservoir on ODF land up Struby Creek, and the others are surface withdrawals from Hobson and Whitney Creeks.

There are eight permitted withdrawals in the Upper Miami subwatershed. They serve private non industrial land owners located near the lower reaches and mouth of Prouty Creek. Two are on ODF land on a very small unnamed stream. All are designated as surface withdrawal permits for domestic and irrigation purposes. Two in the Prouty Creek drainage are located on ODF land.

There are no known significant permitted withdrawals importing water into the project area, although one used for irrigation purposes that is located on the southern boundary is recorded as drawing from a surface source noted as the Kilchis River. There is anecdotal information about an un-permitted withdrawal on ODF land on an unnamed tributary in the upper reaches of the lower Miami subwatershed. When discovered, ODF attempts to encourage un-permitted users to register their facility with the State to claim the right for the withdrawal.

Chapter 5 of the Miami Watershed Assessment (E&S 2001) presents a comprehensive discussion of water rights and use within the Miami River. It was concluded that the potential for dewatering streams with documented fish presence during low flow periods is a concern. This echoes concerns of ODFW and OWRD, which designated the Miami River a state priority for streamflow restoration to support anadromous species. Considering the greater number of permitted withdrawals and the greater amount of use recorded in the Tillamook Bay frontal subwatershed, where surface sources are associated with small streams exhibiting far less annual discharge and available water compared to the Miami River, it is logical to assume that dewatering effects to aquatic species would also be a concern.

4.3 Riparian Conditions and Wetlands

4.3.1 Riparian Conditions

Vegetation in the project area was mapped by aerial photo interpretation using 2004 orthophotos. Polygons that depicted discrete individual patch types were delineated and classified according to the OWAM (OWEB 1999) methodology for attributing cover types. Each individual polygon was assigned a 3-digit code. Each digit in the code represents a unique structural attribute: a vegetation type, a size class, and a density class. Combining each digit into a 3-letter code provides a structural characterization of an individual polygon, thereby conferring a relative stand or patch condition. Table 10 introduces the definitions of each structural attribute and its corresponding code.

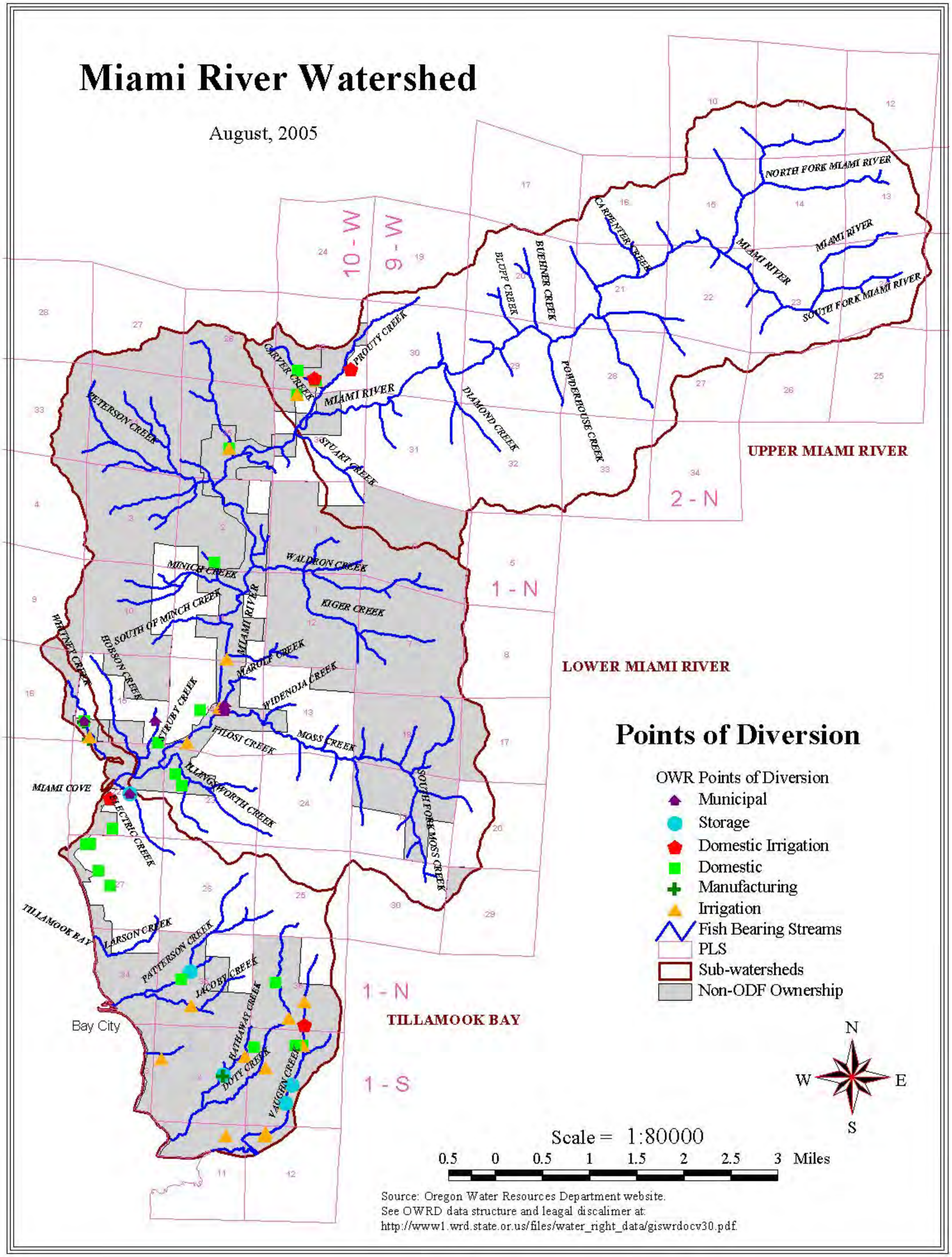

Figure 1. Points of diversion in the Miami River Watershed Project Area.

Table 1. Vegetation Cover Type Definitions

Vegetation Type	1st Digit Code	Size Class	2nd Digit Code	Density Class	3rd Digit Code
Mostly conifers (>70%)	C	Regeneration (<4" avg, DBH)	R	Dense (<1/3 closure)	D
Mostly hardwoods (70%)	H	Small (4-12" avg, DBH)	S	Sparse (>1/3 closure)	S
Mixed conifer/hardwood	M	Medium (>12-24" avg, DBH)	M	Non forest	N
Brush	B	Large (>24" avg, DBH)	L		
Grass/meadow	G	Non forest	N		
No riparian veg.	N				
Rock	R				
Slide area	S				
Right-of-way	ROW				

To assess riparian composition, vegetation cover types within a designated riparian corridor network were compiled. The width of this corridor is one hundred feet on either side of a mapped stream, for a total width of 200 feet. This default was selected based upon OWAM methodology for ecoregions represented in the project area. However, it is the maximum suggested width irregardless of other influencing factors such as confinement and valley form. Actual widths in the field may vary considerably. Nonetheless, this width was used because of the inherent potential for the vegetation zones in the region to produce large tall trees, which represent a potential future source of large wood. This mapped riparian area is assumed to represent the immediate zone of influence to the stream network, and it amounts to approximately 46 percent of the project area. A spatial representation of both riparian and upland vegetation cover types and stream size is presented in Figure 9.

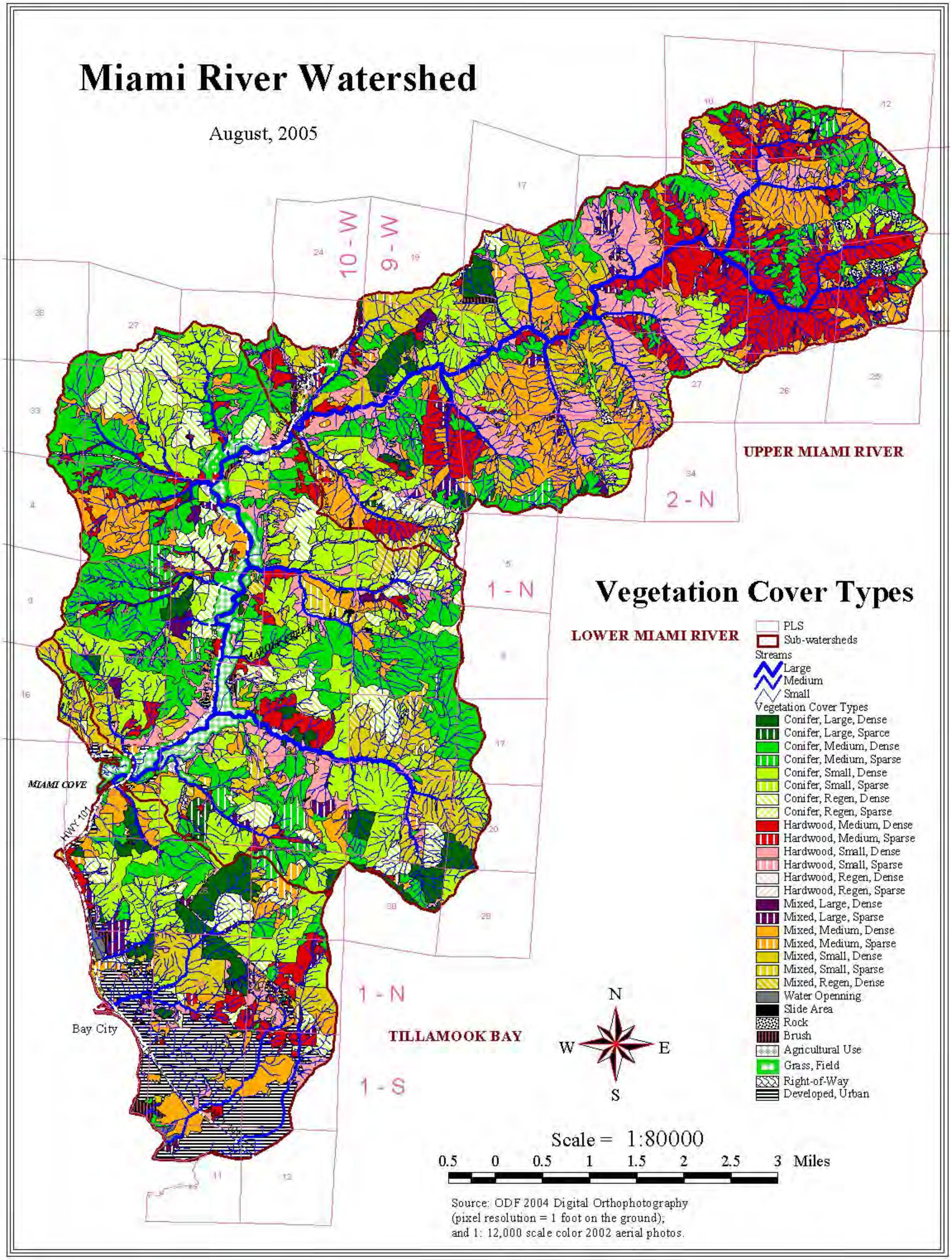

Figure 2. Vegetation cover types and streams in the Miami River Watershed Project Area.

Table 2. Percent Riparian Corridor by Major Cover Type

Cover Type	Total Percent	Percent Area by Subwatershed and Owner Class (nearest whole percent)								
		Lower Miami			Upper Miami			Tillamook Bay		
		PI	PNI	State	PI	PNI	State	PI	PNI	State
Conifers	39	40	1	17	2	<1	22	1	5	28
Hardwood	27	8	2	6	2	1	40	0	10	2
Mixed	27	14	1	5	2	1	29	2	16	8
Non Forest	8	<1	5	<1	<1	<1	2	0	27	1

Key: PI = Private Industrial, PNI = Private Non Industrial

It is estimated that thirty-nine percent of the stream riparian network is comprised of conifer dominated stands, 27 percent is hardwood dominated, 27 percent mixed, and about 8 percent is non forest (Table 11). Most of the non forest patch types are located on non industrial private lands in the Tillamook Bay frontal subwatershed. The Lower Miami subwatershed, which is predominantly in private industrial ownership, exhibits the highest percentage of conifer dominated stands, while the Upper Miami subwatershed which is primarily ODF lands has the greatest percentage of hardwood dominated stands, presumably a reflection of the effects of the Tillamook Burn and post fire salvage.

As displayed in Table 12, the majority (81%) of the riparian network is comprised of medium and small tree size classes (45% and 36% respectively). Only 6 percent is comprised of the large tree size class, and 5 percent is in the regeneration size class. The highest percentage in the Lower and Upper Miami subwatersheds is the medium size tree class. The highest percentage of the large tree size class is in the Tillamook Bay frontal subwatershed.

Table 3. Estimated Percent Riparian Corridor by Vegetation Size Class

		Percent Area by Subwatershed and Owner Class (nearest whole percent)								
Size Class	Total Percent	Lower Miami			Upper Miami			Tillamook Bay		
		PI	PNI	State	PI	PNI	State	PI	PNI	State
Large	6	<1	<1	4	<1	<1	4	0	2	10
Medium	45	29	2	11	3	1	54	0	13	9
Small	36	25	2	12	2	<1	34	3	13	15
Regen.	5	7	1	2	1	0	1	0	2	4

Key: PI = Private Industrial, PNI = Private Non Industrial

Only about 4 percent of the riparian network is comprised of large conifer dominated stands. They are fragmented, widely distributed patch types. Under more natural conditions, where less widespread and complex human and natural disturbance had occurred historically, riparian vegetation would consist of a much greater proportion of large conifer cover types. ODF (2002) estimated the historical distribution of forest types to be 15 - 20% age 100 – 200 years and 40 – 50% age greater than 200 years. If this is true, the current condition could be considered outside the range of variability for the vegetation zones in these types of ecoregions.

About 59 percent of the mapped riparian network is located on ODF lands. Approximately 89 percent of those acres are associated with small steep, headwater tributaries. As displayed in Table 13, cover types in the riparian network on ODF lands are variable, proportions of each are evenly represented. Most of the Upper Miami, which is predominantly ODF land, is comprised of hardwood and mixed components: conifer dominated stands comprise the smallest percentage. The medium and small tree size classes dominate.

Table 4. Percent of Cover Type and Size Class in Riparian Network on ODF Lands

Cover Type	Lower Miami River	Upper Miami River	Tillamook Bay	Grand Total
Conifer Dominated	11	17	8	36
Hardwood Dominated	4	30	1	35
Mixed	4	22	2	28
Size Class				
Large	2	3	3	8
Medium	7	41	3	50
Small	8	25	4	37
Regeneration	2	<1	1	3

Ninety-five percent of the large conifer riparian patches are located on ODF land, their acreage nearly evenly distributed across all three subwatersheds. Several of the largest more prominent patches are located on ODF land on the frontal highlands above the coastal plain in the Tillamook Bay frontal subwatershed. Other large notable patches on ODF land are located in the upper headwaters of Moss Creek, above the north bank of the Miami River across from Diamond Creek, and in the steep headwaters of Bluff Creek.

Using the vegetation mapping of the riparian network, shade and LWD recruitment potential were rated as per the OWAM methodology (Figure 10, Figure 11, and Tables 14 and 15). More than 80 percent of the riparian network is rated as exhibiting high shade potential. Recruitment of LWD on the other hand is rated as low to moderate across more than 95 percent of the mapped riparian network. The same trend holds for Shade and LWD recruitment potentials on ODF lands.

The average stream channel width generally increases in a downstream progression, potentially resulting in decreased shade levels. A comparison of current shade levels on perennial, Type F and critical habitat stream segments on ODF lands indicates no significant difference (Table 14).

Table 5. Percent of mapped riparian buffers by shade rating for perennial, Type F and critical habitat stream segments on ODF lands.

	Perennial		**Type F**		**Critical Habitat**	
Shade class	**acres**	**percent**	**acres**	**percent**	**acres**	**percent**
High	1622.20	87.3%	906.20	85.2%	143.26	87.1%
Moderate	142.42	7.7%	90.97	8.6%	19.67	12.0%
Low	93.76	5.0%	65.83	6.2%	1.46	0.9%
Total	1858.38	100%	1063.00	100%	164.39	100%

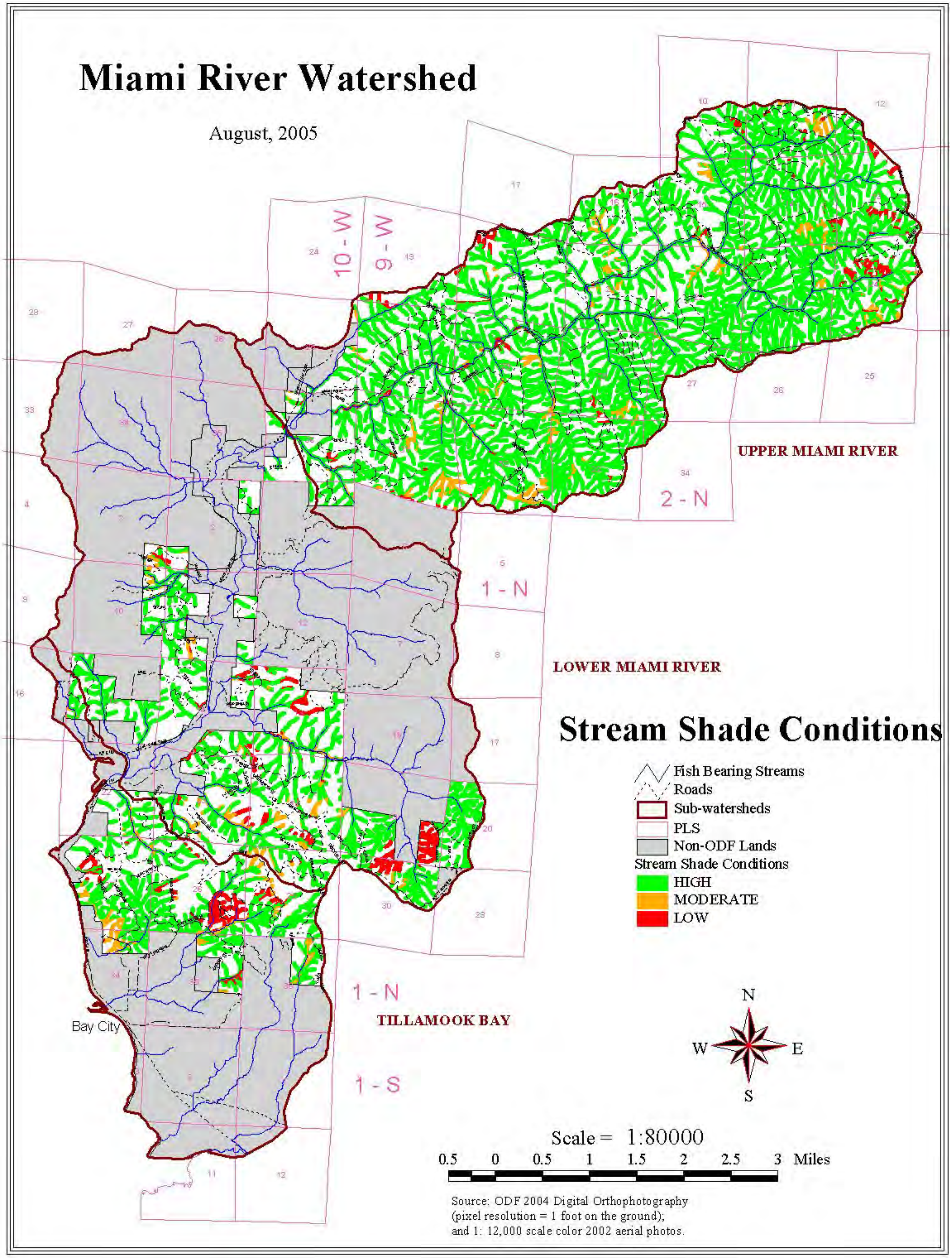

Figure 1. Current estimate of stream shade conditions on ODF Lands in the Miami River Watershed Project Area.

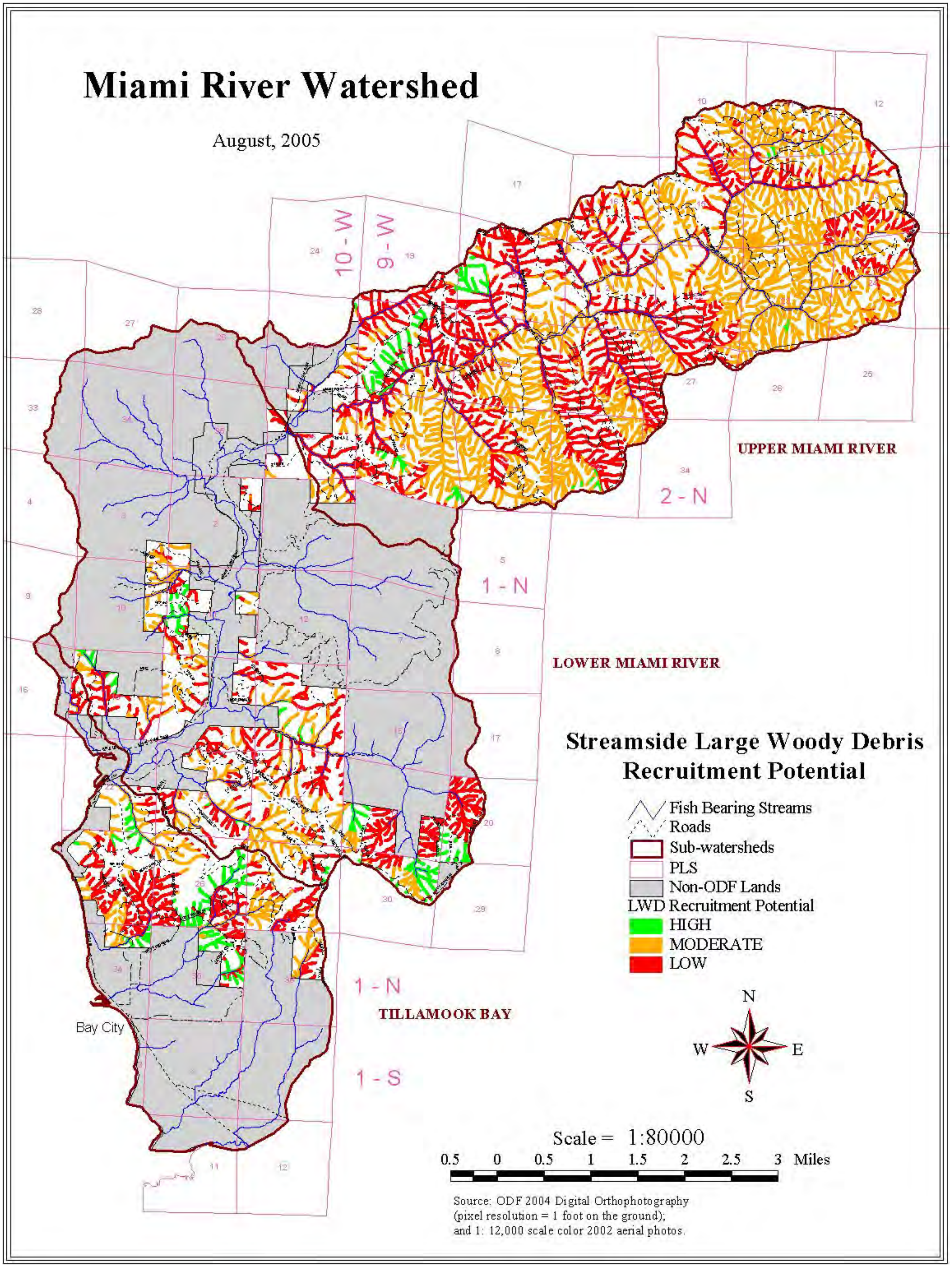

Figure 2. Current estimate of large woody debris recruitment potential on ODF lands in the Miami River Watershed Project Area.

Table 1. Percent of Riparian Network on ODF Lands by Potential Shade Rating and Potential LWD Recruitment Rating.

Shade Potential	Lower Miami River	Upper Miami River	Tillamook Bay	Grand Total
High	84	88	64	83
Medium	10	6	25	9
Low	7	32	12	7
Potential LWD Recruitment				
High	13	12	1	7
Moderate	43	55	46	51
Low	44	43	38	42

4.3.2 Wetlands

The portion of the National Wetland Inventory (NWI) that covers the local region includes the western one-third of the project area (Figure 12). As is described in the existing Miami Watershed Assessment (E&S 2001), the NWI types mapped in the Miami watershed primarily include estuarine and palustrine (non tidal, non riverine) types. The largest areas mapped in the project area include wetlands located at the mouth of the Miami River, Larson Creek, Patterson Creek, Doty Creek, and Vaughn Creek. Nearly all the estuarine classified wetlands are located on private non industrial lands, and have been altered to varying degrees by agricultural or urban land use. Their functional condition is considered diminished, or in some cases converted to a non functional status, which could alter the role these habitats play in various salmonid life stages, particularly for juveniles (TBNEP 1996, TBNEP 1998).

The NWI has also delineated forested wetlands on the lower reach of Larson Creek and several sites on the floor of the Miami Valley, particularly near the lower reaches and mouth of Peterson Creek. These are located on private non industrial lands and have been affected by agriculture, land conversion, and rural residential land use. They all are associated with gentle relief and low gradient stream segments.

Wetlands unmapped by the NWI are likely in the project area, although there is no formal inventory that categorizes their type or significance. Their location, extent, and distribution have not been comprehensively inventoried. As is typical of west side mountainous forests in Oregon, there are likely many small seeps, springs, and wet areas throughout the project area. They commonly occur on valley bottoms and terraces, at the confluence of tributaries, at the toe of slopes, or near geologic contacts. Ancient landslide landforms and earthflows are also areas where the incidence of forested wetlands is potentially high. These unmapped wetland features are most easily documented during project-specific planning.

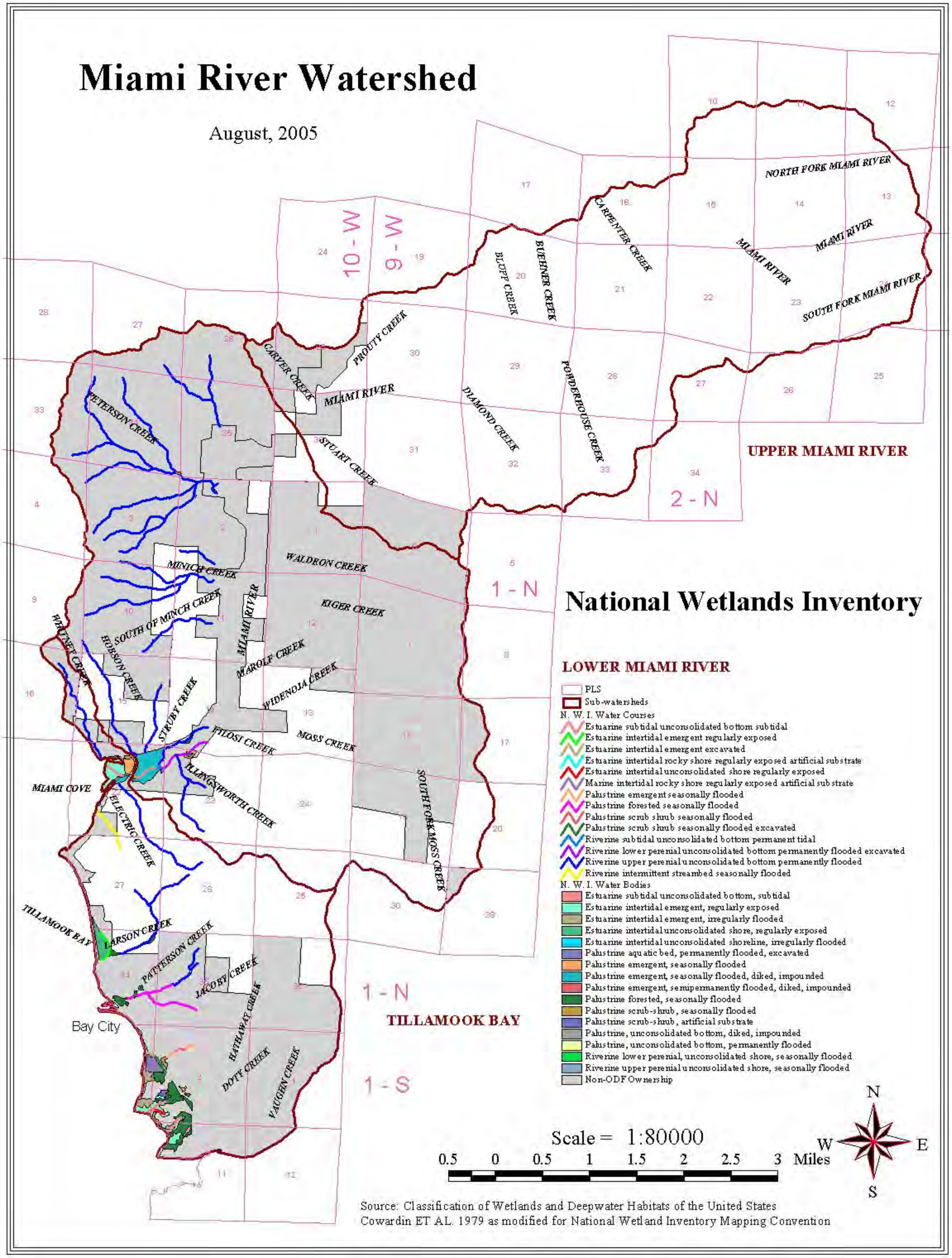

Figure 3. Mapped wetlands in the Miami River Watershed Project Area (Source: NWI).

One notable example that was observed during field review is located on ODF land in the valley bottom of Larson Creek on the east of the old highway between Bay City and Hobsonville (NE ¼ Section 34 T1N R10W).

4.3.3 Invasive Plant Species

There is no known inventory of the types and extent of invasive plant species in the project area. Though there is no process or survey currently underway to inventory the location of invasive plants, there are a number of species that are known to occur. For this study, the location of sites where invasive species were observed was noted during field exercises. These observations are not meant to serve as a systematic sampling, so the information is primarily anecdotal. Also, field reconnaissance occurred during early March prior to the full emergence of many species, such as tansy or Scotch thistle, so only a few species were observed. These included Himalayan blackberry, English ivy, and Scotch broom.

Locations where Himalayan blackberry was observed:

- many segments along the entire length of Highway 101 through the project area (ODF and private non industrial land)
- along many segments of the old highway between Bay City and Hobsonville
- lining the banks along many reaches of the lower Miami River between Highway 101 and Prouty Creek (private non industrial land)
- the crossing of the Miami River Road over Prouty creek (private non industrial land)
- lower Electric Creek (private non industrial land)
- powerline corridor on the divide between the frontal subwatershed and the Illingsworth drainage (ODF and private industrial lands)
- the powerline road bisecting the upper reaches of Patterson and Jacoby Creeks (ODF and private industrial lands)
- the terminus of the Stuart Creek Road near Diamond Creek (ODF land)
- along the banks of Doty and Vaughn Creeks above and below Idaville (private non industrial land)
- along many other road segments in and around Bay City and Idaville (private non industrial land)

Locations where Scotch broom was observed:

- along an open segment of the Patterson Creek Road that bisects several young open plantations (ODF land)
- several individual plants on the uppermost switchback of the Miami road near the top of the watershed divide (ODF)
- powerline corridor on the divide between the frontal subwatershed and the Illingsworth drainage (ODF and private industrial lands)
- the powerline road bisecting the upper reaches of Patterson and Jacoby Creeks (ODF and private industrial lands)

Locations where English ivy was observed:

- along many segments of the Miami-Foley Road, particularly between Highway 101 and Peterson Creek (private non industrial land)
- along many other road segments in and around Bay City and Idaville

In the Nehalem River basin to the north of the project area, there is an extensive infestation of Japanese knotweed, a very aggressive invader of riparian habitats. A heavy knotweed infestation is not currently believed to have gained foothold in the watershed. But the Miami River valley is a prime vector corridor for the spread of knotweed into the interior of the watershed and critical habitat on ODF lands. Early control measures have a high potential for success if they are implemented prior to an intense infestation. As such, an opportunity exists to prevent the spread of knotweed into the Miami watershed.

4.4 Erosion Processes and Sediment Sources

In the Coast Range, important erosion processes commonly considered when regarding land uses and their potential effects on the environment include landslide erosion and fluvial erosion. In the project area, they are the primary inherent sediment-producing processes that occur naturally. Surface erosion is another process of concern. Generally, it is not considered to have been a dominant, inherent sediment-producing factor in western Oregon forests. However, with a loss of vegetation resulting from natural or human disturbances soils can become exposed, which increases their susceptibility to erosive forces. Evaluating the inherent potential or risk of erosion provides an understanding of the relative susceptibility of the project area to disturbance. An increase in the rate of erosion above the normal range of variation as a result of disturbance is considered to be accelerated erosion.

4.4.1 Hillslope Erosion.

Moderate to heavily dissected, steep mountain terrain typifies the majority (93%) of the project area. About 35 percent of its area is characterized as steep or very steep (slopes >60%), and about 39 percent moderately steep (slopes 30-60%). Only 27 percent of the area exhibits slope angles less than 30 percent. Table 16 portrays the estimated distribution of four select slope classes by ownership and subwatershed. The greatest proportion of steep and very steep slopes is in the Upper Miami subwatershed, followed by the Lower Miami subwatershed.

Table 1. Estimated Percent Area by Slope Class and Shallow Rapid Landslide Hazard Rating

			Percent of Subwatershed Area								
Pct Slope	Percent Total Area	Hazard Rating	Lower Miami			Upper Miami			Tillamook Bay		
			PI	PNI	State	PI	PNI	State	PI	PNI	State
<30	27	Low	13	7	6	1	1	9	1	47	16
30-59	37	Moderate	29	2	14	2	0	30	2	9	19
60-79	21	High	11	1	7	2	0	30	1	1	3
>79	14	V. High	5	0	4	2	0	23	<1	<1	<1

Key: PI = Private Industrial, PNI = Private Non Industrial

Steep slopes tend to exhibit the greatest potential for landslide occurrence, particularly with shallow-rapid types of failures that commonly occur throughout much of the Coast Range. Two general categories of landslide erosion that naturally occur in the project area include shallow rapidly moving landslides and deep-seated landslides. The potential for both is highly dependent upon slope angle, among a variety of other factors.

Geologic hazard maps typically categorize the steepest slopes as the most susceptible to landslide occurrence (Beaulieu and Hughes 1974 and ODF 2001). As slope gradient increases, driving forces increase and slope stability decreases. Various Coast Range studies indicate that the incidence of debris slides increases dramatically where slope angles are steep or very steep, particularly on concave slopes and when soils are saturated (Beaulieu and Hughes 1974, Burroughs et al. 1976, Harr and Yee 1975, Ketcheson 1978, Robison et. al. 1999, and others).

Using slope class as a first approximation of the relative hazard for shallow rapid landslides, it is estimated that roughly 36 percent of the project area is rated as exhibiting a high or very high hazard for shallow, rapidly moving landslides. Of the total area rated as a high or very high hazard, 74 percent is located on ODF land, 24 percent on private industrial lands, and 2 percent on private non industrial lands (Figure 13).

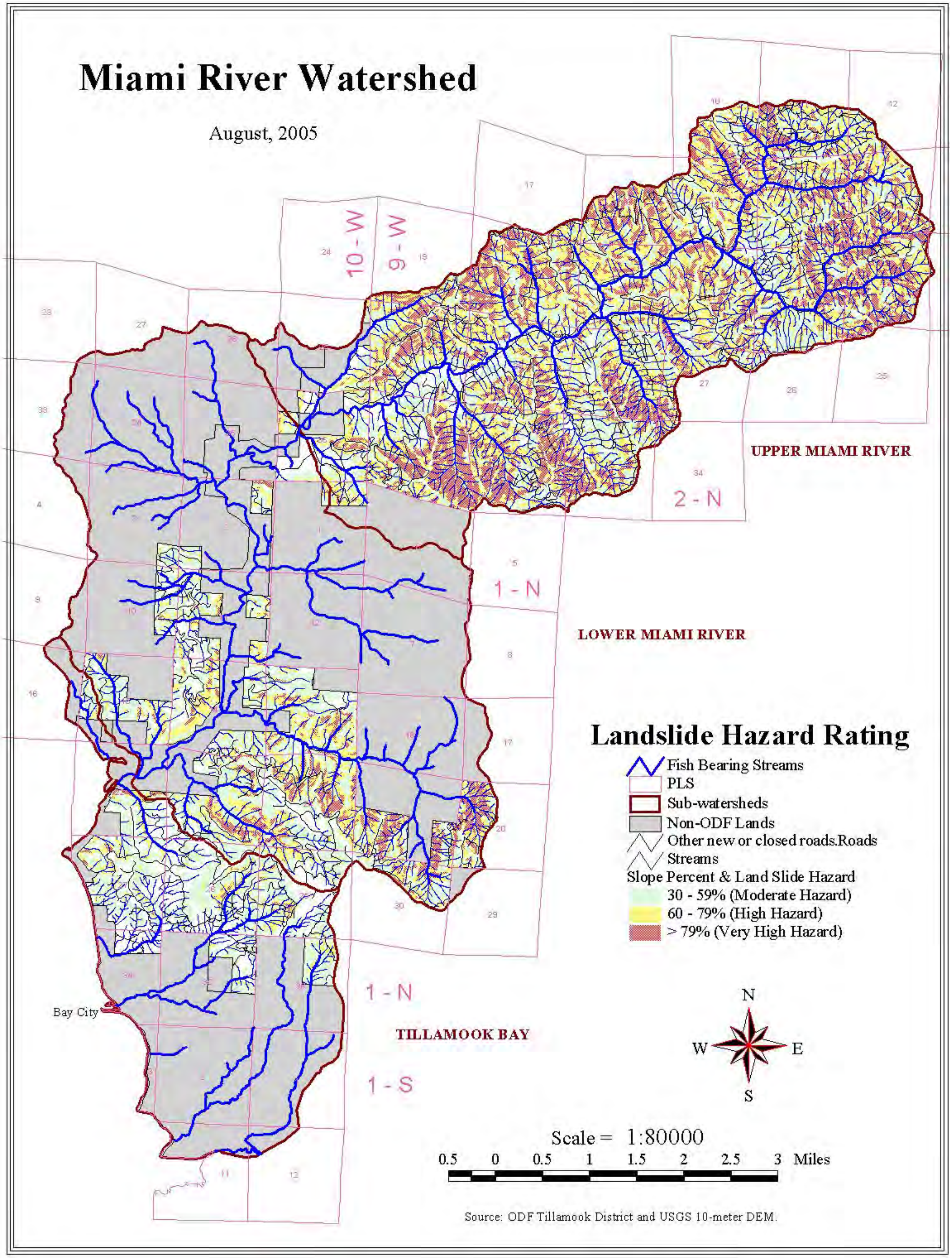

Figure 1. Map of shallow rapid landslide risk on ODF lands in the Miami River Watershed Project Area.

The natural occurrence of rapidly moving landslides in the Coast Range is predominantly associated with steep, confined drainage ways, or streams on steep slopes. Very steep slopes and channels prone to debris flows are landforms where future landslide occurrence can be expected over the long-term. These represent important sources and pathways for the potential transport and delivery of sediment, LWD, and coarse substrate to the stream and riparian network (OWEB 1999).

There are no known comprehensive landslide studies that are specific to the project area, and debris flow-prone channels have not been collectively mapped across ODF lands. An exercise using GIS was conducted in an attempt to predict which channels might be prone to shallow-rapid types of landslides. In Figure 14, the estimated distribution of channels potentially prone to debris flows is displayed. On the map, debris flow-prone channels are those stream segments estimated to have a gradient of at least 60 percent for the majority of their total length. This approach is an assessment of general terrain characteristics, namely stream channels and slope angle that is best suited for the landscape scale. Its intent is to display where the potential for shallow-rapid types of landslides is the greatest across the watershed. Its scale and resolution are not suited for predicting slide runout or site specific hazards.

Using data generated from the map, the majority (65%) of channels potentially prone to debris flows are in the Upper Miami subwatershed, 32 percent are within the Lower Miami subwatershed, and only 3 percent are in the Tillamook Bay frontal subwatershed. Debris flow-prone channels are located in every primary drainage in the upper Miami. About 75 percent of the channels identified as prone to debris flows are located on ODF lands. The majority of steep slopes and steep channels are on ODF land.

To evaluate the accuracy of Figure 14, the mapped distribution of debris flow-prone channels was compared to conditions observed in the field. Seventy-one different locations were sampled. Five sites (7% of samples) that were designated on the map did not exhibit features consistent with debris flow-prone channels. Two (3% of samples) sites that were *not* designated on the map, exhibited characteristics resembling debris flow-prone channels. Additionally, an aerial photo reconnaissance of ODF lands that was conducted revealed eighteen readily identifiable landslide features. Of these, twelve were observed in the field. All were debris slides that corresponded to a debris flow-prone feature on the map. These validations suggest that the automated (GIS) method that was used to predict debris flow-prone channels is reasonably accurate at the watershed scale, and the map is judged to be useful for planning purposes.

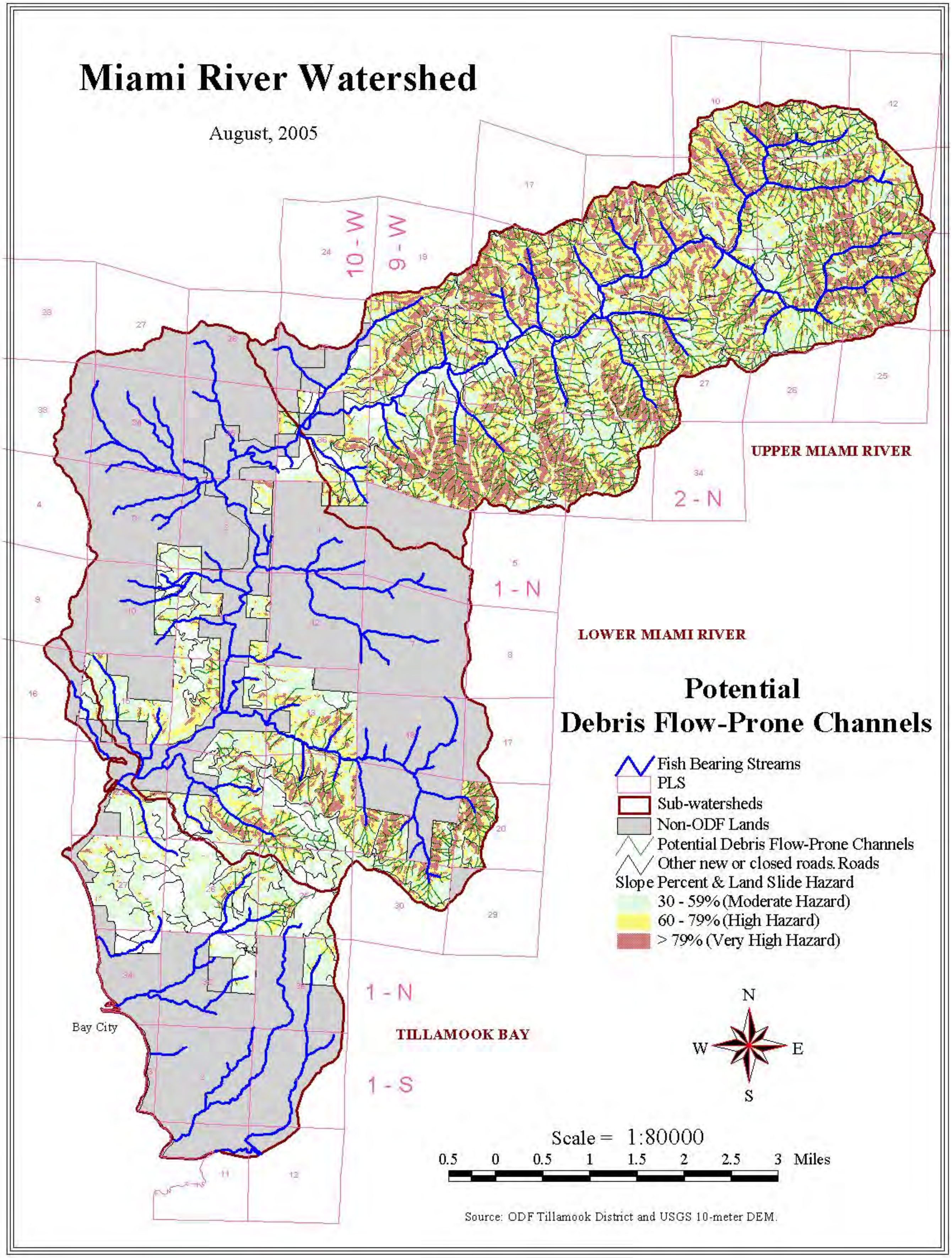

Figure 2. Potential debris flow-prone channels identified on ODF lands in the Miami River Watershed Project Area.

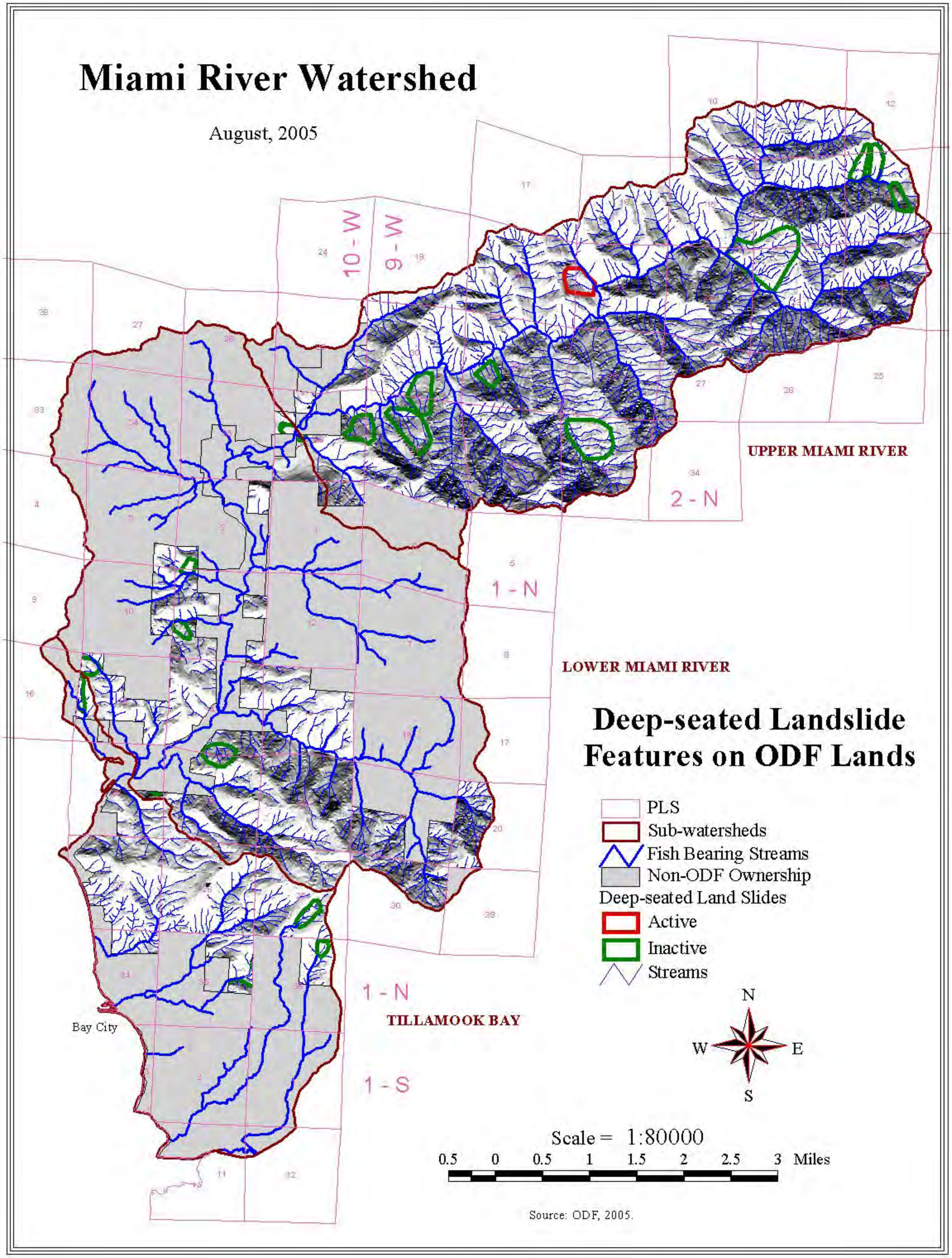

Figure 3. Active and inactive deep-seated landslides in the Miami River Watershed Project Area.

Other potentially unstable features mapped by ODF (2004a) in the project area include slow- imperceptibly-moving, deep-seated landslides. Eighteen features, or portions of features have been mapped on ODF lands (Figure 15). On geology maps of the region these and similar landforms are categorized as ancient landslide deposits, or earthflows (Walker and MacLeod 1991, Wells, et al., 1994). Ten of these features are located in the Upper Miami subwatershed, five in the Lower Miami, and three in the Tillamook Bay Streams subwatershed. Features such as these may be active or inactive. One of the eighteen mapped features is identified as being active. It is located in an unnamed drainage between Buehner and Carpenter Creeks in the Upper Miami subwatershed. The heads or crowns and the toes of earthflow features can be sites where unstable slope conditions are prevalent (Swanson and 1976).

4.4.2 Fluvial Erosion

Streambank erosion is another important sediment generating process in the project area. Oftentimes these processes are inextricably linked with landslide events triggered by intense precipitation and heavy runoff.

Accelerated bank erosion has been observed along a number of reaches that have been heavily modified by human disturbance. Stream surveys indicate that banks along significant portions of the lower and middle reaches of the Miami River show evidence of accelerated erosion (ODF 2004b, ODFW 1995). Other reaches were observed on Moss and Peterson Creeks. These are important sources of sediment directly linked to sensitive, low gradient channel types where critical fish habitat is located. With the exception of Moss Creek, all of the reaches are located on private non-industrial lands, primarily along the channel of the Miami River.

4.4.3 Road Related Erosion

There is an estimated 238 miles of road in the entire project area. The majority (42%) of road mileage in the project area is located on ODF land, 30 percent is on private industrial land, and 28 percent is on private non industrial land. Table 17 shows that the Lower Miami subwatershed contains the greatest amount (47%) of total road miles, followed by the Tillamook Bay (29%) and Upper Miami (24%) subwatersheds respectively. The majority of road miles in all three subwatersheds are located on ODF lands. Most of these have been in place since before the 1960’s (TBNEP 1996). About twenty-four miles of road on ODF lands are old unmanaged abandoned roads or decommissioned road segments.

The density of roads is greatest in the Tillamook Bay subwatershed where the majority of developed land is located and the dominant owner class is private non industrial. The density is the least in the Upper Miami, which is predominantly ODF land.

Table 2. Total Road Miles and Density by Owner Class and Subwatershed

Owner	PI		PNI		State		Total	
Subwatershed	miles	mi./sq. mi	miles	mi./sq. mi	miles	mi./sq. mi	miles	mi./sq. mi
Lower Miami	66	3.5	15	0.8	31	1.6	111	5.9
Upper Miami	4	0.2	2	0.1	51	3.0	58	3.3
Tillamook Bay	1	0.2	49	6.3	19	2.4	69	8.9
Total	71	1.6	66	1.5	101	2.3	238	5.4

Source: ODF 2004a

Although the majority (59%) of total road miles on ODF lands in the project area are located in the Upper Miami subwatershed, it contains the least miles of road of the three subwatersheds. Of the roads that are in the subwatershed, about 97 percent are on ODF land.

In the Lower Miami, most (59%) of the road miles in the subwatershed are on private industrial lands, and 28 percent are located on ODF lands. The majority (94%) of all miles on private industrial lands in the project area are in the Lower Miami. Roads that are located on, or that cross through non industrial lands amount to 14 percent of the miles in the Lower Miami, most are rural county roads that provide ingress and egress for rural residents.

In the Tillamook Bay subwatershed, 71 percent of the road miles are located on, or cross through private non industrial land. The majority of these are rural county and municipal roads in and around Bay City and Idaville, including Highway 101. Roads on ODF land account for 28 percent of the miles in the subwatershed, and roads on private industrial land account for the remaining 1 percent.

The majority (83%) of roads in the project area, and nearly all of the roads on ODF and private industrial lands, are comprised of gravel or dirt surfacing. Paved roads account for an estimated 17 percent of the total road miles. Most paved roads are located in the low lying developed and rural areas of the Tillamook Bay subwatershed, and are associated with Bay City, Idaville, or U.S. Highway 101. The primary paved road in the Miami watershed is the Miami-Foley Road.

For this study, road related erosion in the project area is assessed primarily for ODF lands, conditions on other ownerships is not addressed in detail. Comprehensive and specific information pertaining to road related erosion in the project area has been compiled for ODF land. Road conditions were surveyed in the project area by ODF staff in 2004 and 2005. The information and data that was collected during the survey is stored in the Road Inventory Management System (RIMS), a relatively new program that is being assembled in support of District programs and the FMP.

The inventory was conducted on nearly every road segment open for public travel on ODF land in the project area. An assortment of features and conditions on ODF lands, and their location were assessed as a part of the RIMS inventory. The data is intended to be used for two general purposes: 1) maintenance programming and planning and 2) determining road related effects on watershed resources (pers. comm. K. Mills 2005).

Approximately 77 miles (76%) of the road segments on ODF lands in the project area have been inventoried; about 24 miles were not surveyed because access was blocked, the road was abandoned, or reconstruction activities were underway. The select data from the inventory that were used for this study to evaluate the effects of the road network on the riparian and aquatic system included:

- road segments in critical locations
- stream crossings and their condition
- drainage structures and their condition
- connectivity of road segments to streams
- potential barriers to fish passage
- prism stability
- road surface drainage conditions

Overall, road conditions on inventoried road segments on ODF lands are good. Surface drainage on about 71 percent of the road miles are either functioning properly, or are currently a low priority and do not need immediate attention (see Figure 16). Only one road segment was identified as needing immediate attention to address non-functioning surface drainage. It is a hundred foot section of spur route #15200 where it intersects with the upper end of the Diamond Creek Road near a small seep above a steep slope. Water at this site is actively eroding the road surface. The remaining 29 percent of the inventoried road miles were identified by the RIMS as priority segments where surface drainage should be improved. In the lower Miami and frontal subwatersheds most of these sites are associated with spur roads. In the upper Miami these primarily include the Miami River Road, the Diamond Creek Road, and the upper portion of the Fire Break 3 Road.

RIMS ratings of the general stability of ODF roads indicate that 99 percent of the inventoried miles are stable or exhibit only a minor stability problem (see Figure 17). Currently, there are no road segments that are closed due to a landslide. There are however, about 0.6 miles of road segments affected by a landslide or that have significant slide related erosion. These segments are identified in the discussion below of critical locations.

4.4.3.1 Critical Locations

Critical Locations are used to describe the inherent risk of the road segment to potentially affect aquatic and riparian resources. Critical road locations include slopes in close proximity or in streams, and slopes that are steep or otherwise at risk of landslides. Critical locations have an inherent risk of sediment delivery or direct impact to waterbodies (pers. comm. K. Mills 2005). Slopes under 50 percent, away from streams, lakes, wetlands and landslide terrain are classified as non-critical locations. In these locations, if roads are well surfaced, vegetated and drained there is very low risk of sediment delivery to streams. The greatest effects of roads in critical locations occur during unusually severe storms. Road risk in critical locations can be very difficult to reduce significantly. Most other road conditions (surface drainage, fish and flow passage through structures, and surface erosion) can be corrected by maintenance or repair.

Critical locations are either road segments with a high potential to impact channels, or where there are slope and stability related concerns. As displayed in Figure 18, the RIMS data indicates that the majority (68%) of the surveyed road miles on ODF land are rated as non-critical. Due to the location and condition of these segments, the risk for unwanted impacts to affect aquatic and riparian resources as a result of road conditions is rated to be slight.

Table 1. Miles of Road Segment by Critical Location Category and Risk Rating

	Critical Location Type	Miles	Risk Rating
Stream Related	Canyon Fill	3.0	Highest
	Channel Fill	4.0	High
	Stream in Ditch	<0.1	High
	Stream Parallel	2.5	Moderate
Slope Related	Cut/Fill Slides	0.4	Highest
	Fill Slides	2.7	High
	Deep Active Slides	0.1	High
	Steep Fill	10	Moderate
	Steep Full Bench	1.5	Low
	Non Critical	52.3	Lowest

Conditions on an estimated 3.4 miles of road are rated as the highest risk to aquatic and riparian resources because there are notable segments that are immediately adjacent to a stream where the prism encroaches directly upon the channel. Original construction positioned these segments of road in the valley bottom. In places the fill slope portion of the road prism constricts the original channel. They are subject to surface erosion, washouts, and in places inundation as a result of periodic flooding. Segments that are rated as the highest risk include (see Figure 18):

- Miami River Road – A 3 mile segment between the South Fork confluence and the North Fork crossing where the original channel has been heavily modified as a result of the road prism being located directly in the bottom of the canyon. This segment impinges directly on a reach designated as critical habitat.

Conditions on about 0.4 miles of road are rated as the highest risk to aquatic and riparian resources because there are notable segments where slope stability is a primary concern. These segments are located on steep slopes where cut/fill slides have been observed and the stability of the prism is questionable. The potential for a storm to result in a road-related failure is very high. These include:

- Diamond Creek Road – A steep 0.2 mile grade that traverses up a wet and narrowly confined small drainage at about milepost (MP) 0.8 where three cut/fill slide locations have been identified. Sediment from road related failures along this segment are deliverable to a stream that is tributary to river reaches designated as critical habitat.

- Foley Road – About a 160-foot segment of road at the first switchback up from the bottom where a cut/fill slide is located adjacent to a stream crossing. The subject drainage is a tributary to critical habitat on the river.

- Foley Peak Road – There are several cut/fill slides along a 0.1 mile long segment that traverses across a steep dissected slope in the headwaters of Buehner Creek near the top of the ridge. It is located about 0.9 miles west of the Foley Road intersection. Sediment from failures would be deliverable to contributing headwater tributaries to the fish bearing reaches of Buehner Creek.

- Minich – A tenth of a mile segment on the Minich loop road (Minich Spur 1) that traverses an unstable area in a small wet headwater drainage where there have been recurring failures. Sediment from failures would be deliverable to contributing headwater tributaries to the fish bearing reaches of Minich Creek.

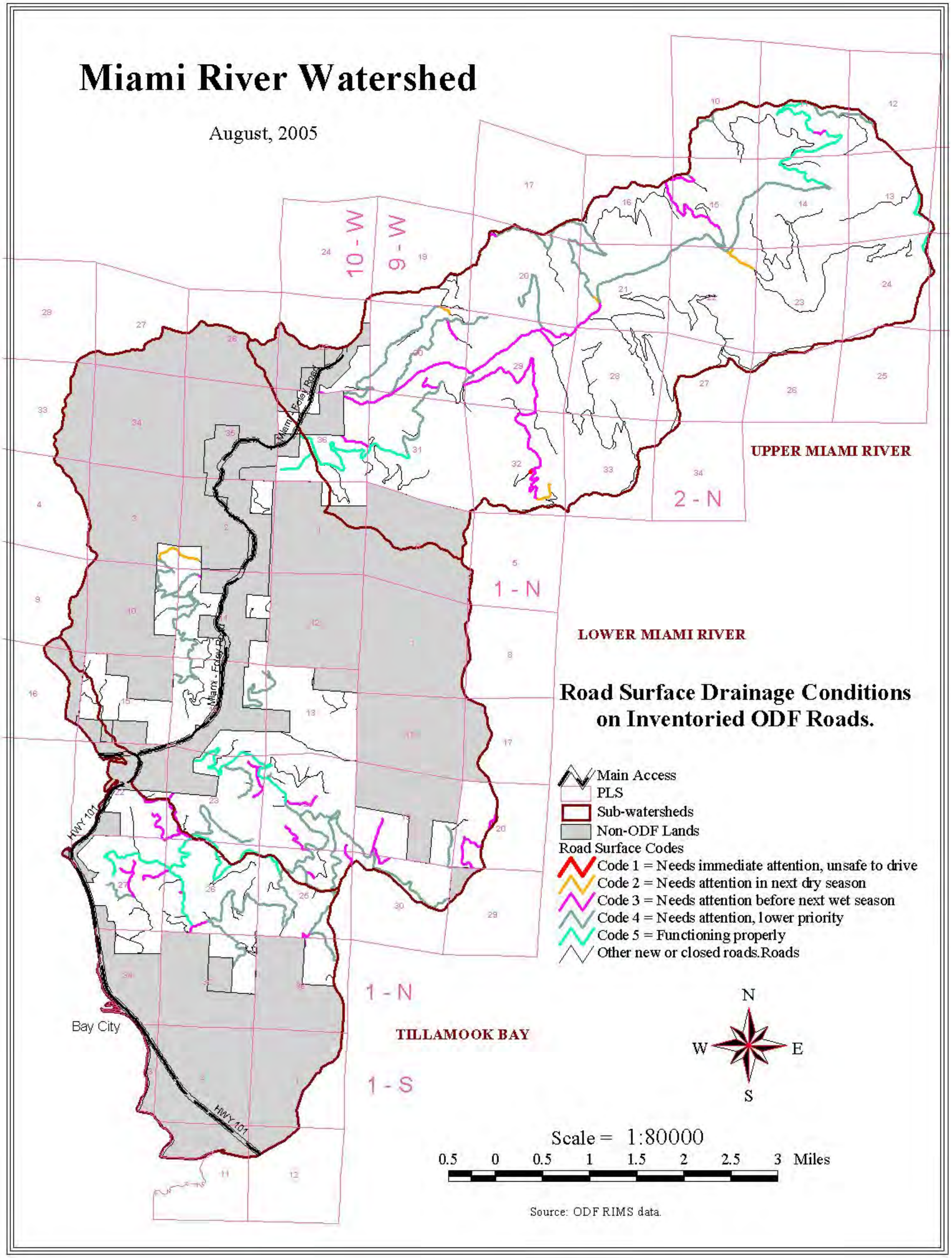

Figure 1. Road surface drainage conditions on inventoried ODF roads within the Miami River Watershed Project Area.

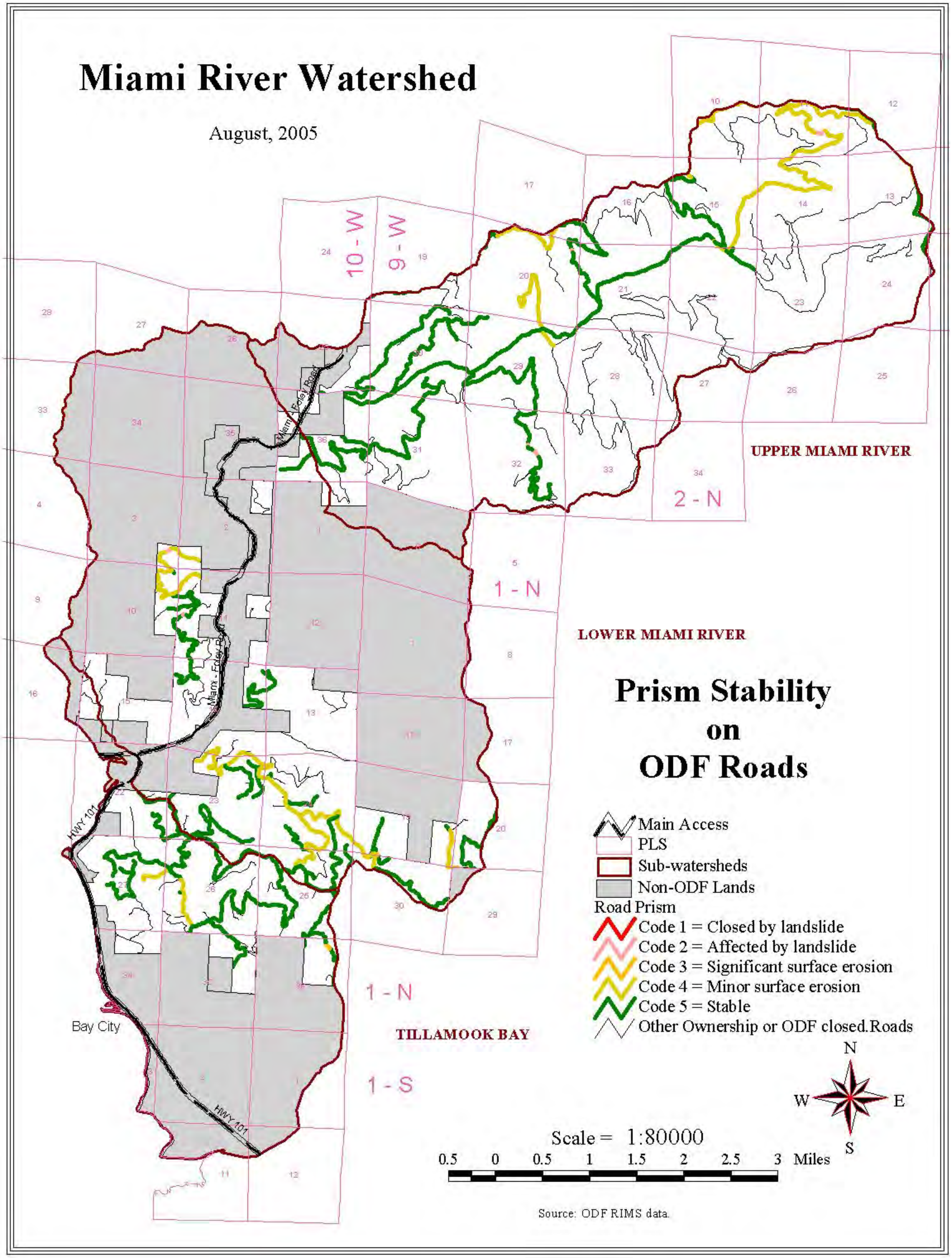

Figure 2. Road prism stability on inventoried ODF roads within the Miami River Watershed Project Area.

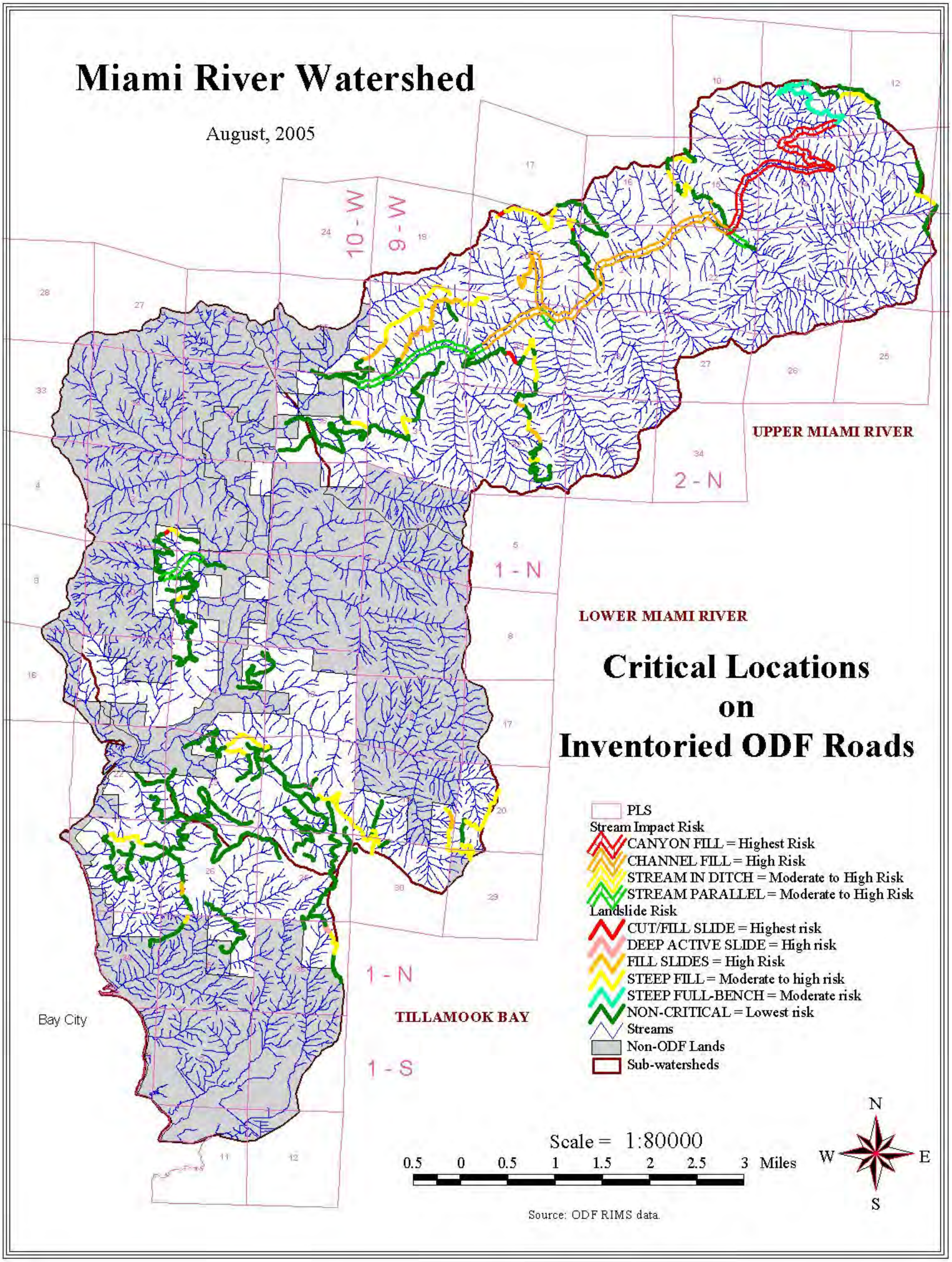

Figure 3. Road segments rated as critical locations for risk to aquatic and riparian resources on ODF lands in the Miami River Watershed Project Area.

There are nearly 7 miles of critical road locations where conditions are rated as a high risk to aquatic and riparian resources. These are segments susceptible to damage from flood events such as fill erosion and prism failures. They are identified as segments where either streamflow has been diverted onto the road or in the ditch, or where fill material has been eroded, or where there are deep-seated slide features. Segments rated as high include:

- Buehner Creek – Multiple problems plague the first 0.6 miles of this road including fill slopes that encroach upon the channel, streams running down the inboard ditch, and failing fill slopes. Sediment from this road enters directly into a fish bearing stream, which is an immediate tributary to a high priority reach designated as critical habitat. Due to this road segment's proximity to critical habitat and it's multitude of problems, it is believed that it could present a risk as high or greater than any of the other segments designated with the highest risk rating, except for the upper segment of the Miami Road.

- The 3.4 mile segment along the river between Diamond Creek and the South Fork confluence. In places the fill slope of this road encroaches upon the channel or is located directly in the active floodplain. It is located immediately adjacent to critical habitat reaches.

- Diamond Creek Road – Eroded fill slopes high up a very steep, highly dissected hillslope. Sediment deliverable to fish-bearing reaches of Diamond Creek.

- East Moss Road – An eroded fill slope high up a very steep headwater slope. Sediment deliverable to fish-bearing reaches of Moss Creek

- Electric Creek Road – An eroded fill slope on a steep headwater slope that is tributary to Larsen Creek. Sediment potentially deliverable to a fish-bearing reaches.

- Fire Break 3 Road – Site of a past failure where a log truck drove off the road causing a fill failure. Sediment deliverable to critical habitat.

- Miami North Road – About a 1.2 mile segment of potentially unstable fill on steep highly dissected slopes. Sediment deliverable to critical habitat.

- Miami West Road – About a 0.3 mile segment of potentially unstable fill on steep highly dissected slopes. Sediment deliverable to critical habitat.

- Minich Ridge Road (MRG) – A small fill failure where eroded sediment is deliverable to South of Minich Creek, a tributary to critical habitat in the lower Miami.

- Vaughn Creek Road – Deep seated landslide feature continually causes deformation of the road prism. High failure potential. Sediment is deliverable to Vaughn Creek and fish-bearing reaches downstream.

4.4.3.2 Washout Risk

There were 156 stream crossings on ODF land surveyed for the RIMS inventory. Only crossings where annual channel scour and deposition was evident were inventoried. Of the 156 locations inventoried, there were 89 (57%) which were either functioning properly or that exhibited a minor degree of flow impairment due to a partial blockage. The risk of these crossings being washed out as a result of high flow was rated to be low (condition code 4 & 5). There were 39 (25%) crossings where a blockage impeded flow and drainage was slow, or where a structure was damaged and weakened, and the risk of a washout was rated to be moderate (condition code 3).

Structures at 25 stream crossings were in poor condition, barely functional, and in the process of failure (condition code 2). The risk of washout at these locations was rated as high. At two locations, the stream crossing has been heavily damaged, or failure has resulted in a washout (condition code 1), both are located on steep slopes in the frontal subwatershed where a road segment crosses a steep first order stream (Table 19). The Electric Creek road site has since undergone repair. All 27 of the crossing locations where there is a high risk of washout are displayed on Figure 19.

Table 2. Inventoried Road Washouts at Stream Crossings on ODF Land.

Subwatershed	Road Segment
Tillamook Bay	Electric Ck road @ unnamed trib to Larsen Ck
	Larsen Ck spur #1-10-27.3 @ unnamed trib. to bay

The inventory also included surveys of 342 cross drains. These primarily were culvert cross drains. However, other types such as waterbars were also inventoried, but only where they were functioning poorly and there was noteworthy erosion as a result. Sixty-four percent (220) of the surveyed cross drains were functioning properly. They posed no immediate erosion hazard (condition codes 4 and 5).

There were 90 (26%) cross drains where flow is partially blocked (condition code 3). These are sites where storm flow could become impeded resulting in overflow or rerouting that could potentially lead to accelerated erosion. These sites are considered to be a moderate erosion hazard.

There were 28 inventoried cross drains that were either not functional, or were mostly blocked, and resultant erosion was evident (condition codes 1 and 2). Four other sites were observed where the installation of a cross drain structure could avert recurring erosion. All 32 of these sites are considered to be a high erosion hazard, and represent a potential risk to fill slopes (Table 20). Their locations are displayed on Figure 19. Another cross drain site, which failed after the road condition inventory had been completed but was observed during field reconnaissance, is located in the Upper Miami on the Miami River road just uphill from the junction of recently decommissioned spur #2-9-11.

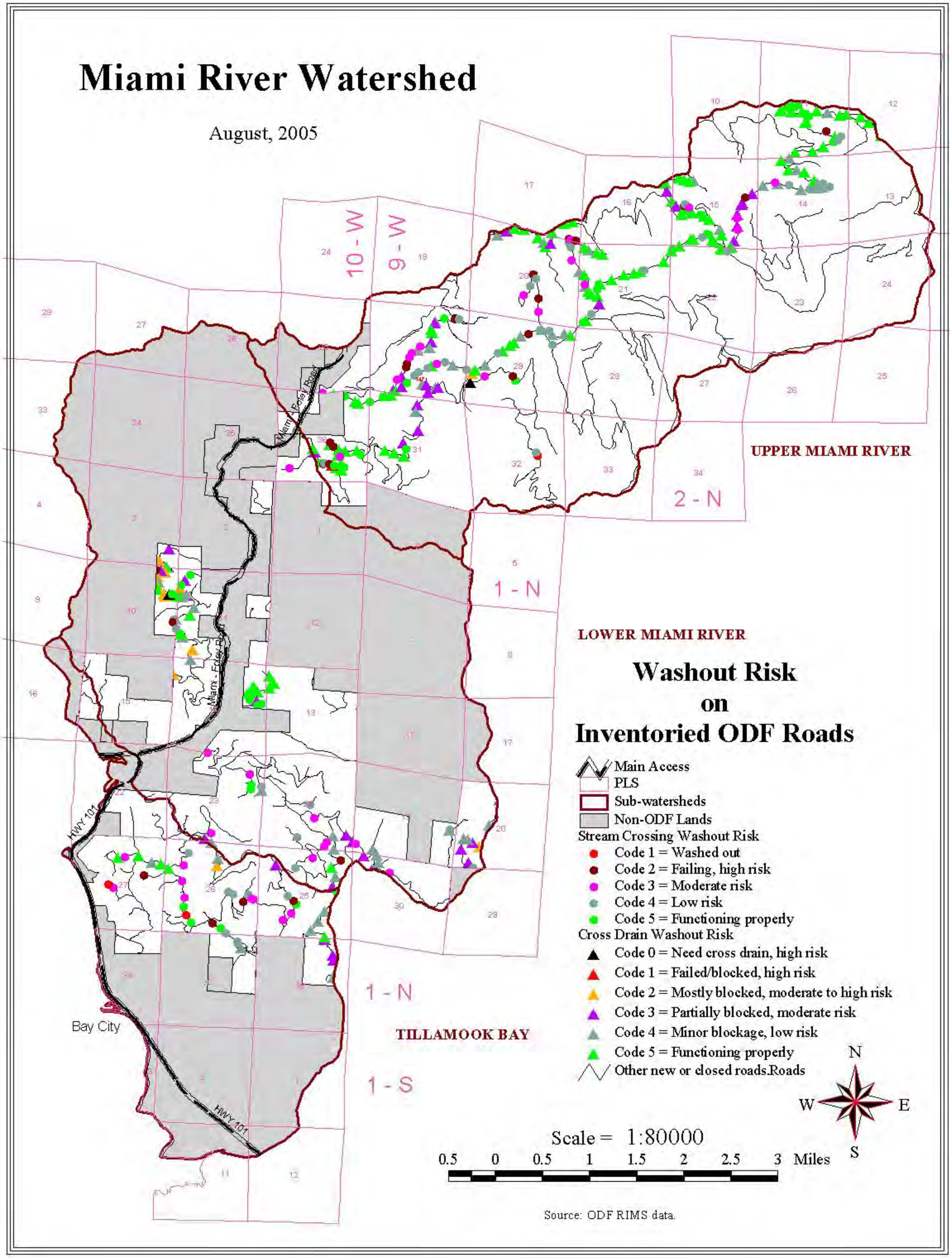

Figure 1. Stream crossings with a high risk of washout on ODF lands in the Miami River Watershed Project Area.

Table 1. Count of Inventoried Cross Drains by Select Condition Code on ODF Land.

Subwatershed	Condition Code 0	Condition Code 1	Condition Code 2
Lower Miami	1	1	18
Upper Miami	3	2	3
Tillamook Bay		1	3
Total	4	4	24

Key to Cross Drain Condition Codes:

0. cross-drain needed
1. cross-drain has completely failed or blocked; direct sediment delivery into stream, fill washing out or sliding; not easily passable
2. cross-drain mostly blocked due to damage or debris; or gully developed at culvert outlet and extending beyond road

4.4.3.3 Hydrologic Connectivity

The RIMS inventory evaluated road segments and their connection to the stream network. Segment lengths that drain directly into a stream at a crossing, or that contribute to a cross drain that delivers outflow to a stream were measured. Roads that cross many streams have a high potential to be hydrologically connected to the stream network. Structural elements of the road prism can intercept and divert flow to streams, in effect lengthening the stream network. Where road systems have expanded the stream network substantially, hydrologic processes can become altered, particularly runoff and peak flow processes.

Cross drains emplaced at intervals on roads help truncate the expansion of the stream network, and reduce the hydrologic connection. It is estimated using the RIMS data that 20 percent of the inventoried road miles on ODF land are directly connected to the stream network. Figure 20 depicts the stream crossings and cross drains that are hydrologically connected to a water body.

Out of the 432,575 feet of road surveyed using the RIMS protocol, only 85,444 feet was connected to streams. This is 20 percent of the road system. Most of this connection occurred at stream crossings, with 149 out of 157 of stream crossings having hydrologic connection. Of the 335 cross drain culverts, only 50 had hydrologic connection to streams. The percentage of surveyed road segments with hydrologic connection is lower than all known surveys of forest roads. For example, a similar survey for the adjacent Kilchis watershed analysis in 1995 found between 25 and 39 percent of the road connected to streams, a percentage comparable to the statewide average determined by monitoring at that time (K. Mills pers. comm.).

Road segments with over 500 feet connection, with cross drains assigned a RIMS attention priority code for washout (high risk) of 0,1, or 2 are in need of immediate repair and should be candidate locations for a new culvert or waterbar.

Noteworthy segments of road on ODF land that are highly connected to the stream network include the Miami River Road between Prouty Creek and the North Fork crossing, the lower segments of the Minich Creek Road, the Miami North Road, the Stuart Creek Road, and segments of the Patterson Creek Road.

There remain opportunities to further reduce hydrologic connection to streams on certain roads. The Miami Forest Road, for example, has 43 percent of its road length with hydrologic connection to the Miami River. This is a winter haul turbidity concern for this road. In addition, the just improved Electric creek road appears to have had no additional disconnecting culverts installed during recent repairs.

4.4.3.4 Anecdotal Observations

During field reconnaissance, evidence of road related erosion on non inventoried roads on ODF land was observed. These were sites that were not identified during RIMS surveys, but were judged to be other sources of road-related sediment. The location of these sites was noted along with anecdotal observations. These observations are not intended to represent a comprehensive listing or survey of un-inventoried road conditions.

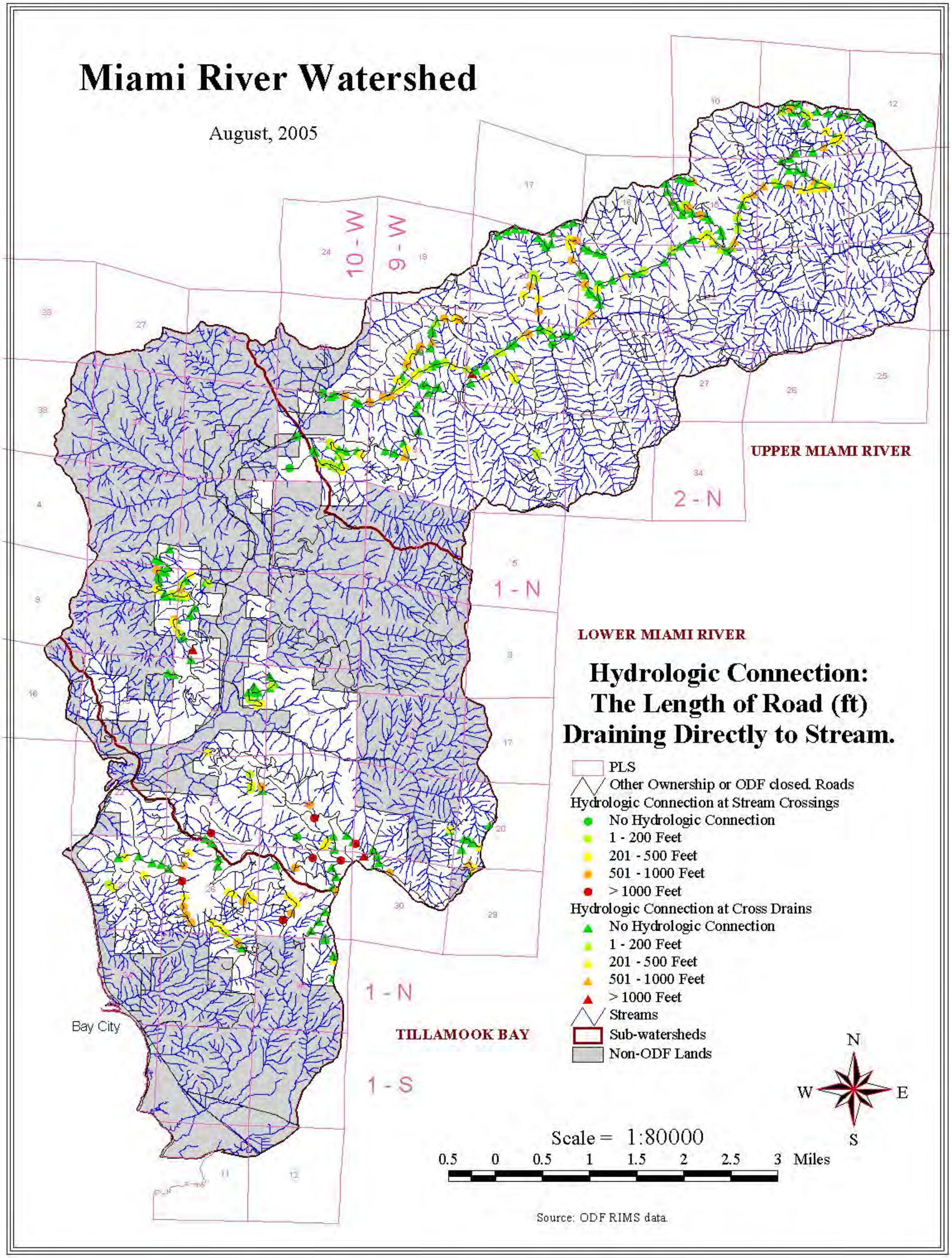

Figure 2. Road segments on ODF lands draining directly to streams in the Miami River Watershed Project Area.

The Main Miami River road between Diamond and Powderhouse Creeks is immediately adjacent to the river has undergone repair and armoring, as well as some relocation in the recent past to prevent damage from high flows. These improvements should minimize impacts and erosion, however, several segments impinge upon the channel and could still be impacted during high flows.

Noteworthy gully erosion associated with roads was observed on:

- the lower segment of the closed 2-9-22.2 road off of the South Miami road,
- a stream crossing on the decommissioned 2-9-11 road where the culvert has failed and the remaining fill has been deeply eroded

Sites where ravel erosion steadily contributes sediment to ditch lines, potentially contributing to the failure of drainage structures (i.e. ditch lines or cross drains) were observed where steep, relatively bare backslopes are located. These included:

- segments of Stuart Ck rd,
- recently reconstructed spurs off the Stuart Creek road,
- steep full bench sections of the upper segments of the Miami River road,
- lower segments of the Diamond Creek road,
- steep grades of the Miami West and Miami North roads,
- lower segments of the Foley road,
- lower and upper segments of Fire Break 3 road,
- lower segments of the Electric Creek road north of Bay City,
- upper segments of the Patterson Creek road

Heavy ground disturbance and bare soil conditions were observed in areas where high OHV use occurs, and where potentially illegal off-road recreation trails are located. These included:

- powerline access roads in the Electric, Larsen, and Patterson Creek drainages,
- unnamed spurs off the Electric Creek road just north of Bay City,
- the closed segments of the South Miami road,
- closed spur 2-9-22.2 off of the South Miami road

Recent road improvement, upgrade, and reconstruction projects have been completed, or are in progress on upper segments of:

- Miami River road between the North Fork and the top of the watershed divide
- Powderhouse Creek road system
- Electric Creek road between the ODF boundary north of Bay City and Electric Creek. Note: Recent repairs were made but without reducing the hydrologic connection (i.e., installation of cross drains).

Conditions on unsurveyed roads have not been evaluated. Road surveys conducted by ODF between 1997 and 1999 contain information stored in the Road Information System (RIS) database. Some of these are located on steep terrain where drainage and stability factors could be a concern; and where road related landslides and erosion may have an effect on aquatic and riparian habitat. These include:

- the closed segments of the Lower Moss Creek road,
- recently constructed and reconstructed spurs off of the Stuart Creek road,
- the entire Powderhouse Creek road network,
- the closed 2-9-21 road network east of Powderhouse Creek,
- abandoned sections of the South Miami road that extend into the upper reaches of the South Fork,
- the closed 2-9-22.2 road network off of the South Miami road
- an assortment of small, local closed and overgrown spurs off of the Doty Hill, Illingsworth, Minich, and Stuart road networks

Sites where rock sources for road construction have been recently worked are in close proximity to streams. Bare soil conditions are prevalent, and fine sediment is exposed.
- Junction of Foley and Miami River roads
- upper most segment of Miami River road just below the divide

4.5 Water Quality

A thorough and comprehensive analysis of water quality in the Miami watershed is presented in the existing E&S study, and for the sake of brevity is summarized here. Additional and equally comprehensive analyses of water quality are presented in the Kilchis Watershed Assessment and the Trask Watershed Analysis (ODF/BLM 2003). Those analyses are used to address select water quality issues associate with the streams in the Tillamook Bay subwatershed because they occupy the same coastal plain, are subject to similar land use, and have similar designated beneficial uses. These documents are incorporated here by reference, and supply an abundance of detailed data regarding water quality conditions that are applicable to conditions in the project area.

The beneficial uses designated by DEQ for all streams and tributaries in the North Coast Basin, including those in the project area are listed in Table 21. Beneficial uses considered sensitive include salmonid spawning and rearing and water contact recreation. Water quality evaluation criteria for designated beneficial uses are listed for each basin in the Oregon DEQ Water Quality Standards. A default list, which is applicable to most of the streams in the North Coast Basin is displayed in table 7.4 of E&S (2001) and Chapter 8 of the OWAM. Parameters that the evaluation criteria are applicable to include: temperature, dissolved oxygen, pH, nutrients, bacteria, turbidity, and organic and metal contaminants.

Table 2. Beneficial uses applicable to all stream reaches in the Miami River Watershed Project Area.

Public domestic water supply	Salmonid fish spawning
Private domestic water supply	Resident fish and aquatic life
Industrial water supply	Wildlife and hunting
Irrigation	Fishing
Livestock watering	Boating
Anadromous fish passage	Water contact recreation
Salmonid fish rearing	Aesthetic quality

Source: E&S 2001

For the project area, the Miami River from its mouth to Stuart Creek is the only stream segment in the project area listed on the 1998 303(d) list of limited water bodies (E&S 2001). From the mouth to Moss Creek it is limited due to exceeding the established temperature criteria for salmonid rearing and spawning. The reach from the mouth to Stuart Creek is listed due to exceeding established criteria for bacteria. These reaches are the only reaches of the Miami that are listed in the project area. Both reaches flow through private non-industrial lands and are downstream of ODF lands.

Water quality data indicate that since there was a somewhat frequent incidence of water monitoring samples that exceeded the evaluation criteria for temperature, nitrogen, and bacteria; that the Miami River may be impaired. Based on Oregon Water Quality Index values, the Miami River exhibits water quality ranges from fair during summer, to good during fall, winter, and spring.

The 303(d) temperature listing for the Miami River applies to the low gradient, wide reach below Moss Creek where conversion from forest to agriculture land use has occurred and riparian vegetation is sparse. Further upstream on ODF lands however, temperature monitoring has not revealed any exceedance of temperature parameters, even during summer low flows, suggesting that the potential for stream temperature to be a limiting factor in the critical reaches in the upper Miami is low for salmonid beneficial uses. Based on an evaluation of potential shade conducted as part of this analysis, there is an adequate range of shade levels on ODF lands (see Analysis Section; Limiting Factors Analysis).

Beneficial uses in the Tillamook Bay subwatershed are the same as those listed in Table 21. The most sensitive beneficial use in these streams is salmonid spawning and rearing. A cursory examination of water quality data for the frontal streams, specifically Patterson and Vaughn Creeks indicates that there has been a frequency of exceedance detected for temperature, bacteria, and nutrients. All the samples collected came from the lower reaches of the frontal streams, which flow through private non-industrial urban, rural residential, and agricultural lands.

4.6 Fisheries, Aquatic Habitat and Amphibians

A considerable amount of historical information and current data has been compiled and summarized for fish species and their habitats in Tillamook Bay and in the Miami River watershed, specifically (TNEP 1998, TBNEP 1996, E&S 2001, ODFW 2005). This assessment incorporates these documents by reference. This assessment will focus on summarizing key fisheries information in preparation for the subsequent "analysis" phase, which will provide the rationale for basing management recommendations, and identifying restoration opportunities on ODF administered lands in the Miami River Watershed and adjacent frontal subwatershed. Information to be discussed here will focus on:

- presence and distribution of fish species,
- potential passage barriers and associated blocked stream miles,
- current habitat conditions,
- location of critical habitats on ODF lands,
- and, potential presence of selected amphibians.

4.6.1 Fish Presence and Distribution

Anadromous fish species known to occur in the mainstem and most tributaries of the Miami basin, are coho salmon (*Oncorhynchus kisutch*), fall Chinook salmon (*O. tshawytscha*), chum salmon (*O. keta*), and winter steelhead (*O. mykiss*). These species are distributed throughout the watershed to varying degrees. Chum and Chinook salmon spawn and rear in the low gradient portions of the Miami River and into the lower reaches of some tributaries (Figure 21 and 22). Coho salmon and winter steelhead are found throughout the mainstem and larger tributaries (Figure 23 and 24).

On figures 21 – 24, species distribution is designated by life stage. Here life stages are defined as type of use during a specific stage in the species time in fresh water. Spawning and rearing refers to areas used by the species for spawning and once emerged, areas conducive to juvenile rearing and growth. Rearing and migration refers to areas where juvenile rearing occurs as well as migration of adults and juveniles. No spawning is likely to occur in these areas. Similarly, migration refers to areas where the species (adult or juvenile) travels though but does not spend sufficient time in order to spawn or rear.

In 1998, coho salmon were listed as threatened under the federal Endangered Species Act (http://www.nwr.noaa.gov/). However, the listing status of Oregon coastal coho salmon is currently under review.

Resident and anadromous cutthroat trout (*O. clarki clarki*) and Pacific lamprey (*Lampetra tridentata*) are present. Native non-salmonid species are present in the watershed, but their distributions are not known at this time. Additionally, the presence of exotic or non-native species is not known or documented at this time.

The distribution of anadromous fish varies depending on the species habitat needs at various life stages. Fish distribution by general life stage category is illustrated in Figures 21-24 (www.streamnet.org). Streamnet estimates fish distribution based on a 1:100,000-scale streams layer (Figure 25 and Table 22). It is likely that fish distribution is more extensive than portrayed by , particularly for winter steelhead and coho salmon.

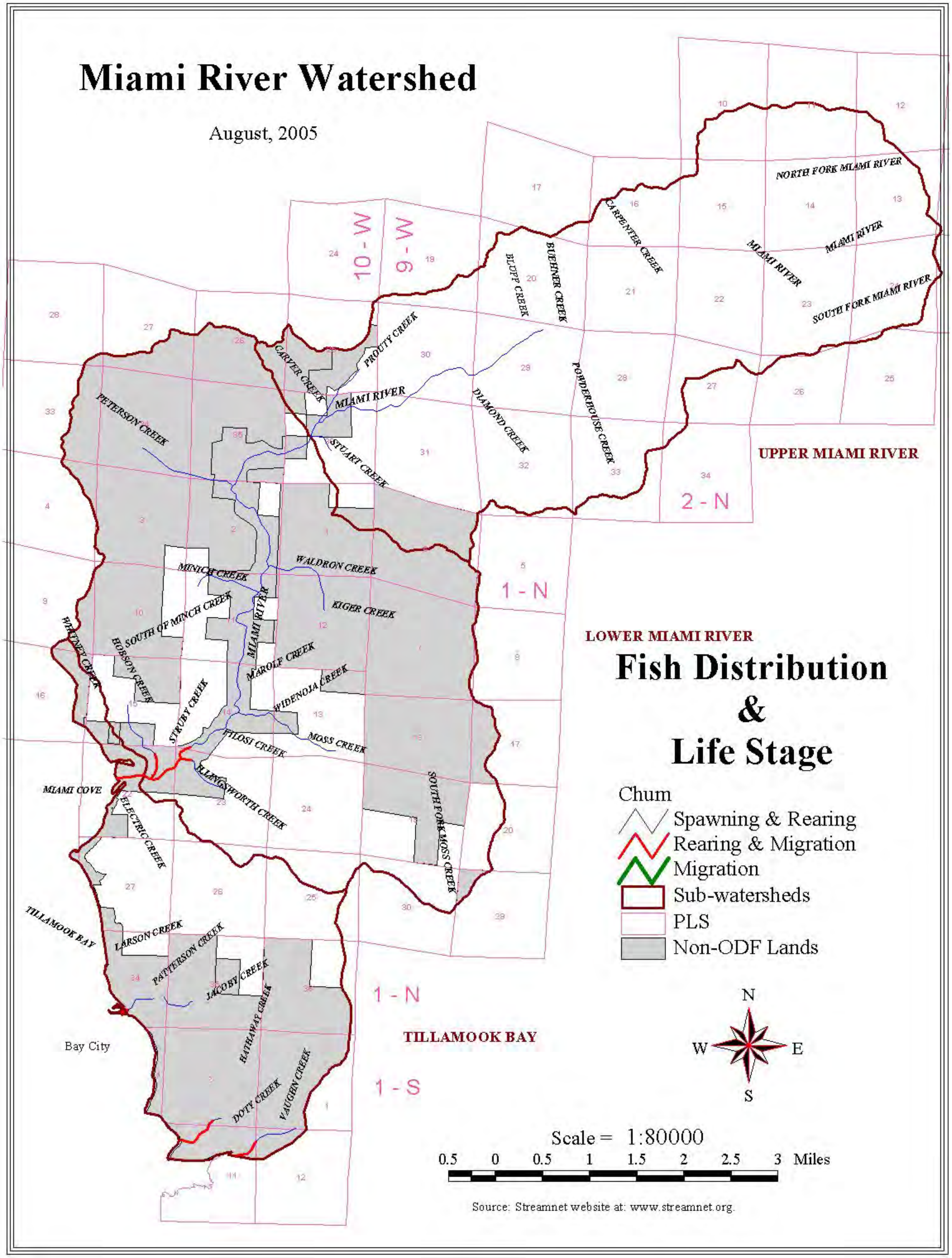

Figure 1. Estimated chum salmon distribution in the Miami River Watershed Project Area.

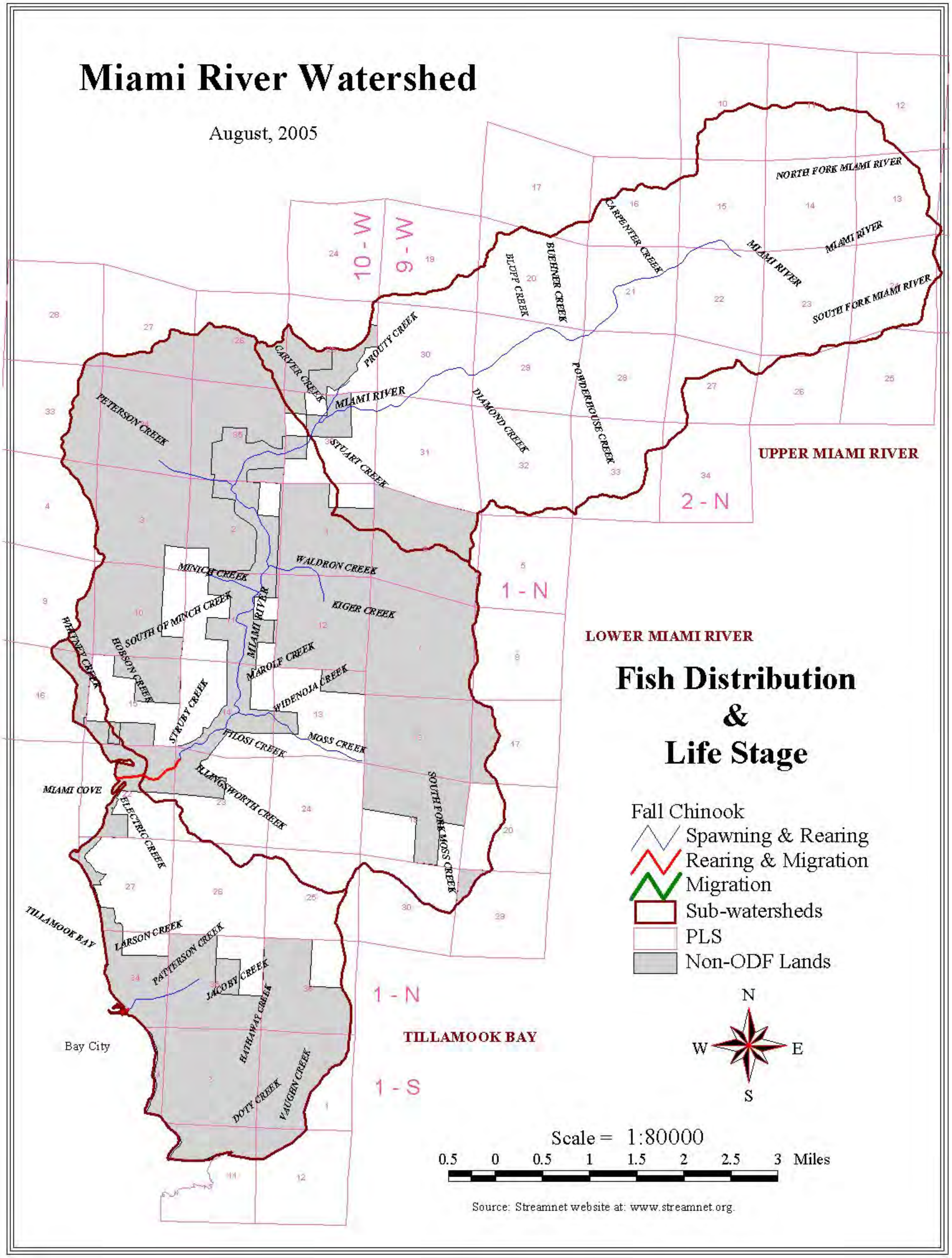

Figure 2. Estimated fall Chinook salmon distribution in the Miami River Watershed Project Area.

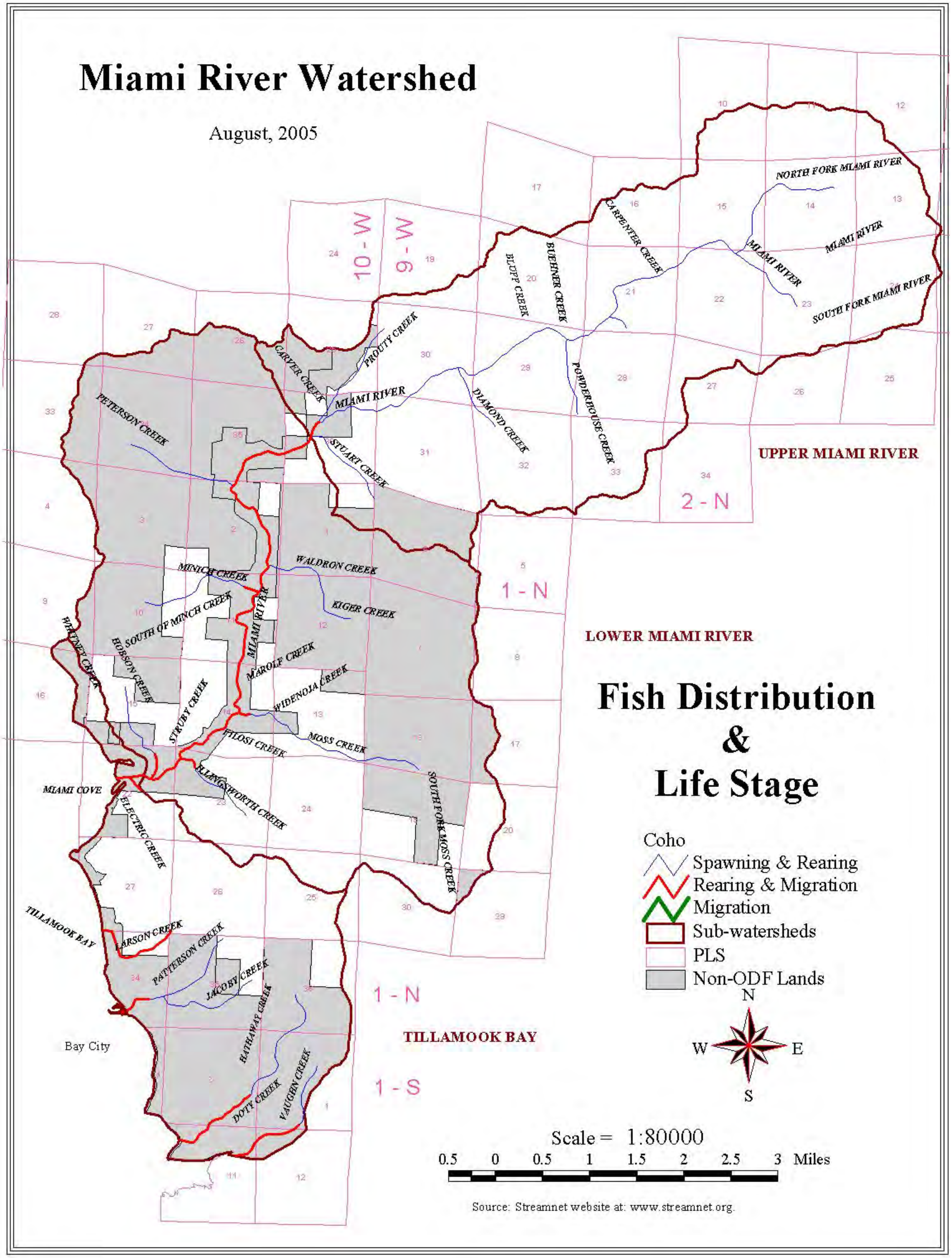

Figure 3. Estimated coho salmon distribution in the Miami River Watershed Project Area.

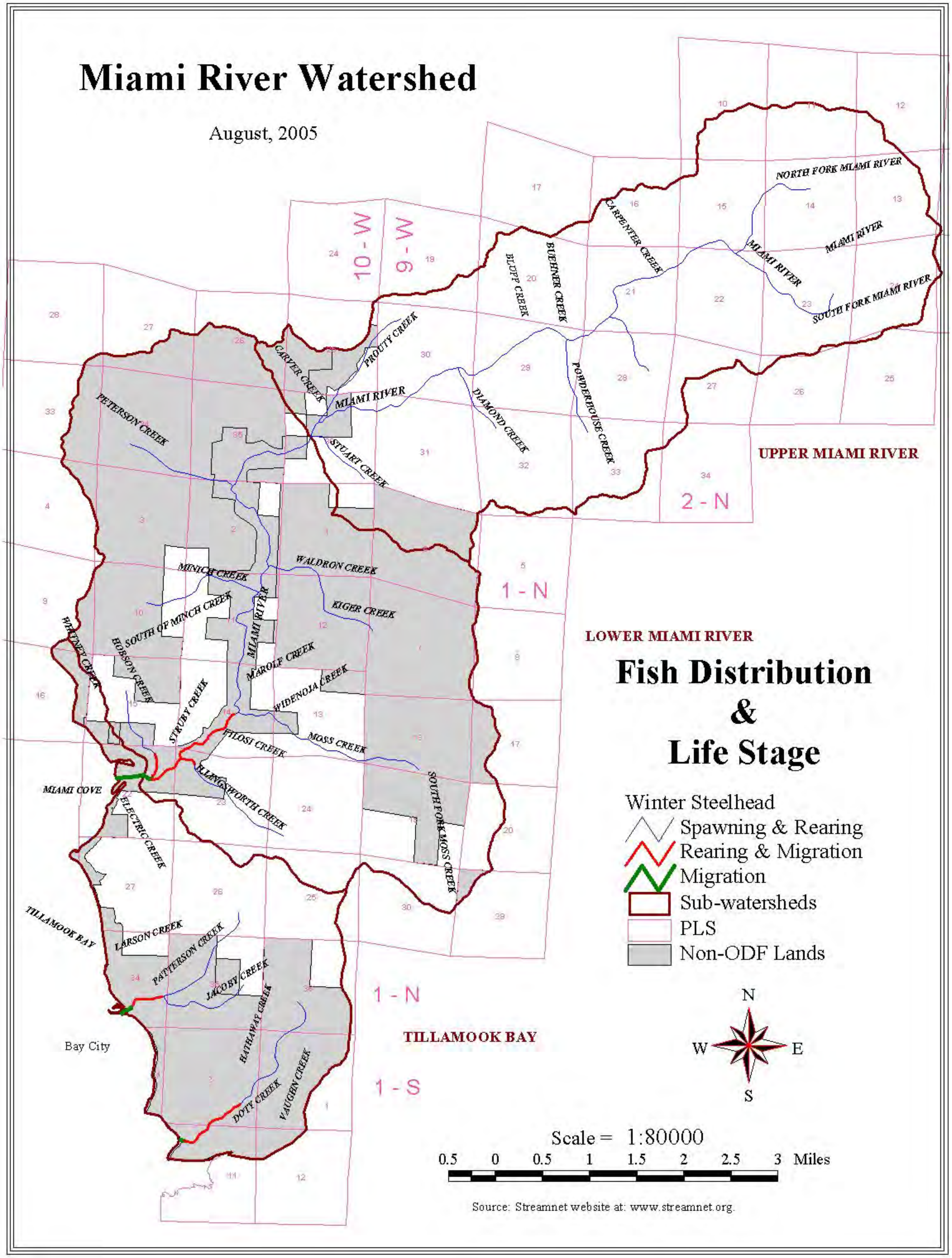

Figure 4. Estimated winter steelhead distribution in the Miami River Watershed Project Area.

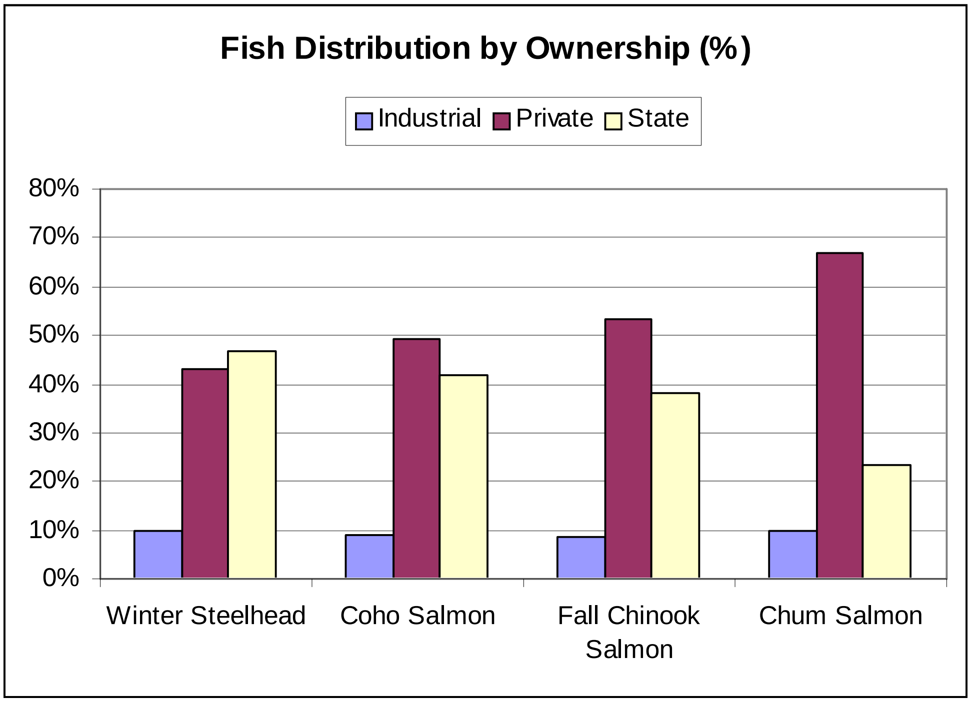

Figure 5. Fish distribution as a function of ownership (in percent) for the Miami River Watershed Project Area.

Table 1. Miles of fish distribution by ownership and general life stage category for the Miami River Watershed Assessment project area (www.streamnet.org).

UPPER MIAMI RIVER

Fish Species	Industrial	Private	State	Total
Winter Steelhead				
Spawning and Rearing	0.00	1.16	12.09	13.25
Rearing and Migration	0.00	0.00	0.00	0.00
Migration	0.00	0.00	0.00	0.00
Total	0.00	1.16	12.09	13.25
Coho Salmon				
Spawning and Rearing	0.01	0.97	11.03	12.00
Rearing and Migration	0.00	0.19	0.01	0.19
Migration	0.00	0.00	0.00	0.00
Total	0.01	1.16	11.03	12.20
Fall Chinook Salmon				
Spawning and Rearing	0.00	0.88	0.00	0.88
Rearing and Migration	0.00	5.43	0.00	5.43
Migration	0.00	0.00	0.00	0.00
Total	0.00	6.31	0.00	6.31
Chum Salmon				
Spawning and Rearing	0.00	0.99	3.04	4.03
Rearing and Migration	0.00	0.00	0.00	0.00
Migration	0.00	0.00	0.00	0.00
Total	0.00	0.99	3.04	4.03

LOWER MIAMI RIVER

Fish Species	Industrial	Private	State	Total
Winter Steelhead				
Spawning and Rearing	3.27	6.46	2.72	12.45
Rearing and Migration	0.00	1.70	0.00	1.70
Migration	0.00	0.09	0.00	0.09
Total	3.27	8.25	2.72	14.23
Coho Salmon				
Spawning and Rearing	2.98	2.17	2.18	7.33
Rearing and Migration	0.00	6.07	0.12	6.20
Migration	0.00	0.00	0.00	0.00
Total	2.98	8.25	2.30	13.52
Fall Chinook Salmon				
Spawning and Rearing	1.42	6.39	0.97	8.77
Rearing and Migration	0.00	0.48	0.00	0.48
Migration	0.00	0.00	0.00	0.00
Total	1.42	6.86	0.97	9.25
Chum Salmon				
Spawning and Rearing	1.74	7.16	1.00	9.89
Rearing and Migration	0.00	1.09	0.00	1.09
Migration	0.00	0.00	0.00	0.00
Total	1.74	8.25	1.00	10.98

TILLAMOOK BAY

Fish Species	Industrial	Private	State	Total
Winter Steelhead				
Spawning and Rearing	0.04	3.27	0.54	3.85
Rearing and Migration	0.00	1.15	0.00	1.15
Migration	0.00	0.40	0.00	0.40
Total	0.04	4.81	0.54	5.39
Coho Salmon				
Spawning and Rearing	0.04	4.03	0.31	4.38
Rearing and Migration	0.00	3.09	0.46	3.56
Migration	0.00	0.00	0.00	0.00
Total	0.04	7.13	0.78	7.94
Fall Chinook Salmon				
Spawning and Rearing	0.00	0.87	0.00	0.87
Rearing and Migration	0.00	0.34	0.00	0.34
Migration	0.00	0.00	0.00	0.00
Total	0.00	1.20	0.00	1.20
Chum Salmon				
Spawning and Rearing	0.00	1.27	0.00	1.27
Rearing and Migration	0.00	1.07	0.00	1.07
Migration	0.00	0.00	0.00	0.00
Total	0.00	2.34	0.00	2.34

4.6.2 Fish Passage Barriers

Fish distribution can be altered by the presence of fish passage barriers.
Potential barriers impeding the movement of anadromous and resident fish species (at various life stages) exist in the watershed. The Oregon Department of Fish and Wildlife (ODFW 2005) documented 25 barriers across all ownerships in the Miami River watershed as determined by Streamnet (www.streamnet.org) and ODF.

Culverts identified in the Streamnet barrier database are those that do not meet certain fish passage criteria, not necessarily those that prevent all fish at all times. Of the 21 barriers listed by Streamnet, 19 are culverts (the other two are a waterfall and a dam). Streamnet barrier number 3 identified in ODFW (2005) has apparently been removed and no longer poses as a barrier. Three identified barriers are thought to have partial passage. The remaining 18 are documented as either “non-blocking” or “unknown”, leaving considerable speculation as to the validity of the data. Streamnet barriers on non-ODF lands are displayed on Figure 26. Potential barriers on ODF lands will rely more specifically on road survey data and field verification where available.

In 2004, the ODF conducted a road survey known as RIMS. The survey was conducted on all Oregon State Forest roads open for winter travel in the Miami River watershed. Among general road condition characteristics, RIMS contains information related to fish presence and passage. Fish presence was categorized into four groups:

- known fish presence (known Type F stream),
- no fish presence (confirmed Type N),
- likely fish presence,
- and, unknown fish presence.

In addition, the passage capability of the stream crossing structure was documented as:

- adult barrier (> 2-foot drop, or bare culvert with >5% slope),
- juvenile barrier (>6-inch drop, or bare culvert without complete backwatering through entire culvert),
- or, full passage (<6-inch drop, or gravel in bottom of culvert, or complete backwatering).

Of the 154 stream crossings inventoried, the database identified 42 as potential barriers: 11 juvenile barriers and 31 adult barriers. The RIMS survey identified one certain barrier to all fish migration, and 3 additional barriers to juvenile migration in the 154 stream crossings surveyed. The one adult barrier included less than 150 feet of usable habitat above the crossing before waterfalls naturally block all fish passage.

This survey also identified likely and possible barriers based on stream characteristics. Likely barriers mean that the stream below the crossing had physical characteristics of a fish bearing stream. Many of these likely barriers may be on streams that do not contain fish because of barriers downstream. The RIMS survey identified 6 possible adult barriers and an additional 2 juvenile barriers in this category. If there are no accurate fish presence surveys in these areas, such surveys should be a priority in these 8 locations.

Unknown barriers include all streams where physical characteristics below the crossing could not rule out fish passage. There were 24 adult barriers and an additional 6 juvenile barriers in this category. These would be marginal fish habitat if fish use were found below the crossing, and should be a moderate priority for survey if such surveys are not already available.

RIMS barrier data was further refined based on limited field reconnaissance. Potential barriers were grouped into four categories: known natural barriers, Streamnet non-ODF barriers, ODF barriers unconfirmed, and ODF barriers confirmed (Figure 26). Barriers depicted in Figure 26 that are outside of the mapped fish distribution may be barriers to cutthroat trout.

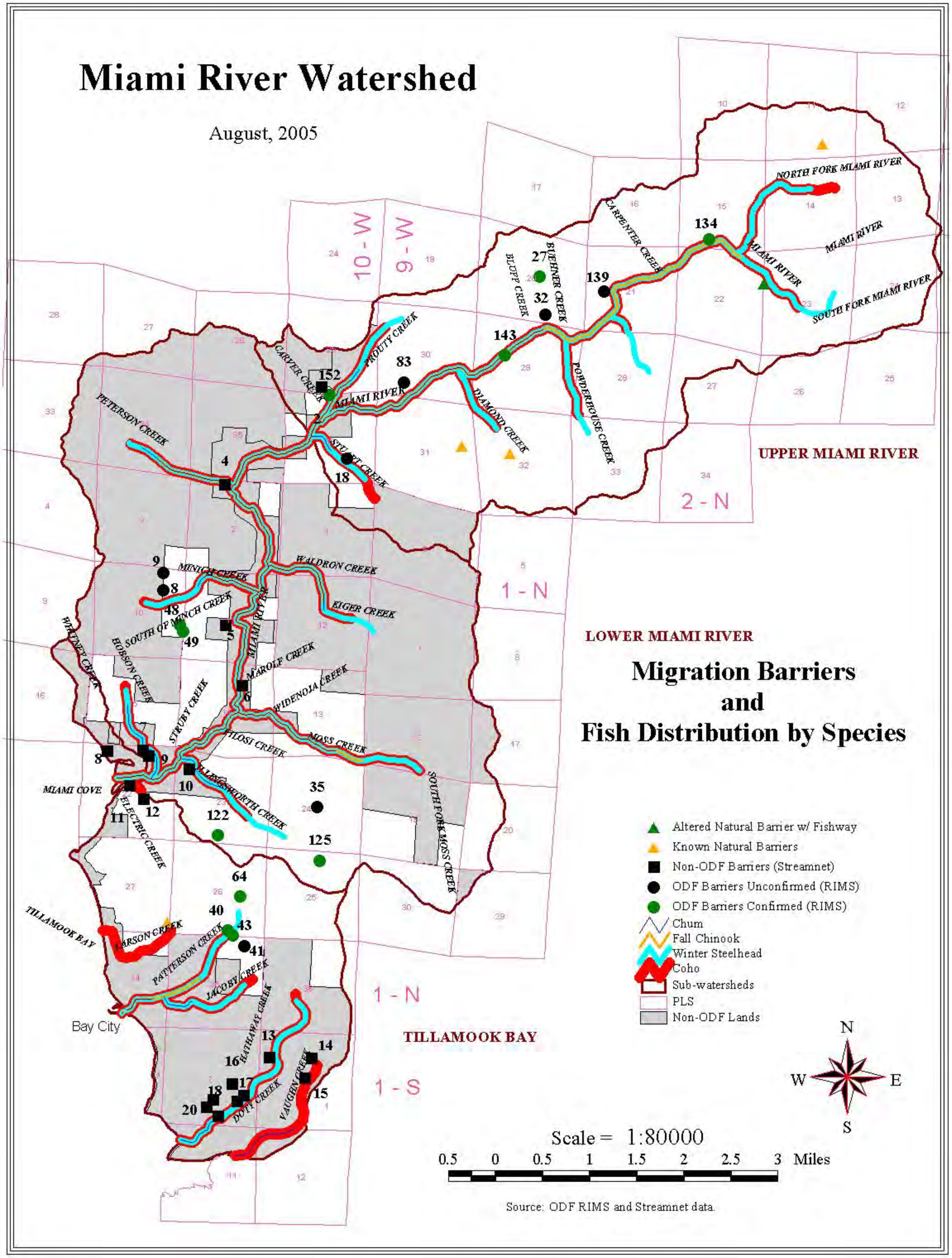

Figure 6. Map of fish passage barriers from RIMS and Streamnet and fish distribution by species for the Miami River Watershed Project Area.

There are five (5) barriers known to occur naturally. One of these is on the upper reach of the mainstem Miami River. This waterfall has a fishway and both coho and winter steelhead have been found above the falls, illustrating it is not a complete barrier. There are 19 barriers identified by Streamnet depicted on Figure 26. ODFW (2005) identified five (5) barriers (Streamnet barriers 10, 11, 12, 5, 6) located on private land that are potentially limiting fish access to streams on ODF lands. Possibly as much as 3.6 miles (5.8 kilometers) may be potentially blocked.

Eight stream crossings identified as potential barriers in the RIMS database need field verification to confirm their barrier status. These are identified on Figure 26 as “ODF Barriers Unconfirmed (RIMS)” and are locations 8, 9, 18, 32, 35, 43, 83, and 139. Twelve stream crossings were identified as likely barriers and identified on Figure 26 as “ODF Barriers Confirmed (RIMS)”. They are further described in Table 23.

Table 2. Fish migration barriers identified in RIMS and confirmed in the field.

RIMS ID#	Subwatershed	Fish Presence (RIMS)	Field Observation	Notes
27	Upper Miami	Fish	Fish	Barrier confirmed, culvert located at end of known fish presence in Buehner Creek.
40	Tillamook Bay	Unknown	Unknown	Barrier confirmed, however possible barrier downstream on private land (Patterson Creek)
41	Tillamook Bay	Unknown	Unknown	Barrier confirmed, however possible barrier downstream on private land (Patterson Creek)
48	Lower Miami	Likely Fish	Fish	Barrier confirmed. Fish observed during field review.
49	Lower Miami	Unknown	Fish	Barrier confirmed. Fish observed during field review.
64	Tillamook Bay	No Fish	Unknown	RIMS data indicates no barrier. Field review indicates likely fish and culvert with over 3-foot drop.
122	Lower Miami	Unknown	Unknown	Barrier confirmed. Stream was perennial 05 March 2005. Streamnet barrier #10 identified downstream on private land.
125	Lower Miami	Likely	Likely	Barrier confirmed.
127*	Upper Miami	Unknown	Unknown	Barrier confirmed. No fish presence because of downstream barrier.
134	Upper Miami	Likely	Likely	Barrier confirmed, limited habitat available above culvert.
143	Upper Miami	Likely	Likely	Barrier confirmed, limited habitat available above culvert.
152	Upper Miami	Fish	Fish	Partial barrier depending on flow conditions. Prouty Creek at edge of ownership.

*This barrier is not identified on the map since there is no fish presence and it is clearly above a natural barrier on the North Fork tributary to the North Fork Miami River.

4.6.3 Current habitat conditions

Aquatic habitat conditions in the Miami River watershed have been described in the Miami River Watershed Assessment (E&S 2001) and more recently in *Fish Habitat Assessment in the Miami Basin* (ODFW 2005). These assessments relied on stream survey data collected through the ODFW Aquatic Inventories Project from 1993 – 2003 specific to the Miami River and selected tributaries (Figure 27). The following is a summary of habitat conditions focusing on the key variables; fine sediments in the gravels, presence and abundance of pool habitat, quantity of instream large woody debris, and quality of summer and rearing habitat for coho salmon. A detailed account of the stream survey data can be found in ODFW (2005).

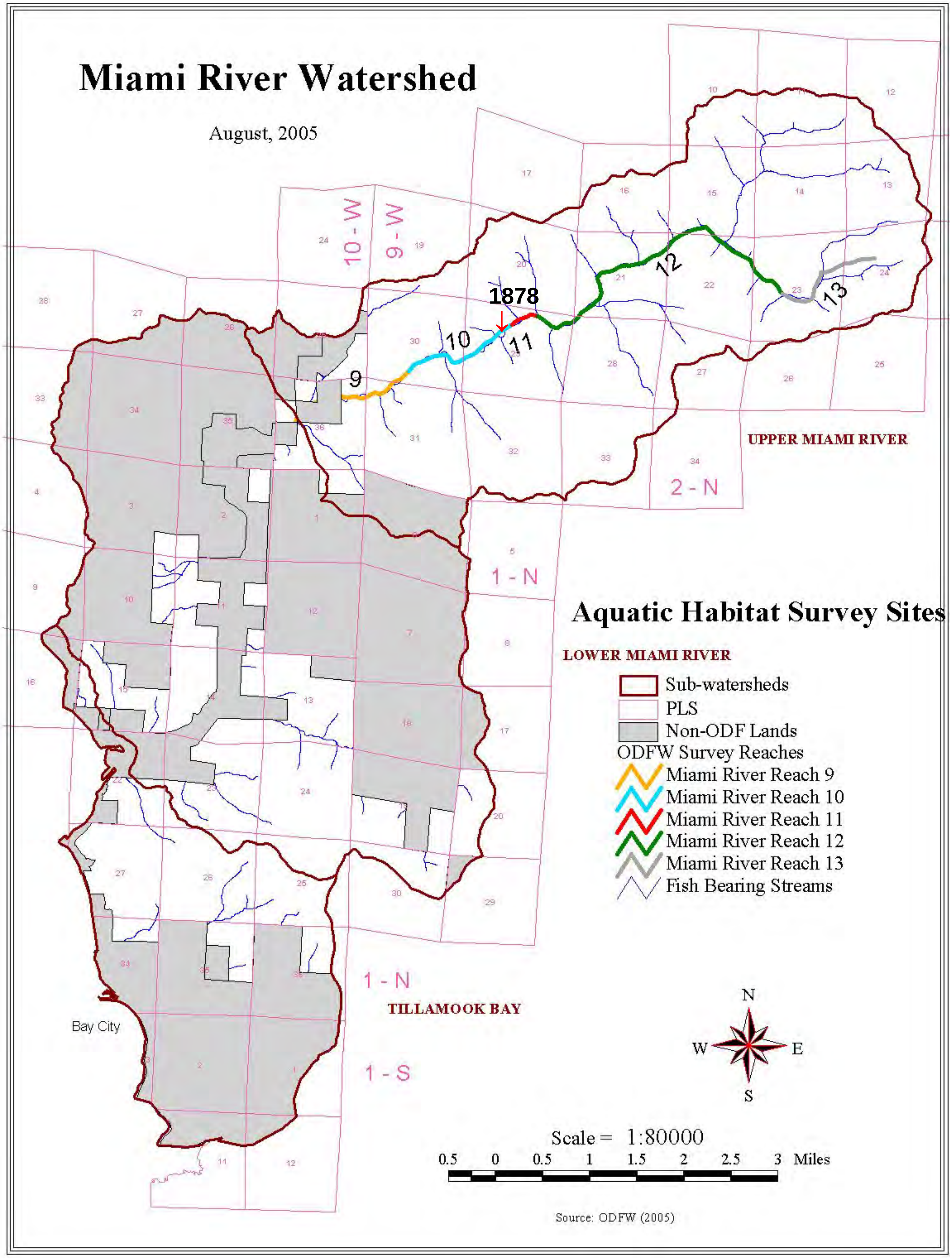

Figure 1. ODFW aquatic habitat survey sites on ODF lands within the Miami River Watershed Project Area (from ODFW 2005).

Qualitative ratings (low, moderate and high) describing habitat variables are used. These were established by ODFW (2005) based on “reference” values collected from reference sites between 1992 and 2003. Low, moderate and high represent the 25th, median, and 75th percentile, respectively, of the reference values. ODFW (2005) does not present correlations between these percentages and what would be expected in a natural range of variability. Therefore, a value (i.e. high >75%) does not necessarily represent a goal or target value.

4.6.3.1 Tillamook Bay Frontal Subwatershed

The only stream surveyed in this subwatershed was Vaughn Creek on private lands. The surveyed reaches had a low amount of pool habitat, due to the lack of deep pools and a low amount of secondary channel habitat. The amount of gravel in the streambed was good and the amount of fine sediments was low to moderate. Structural complexity was low due to the lack of large pieces of wood. Riparian zones lacked large conifer trees and shade levels were low.

Overall, summer and over-winter habitat capacity and quality was rated low for juvenile coho salmon in Vaughn Creek. The amount of pool habitat, number of deep pools, and amount of secondary channels was low providing for poor rearing habitat. This is likely due to extensive channel alterations caused by agriculture, rural residential and urban development. The lower reaches of Vaughn Creek, which are sensitive, low gradient channel types, are the most extensively modified reaches in the project area.

4.6.3.2 Lower Miami Subwatershed

Surveys were conducted on several tributaries to the Miami (Peterson Creek, Margary Creek, Moss Creek, Waldron Creek, Munich Creek), and the lower reaches of the Miami River, all of which are private lands. No surveys were conducted on ODF lands.

The surveyed tributaries had a low to moderate amount of pool habitat, but lacked deep pools. There was a moderate amount of secondary channel habitat. The amount of gravel in the streambed was moderate, and the amount of fine sediments was low to moderate. Structural complexity was good in the surveyed reaches, due to the amount of large pieces of wood. With the exception of Margary Creek, riparian zones lacked large conifer trees in all of the surveyed reaches, but shade levels were relatively high.

Overall, summer and over-wintering habitat capacity and quality was rated poor to fair for juvenile coho salmon in these tributaries. Despite moderate to good levels of large wood, the amount of pool habitat, number of deep pools, and amount of secondary channels was relatively low.

The surveyed reaches of the lower Miami River had an abundance of pool habitat, including deep pools and the amount of secondary channel habitat was high. The amount of gravel in the streambed was low and the amount of fine sediments was moderate. Structural complexity was low in the surveyed reaches, primarily due to the lack of large pieces of wood. Riparian zones lacked large conifer trees in all of the surveyed reaches, and shade levels were low. This can be expected since the lands adjacent to the lower reaches of the Miami River are of a grass/meadow composition.

Overall, summer habitat capacity and quality was rated fair for juvenile coho salmon in the lower Miami River. The amount of pool habitat, number of deep pools, and amount of secondary channels provide good rearing habitat. The number of low gradient stream miles in the tributaries also indicates good rearing potential.

Over-winter habitat capacity for coho salmon was rated as fair because of the abundance of pool habitat and size of stream, but the quality was low to fair. The streams lack slow-water pool habitat and few of the pools contained sufficient large wood to create complex habitats.

4.6.3.3 Upper Miami Subwatershed

Surveys were conducted on Prouty Creek and the mainstem Miami River upstream of confluence with Prouty Creek, all of which represent ODF lands. The surveyed reaches of streams had an abundance of pool habitat, including deep pools and the amount of secondary channel habitat was high. The amount of gravel in the streambed was moderate, but the amount of fine sediments was high, except in the most recent survey of reach 10. Structural complexity was low to moderate in the surveyed reaches, primarily due to the lack of large pieces of wood. Riparian zones lacked large conifer trees in all of the surveyed reaches, and shade levels ranged from low to high.

Overall, summer habitat capacity and quality was rated fair to high for juvenile coho salmon in the mainstem Miami River. The amount of pool habitat, number of deep pools, and amount of secondary channels provide good rearing habitat. The number of low gradient stream miles in the tributaries also indicates good rearing potential.

Over-winter habitat capacity for coho salmon was rated as fair to high because of the abundance of pool habitat and size of stream, but the quality was low to fair. The streams lack slow-water pool habitat and few of the pools contained sufficient large wood to create complex habitats.

4.6.4 Critical Habitats

Critical habitats for fish are designated channel habitat types that potentially contain large areas of preferred habitat conditions. In general, these are the low gradient (less than 4%) stream reaches important to anadromous and resident salmonids for spawning, rearing and migration. In the Miami River assessment area, all of the FP1, FP2, FP3, LM, MM, and MC channel habitat types (see Figure 28) can be considered critical or important to a species or specific life stage.

Critical habitats were identified for State lands by overlaying spawning and juvenile fish survey (ODFW 2005) information with the FP1, FP2, FP3, LM, MM, and MC channel habitat types. Coho salmon spawning surveys from 1998 to 2003 found that spawning occurred in the upper reaches of the Miami River, Prouty Creek, Stuart Creek and Moss Creek. This corresponds to habitat conditions in the upper Miami River subwatershed, which exhibit good conditions for coho salmon. Even though Moss Creek exhibits only poor to fair conditions for instream habitat, surveys indicate that coho salmon have an affinity for utilizing these habitats based on continued presence.

Figure 28 identifies approximately 10 miles of critical habitat on state lands (9.1 miles in the upper Miami River and on 1.1 miles in the lower Miami River subwatersheds).

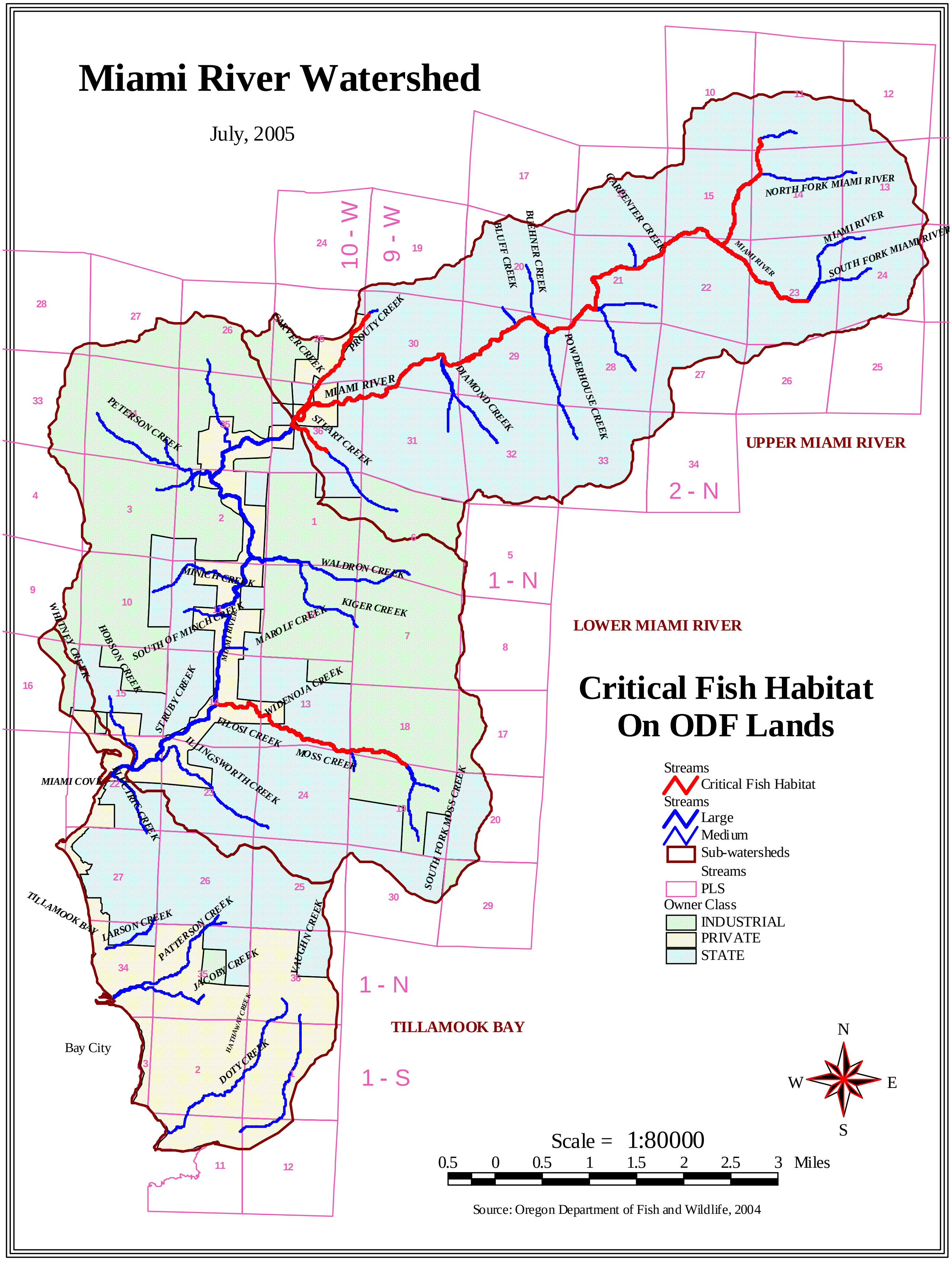

Figure 2. Potential critical fish habitat on ODF lands within the Miami River Watershed Project Area.

4.6.5 Torrent Salamanders and Tailed Frogs

4.6.5.1 Species Status

The Columbia torrent salamander (*Rhyacotriton kezeri*), also commonly known as the Columbia seep salamander, is classified by the ODFW as "Sensitive-Critical"*.* The species has Natural Heritage Network ranks of Global-3 and State-3 (ORNIC 2004). The tailed frog (*Ascaphus truei*) is classified by ODFW as "Sensitive-Vulnerable" and has Natural Heritage Network ranks of Global-4 and State-3 (ORNIC 2004). The U.S. Fish and Wildlife Service (USFWS) considers the tailed frog a Species of Concern in Oregon (USFWS 2004). Neither the torrent salamander nor tailed frog have been determined to be Threatened or Endangered under the Endangered Species Act.

4.6.5.2 Natural History

Columbia Torrent Salamander

The Columbia torrent salamander is one of four species (*R. olympicus, R. cascadae, R. variegatus,* and *R. kezeri*) in the genus *Rhyacotriton*. Until 1992, the genus was considered to be a single species, all of which were formally known as *R. olympicus*. The geographic ranges of the four species are almost entirely isolated from one another—the single exception being a possible area of overlapping ranges of *R. kezeri* and *R. variegatus* in southern Tillamook County, Oregon (Csuti et al. 1997). The Columbia torrent salamander occurs north of the Little Nestucca River and south of the Chehalis River in the Coast Range of Oregon and Washington (Good and Wake 1992). The four species of *Rhyacotriton* are morphologically very similar, but can be differentiated based on pigmentation features, minor variation among some life history characteristics (Good and Wake 1992), and genetics (Good et. al 1987). There is apparently little variation in habitat selection among the four species of *Rhyacotriton* (Good and Wake 1992).

Torrent salamanders are usually found along the wetted edge of steep streams, seeps, and waterfall splash zones. Torrent salamanders prefer cold environments and begin to exhibit signs of stress at relatively low temperatures (17.2 C) compared to other salamanders (Brattstrom 1963). The highest abundances of torrent salamanders are observed in water temperatures of 8-13 C (Welsh and Lind 1996). Adult torrent salamanders are occasionally found in moist, riparian environments as well. However, they are extremely vulnerable to desiccation in terrestrial environments. Ray (1958) demonstrated experimentally that torrent salamanders become physically incapacitated when subjected to more than a 7.4% loss of body water, a much lower threshold for water loss than any other salamander tested. Not surprisingly, torrent salamanders are only able to persist out of water in closed-canopy forests (Good and Wake 1992). Welsh and Lind (1996) suggested that torrent salamanders are dependent on the microclimate and habitat structure associated with late-successional forests. Diller and Wallace (1996) concluded that highly suitable microhabitats are most likely to exist in late-successional forests, but torrent salamanders are widespread in other habitat types.

Given its low tolerance for warm, dry environments, it would seem likely that torrent salamanders would prefer sites on northerly aspects. Diller and Wallace (1996) found evidence that torrent salamanders were more likely to occur in streams on northern slopes than other aspects when aspect measurements were averaged at a landscape-scale using a geographic information system (GIS). But the same study failed evidence of habitat selection for aspect at a microsite scale. This is not particularly surprising because stream water temperature (and presumably torrent salamander abundance) is more strongly affected by upstream conditions than aspect or other conditions at the point of temperature measurement. Another California study (Welsh and Lind 1996) tested, but failed to find a significant association between torrent salamander abundance and landscape-scale aspect.

Torrent salamanders reportedly are most abundant in streambed substrates composed of coarse gravel and cobble (Good and Wake 1992, Diller and Wallace 1996, Welsh and Lind 1996). The interstitial spaces among streambed particles are used as oviposition sites and hiding cover by adults and larvae. Good and Wake (1992) report that adult salamanders tend to be found among rocks, while larvae tend to use coarse gravel. Welsh and Lind (1996) suggest that stream reaches having a variety of particle sizes provides the most suitable torrent salamander habitat for hiding, foraging, and reproduction. However, habitat is degraded where interstitial spaces become filled with sand or fine sediment. Lowell and Diller (1996) found that consolidated geological formations (vs. unconsolidated sedimentary formations) and stream gradient were among the best predictors of torrent salamander occurrence. The authors believed the relationship could be explained by the relatively large streambed particles that result from the decomposition of consolidated bedrock, and the downstream transport of fine particles caused by fast water moving down steep slopes.

Tailed Frog

In Oregon, tailed frogs are distributed throughout the Coast Range, Siskiyou region, western Cascades, and the Blue Mountains (Csuti et al. 1997).

Tailed frogs are almost always associated with cold, mountain streams. Unlike most other frogs in the Pacific Northwest, the species does not use lakes or wetlands. deVlaming and Bury (1970) reported that first year tailed frog tadpoles tend to prefer water temperatures <10° C, while older tadpoles prefer temperatures 10-22° C. In a stream amphibian survey conducted in the Kilchis River basin (Tillamook Co., OR), water temperatures where tailed frogs were captured averaged 11.2° C (Pacific Wildlife Research, unpublished data)

Adult tailed frogs are also found outside of stream channels in riparian and upslope forests (Gomez and Anthony 1996, McComb et al. 1993). Research on tailed frogs does not clearly describe a relationship between forest conditions and tailed frog occurrence or abundance. However, Blaustein et al. (1995) suggested that tailed frogs are among the amphibian species most sensitive to the loss of old-growth forests in the Pacific Northwest. Furthermore, Gomez and Anthony (1993) found tailed frogs to be more abundant in large conifer and old-growth forests than in younger forest types in the Oregon Coast Range. In contrast, Bull and Carter (1996) did not find evidence of a relationship between tailed frog abundance and timber harvest intensity in northeastern Oregon. Wahbe and Bunnell (2003) concluded tailed frog abundance was more strongly affected by stream microhabitat features than the logging history of the site.

Cobbles and large rocks in stream channels are important habitat elements for tailed frogs. Tailed frog tadpoles use a specialized oral disk to attach themselves to cobbles and boulders while feeding on diatoms and periphyton (Altig and Brodie 1972, Bull and Carter 1996). The interstitial spaces between rocks are used as oviposition sites and as hiding cover by tadpoles and adults.

4.6.5.3 Population Distributions in the Miami Watershed

A review of scientific literature, state and federal agency reports, and watershed analyses for the Miami River basin failed to reveal any evidence that the watershed has ever been systematically surveyed for stream-dwelling amphibians. However, there are a number tailed frog observations recorded throughout the watershed during fish surveys conducted from 2002 to 2004 (Table 24). Without systematically collected amphibian data from the Miami River watershed, predicting the distribution of torrent salamanders and tailed frogs in unsurveyed reaches is tempered by a great amount of uncertainty. Research conducted on torrent salamanders and tailed frogs have described general associations between the probability of their occurrence and variations in the physical or biological environment. Such associations have been commonly used to make spatially-explicit, model-based inferences about other wildlife population distributions—providing that the requisite habitat data are available for the area of interest. In the case of torrent salamanders and tailed frogs, research indicates that water temperature, stream gradient, average streambed particle size, and possibly forest seral stage best indicate the likelihood of their occurrence. This information was collected during ODFW aquatic inventory surveys conducted in the Miami watershed, but the surveys were restricted to stream reaches where salmon are present. Torrent salamanders and tailed frogs are able to utilize headwater habitats that are inaccessible to anadromous fish. Thus, model-based maps of stream amphibian distributions must either be limited to the geographic extent of ODFW inventory data, or rely on a set of indicators that are assumed to be reliable surrogates for the water temperature, streambed particle size, and other requisite variables. The former approach would be unable to meet the information needs of ODF, while the latter approach would require research and fieldwork unaffordable for this assessment.

Anecdotal observations of tailed frog tadpoles recorded during fish surveys suggest that the species is probably well distributed throughout the Miami watershed. No similar observations were made of torrent salamanders in the watershed. However, a 1998 amphibian survey that included 33 stream reaches in the Kilchis watershed resulted in a dataset (Pacific Wildlife Research, unpublished data) that may offer some further information as to the general distribution of torrent salamanders and tailed frogs in the Miami watershed. The Kilchis River lies immediately southeast of the Miami River and the two watersheds are generally similar in geology, topography, stream habitats, and forest cover (See Figures 29-32). Only the lowest reaches of the mainstem Kilchis River (elevation <100 ft ASL) were excluded from the survey because investigators assumed they were unsuitable for most stream-dwelling amphibians. Survey results indicate that torrent salamanders and tailed frogs were widespread throughout the upper Kilchis watershed. Torrent salamanders were observed at 61% of the surveyed reaches and tailed frogs were observed at 81% of the reaches. A visual examination of survey locations classified by number of individuals animals counted and overlaid on maps of elevation, bedrock geology, stream size classes, and timber size classes does not reveal any strong pattern of torrent salamander or tailed frog abundance with any of the four landscape features (Figures 29-32). It seems likely that the two species could potentially be present in any reach of the Upper Miami or Moss Creek sub-basins based on their proximity and similarity to the Kilchis watershed. More precise estimates of torrent salamander and tailed frog distribution in the Miami watershed will require more information about microhabitat conditions in all permanent and intermittent stream reaches than is currently available in the watershed.

Table 1. Observations of tailed frog tadpoles in the Miami River watershed recorded during fish surveys performed from 2002 to 2004. Source: Dave Plawman, ODFW Tillamook Office.

YEAR	STREAM	UTM EASTING	UTM NORTHING	TADPOLE COUNT
2002	NORTH FORK MIAMI R.			2
2003	POWDERHOUSE			10
2003	UN-NAMED TRIB [A] TO MIAMI R.	436732	5052398	5
2003	UN-NAMED TRIB [B] TO MIAMI R.	439020	5053409	10
2003	UN-NAMED TRIB [C] TO MIAMI R.	440267	5054349	10
2004	STUART			3
2004	DIAMOND			6
2004	CARPENTER			15
2004	UN-NAMED TRIB TO CARPENTER CK			6
2004	UN-NAMED TRIB [1] TO MIAMI R.	432544	5049625	1
2004	UN-NAMED TRIB [D] TO MIAMI R.	437727	5054475	1
2004	UN-NAMED TRIB [K] TO MIAMI R.	44291	5053409	6

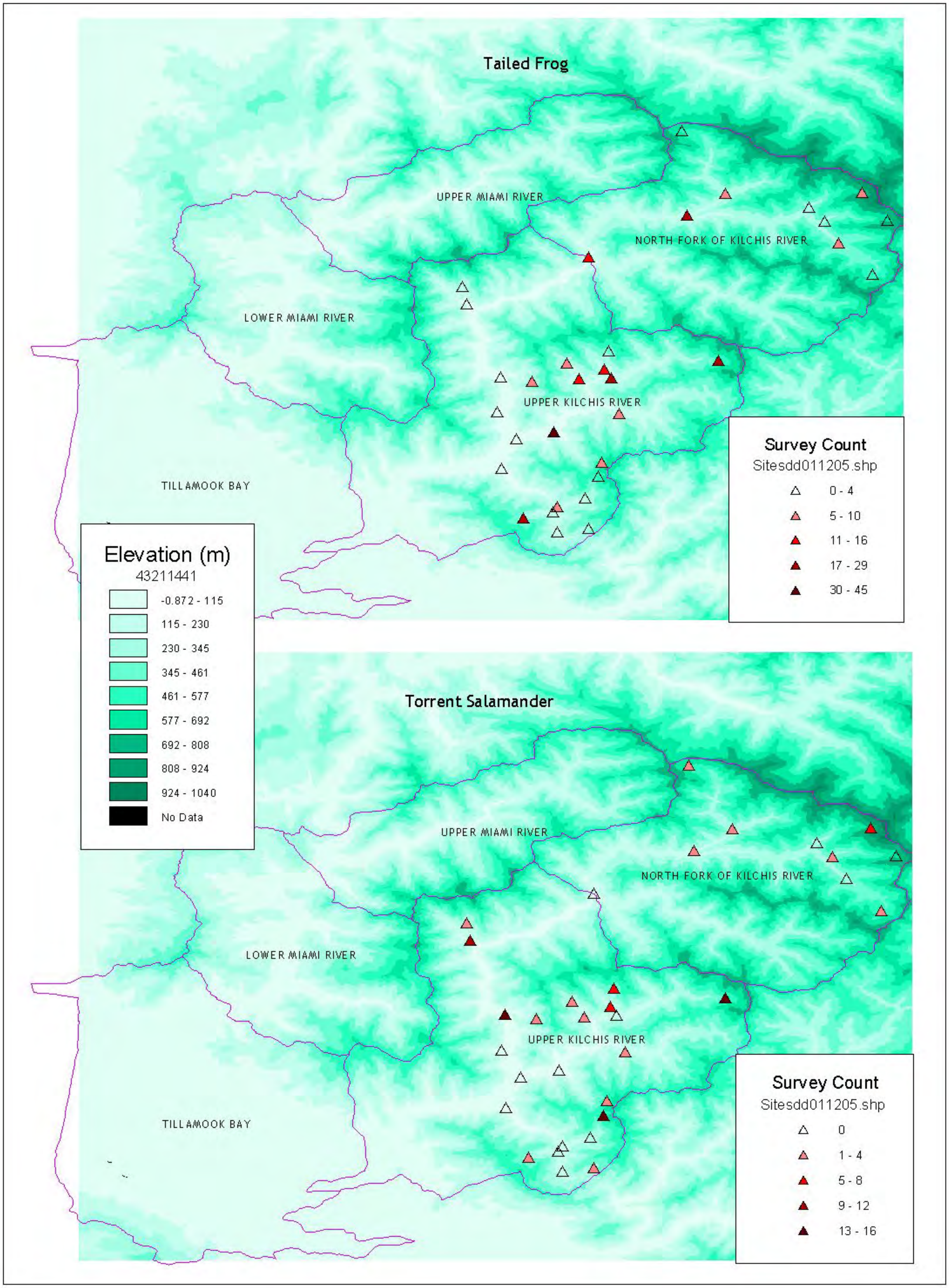

Figure 1. Numbers of tailed frogs (top map) and torrent salamanders (bottom map) by elevation at sampling locations in the Kilchis River basin.

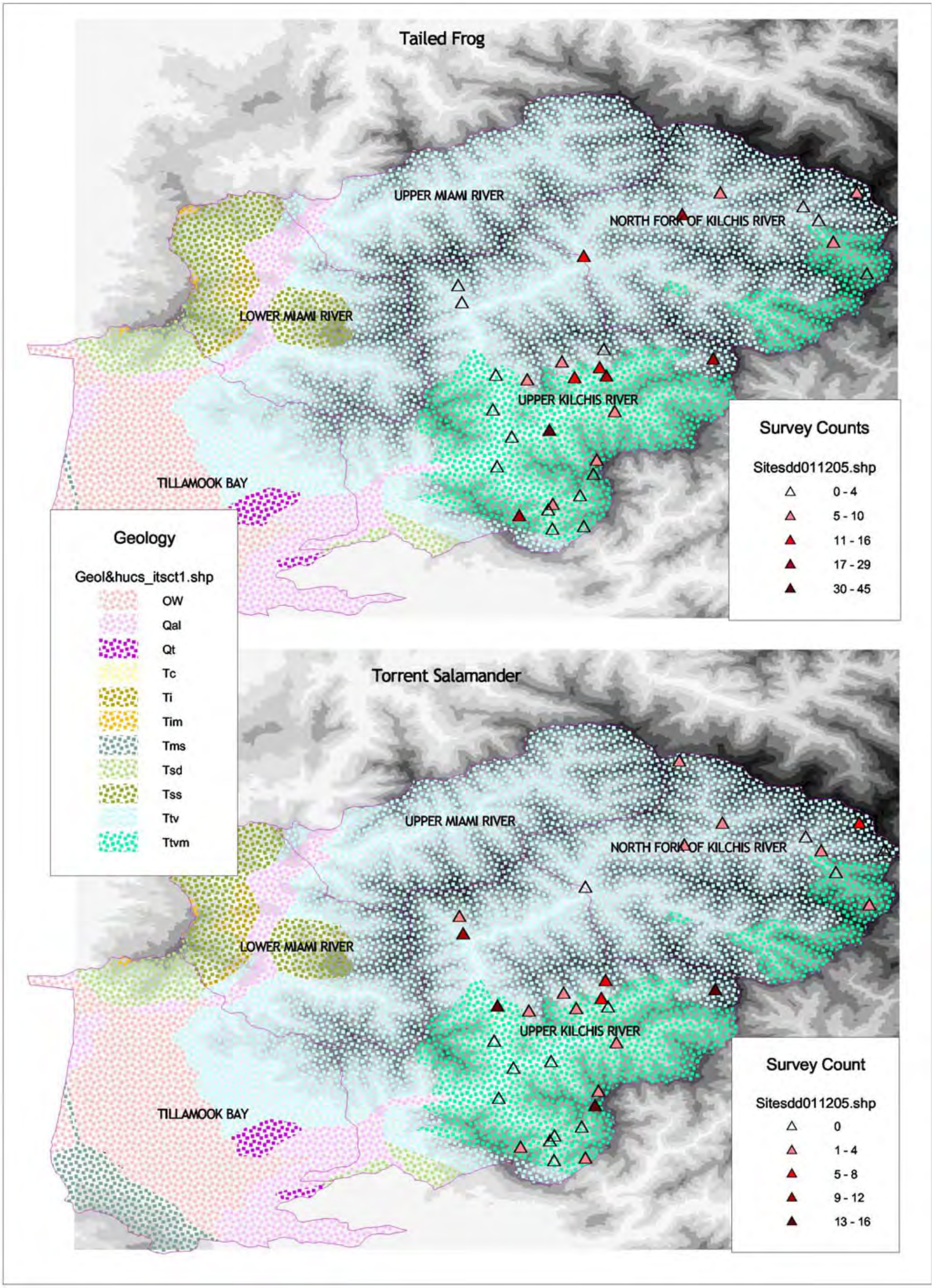

Figure 2. Numbers of tailed frogs (top map) and torrent salamanders (bottom map) by geologic type at sampling locations in the Kilchis River basin.

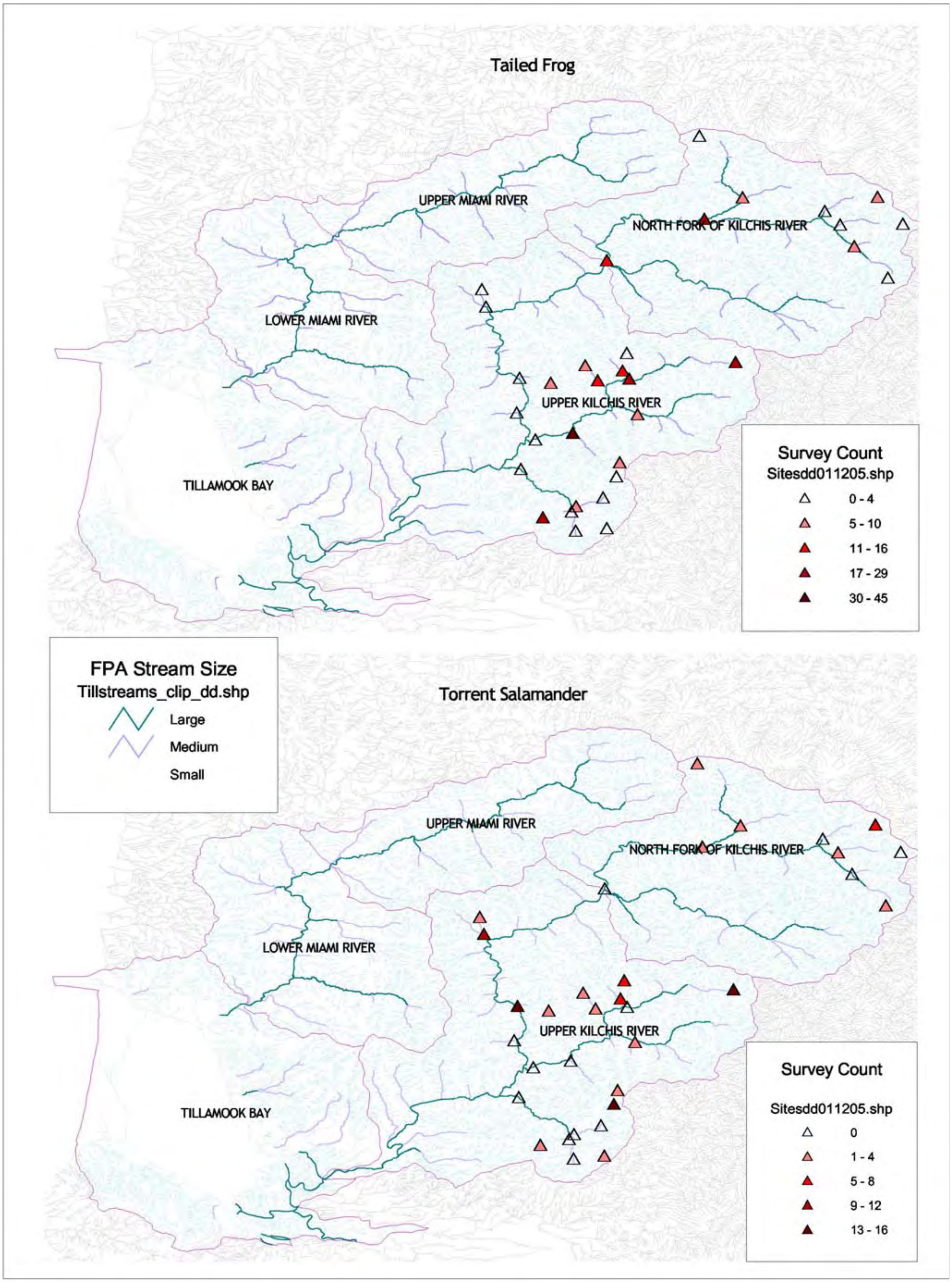

Figure 3. Numbers of tailed frogs (top map) and torrent salamanders (bottom map) by stream size at sampling locations int he Kilchis River basin.

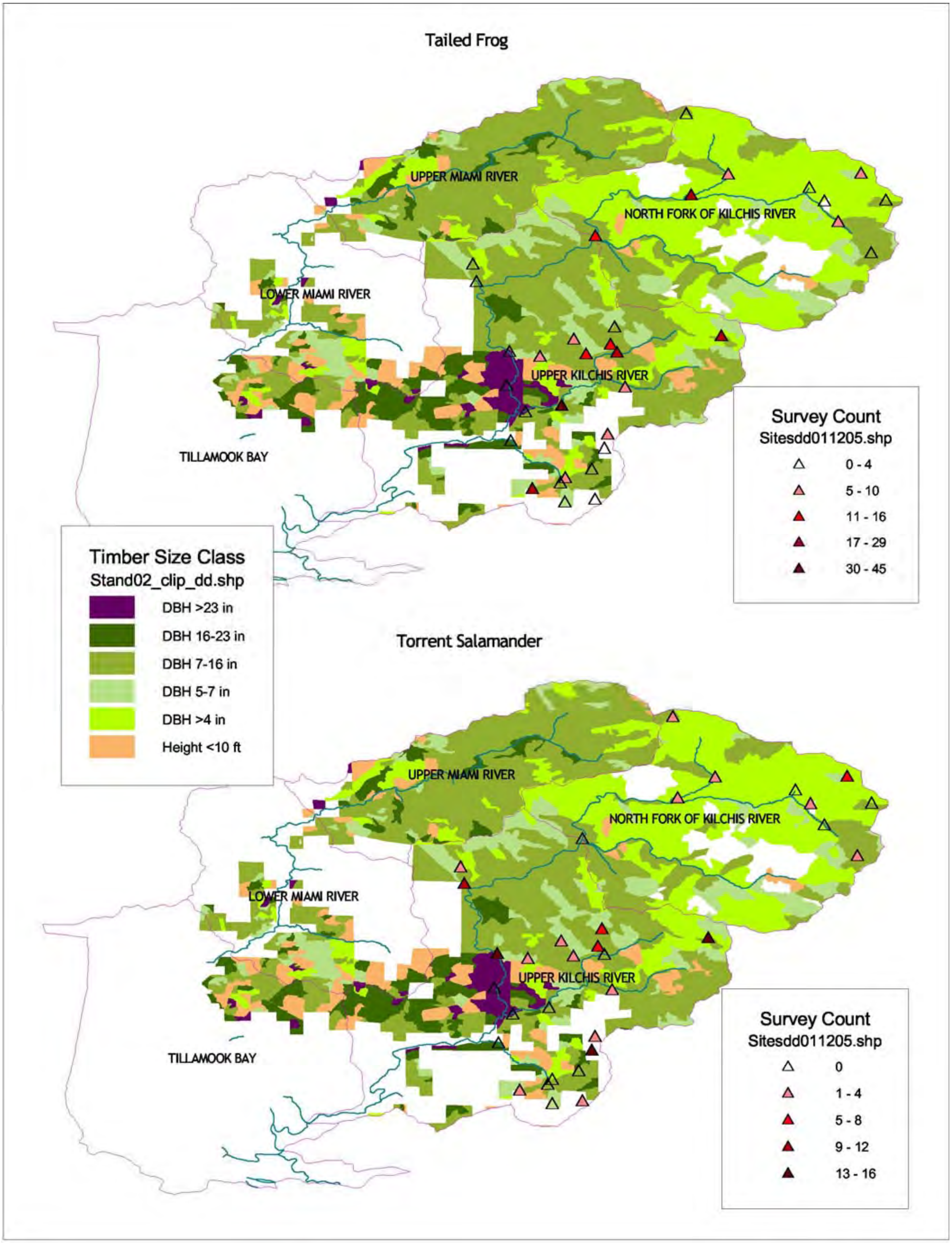

Figure 4. Number of tailed frogs (top map) and torrent salamanders (bottom map) by forest cover type at sampling locations in the Kilchis River basin.

5.0 Watershed Analysis on ODF Lands

This chapter addresses conditions described in the assessment phase as they relate to the functionality and quality of aquatic and riparian habitat. Select parameters identified in the ODF Watershed Analysis Manual (ODF 2004) are used to analyze aquatic and riparian habitats to determine if they are functioning properly. The distribution of properly functioning conditions (PFC) in the project area is determined, and conversely so are the areas where conditions are not functioning properly. Areas where functions are impaired or limited represent potential management opportunities to enhance and promote PFC in the long-term. As with the assessment, this analysis is based on interpretation of existing data.

Four primary topics were assessed to determine if aquatic and riparian resources are functioning properly: Limiting Factors, Alternative Vegetation Management, Slope Stability, and Roads. Under each topic, the set of Key Questions specified in the ODF contract are addressed.

5.1 Limiting Factors

Objective: Identify specific conditions within the project area that are limiting the attainment of properly functioning conditions of aquatic habitats; and then evaluate whether stream restoration projects or other management activities (for example, those related to slope stability, recreation trails, roads, or upland conditions) are likely to remedy the limiting factor(s). The key analysis questions are addressed below.

5.1.1 Are there subwatersheds where the current level of in-stream wood is a limiting factor for achieving properly functioning aquatic systems?

For this analysis, the levels of in-stream wood are considered a function of what currently exists in the channel (measured during ODFW aquatic habitat surveys) and the recruitment potential from streamside forests (based on vegetation cover types).

In-stream Wood

Large wood adds needed complexity to the stream channel. It produces and maintains pool habitat, provides cover, and dissipates stream energy retaining gravels and sediment. Overall, the current levels of in-stream large woody debris in all subwatersheds are likely limiting the attainment of a properly functioning aquatic system in the short term (in the next 25 to 50 years). Additionally, there are stream segments where “properly functioning” may only be achieved in the long term (100+ years). The attainment of properly functioning conditions for aquatic resources is discussed in section 5.2.

It should be noted that the analysis of in-stream levels of wood has relied on data from streams with ODFW aquatic habitat surveys, which are only done on fish bearing streams. No data exists for the other streams in the watershed, specifically headwater streams (type N). Therefore, interpretations about in-stream conditions can only be inferred from streamside forest characteristics. On ODF lands in the Miami watershed, a total of 9.2 miles of streams were surveyed from 330 total miles (about 3%). Over all ownerships, 20.5 miles of stream were surveyed out of 563 total miles in the watershed (total miles include fish and non-fish bearing; type N and F streams).

Of the nearly 9 miles of streams surveyed on ODF lands, only one reach (NC1878) contained the number of key pieces (12 per 100 meters; 3.6 per 100 feet) and volume (125m^3 per 100 meters; 1350 ft^3 per 100 feet) considered high by ODFW (2005). This 0.62 mile reach was surveyed in 2002 and is located on the mainstem Miami River near Bluff Creek (Upper Miami Subwatershed) (see Figure 27 for location). Note that 1993 surveys of the same approximate area show a significantly lower number of key pieces (0.5/100m). The increase measured in 2002, may be attributed to wood recruitment as a result of the 1996 floods and manual placement for instream enhancement purposes. The degree to which similar changes may have occurred within the watershed is unknown since subsequent habitat surveys have not been conducted.

Additionally, the South Fork Miami River (reach 13, 1.7 miles) contained a fair amount of volume (58 m^3 per 100 meters; 628 ft^3 per 100 feet), but had low numbers of key pieces (1.3 per 100 meters; 0.4 per 100 feet). ODFW (2005) considers volumes greater than 58 m^3 per 100 meters to be high based on reference reach measurements.

As a comparison, consider how levels of in-stream wood on ODF lands in the Miami compare to the findings documented in the Elliott State Forest Watershed Analysis. In the Elliott analysis, the overall mean wood volume on ODF lands was 193 cu. ft^3 per 100 ft., and the mean number of key pieces was 0.33 per 100 feet of stream (97 reaches represented (ODF 2003A, page 7-18). The mean wood volume on ODF lands in the Miami was 385 ft^3 per 100 ft., and the mean number of key pieces was 0.7 per 100 feet of stream (7 reaches represented, ODFW 2005). If you remove the one reach with high volume and key pieces (reach NC1878) from the calculation, the mean wood volume is 225 ft^3 per 100 ft., and the mean number of key pieces is 0.1 per 100 feet of stream. This simply illustrates the weight and importance this one reach has on the overall in-stream wood levels. It further illustrates the importance of this reach as critical habitat for salmonids since habitat quality far exceeds that of other mainstem reaches. As previously noted, the 1996 flood may have accomplished significant changes in other reaches resulting in increased habitat quality.

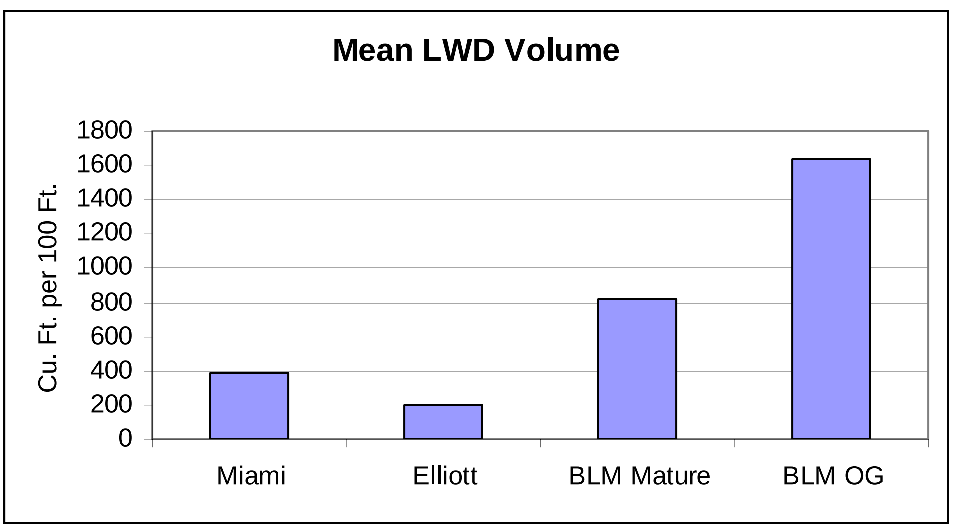

Figure 1. A comparison of large wood volumes in the Miami River Watershed to the Elliott State Forest and BLM mature and old-growth stands.

The Elliott analysis also determined the volume of instream wood for adjacent BLM lands consisting of old-growth and mature timber stands. Instream wood volume averaged 816 cu. ft. per 100 ft. for mature stands and 1634 cu. ft. per 100 ft. for old growth stands (ODF 2003A, page 7-18). The two reaches identified above have volumes of 1350 and 628 ft^3 per 100 ft., respectively. This lends further evidence that the level of instream wood is not currently a limiting factor for these two reaches. Overall large wood volumes in the Miami were greater than those documented for the Elliott, but still nearly 50% and 25% of the volume reported for mature and old-growth conditions (Figure 33).

Since, no habitat surveys have been conducted on ODF lands in the Lower Miami or Tillamook Bay Frontal Subwatersheds, the level of in-stream wood is not known. However, habitat surveys have been conducted on approximately 5 miles (8000 meters) of private industrial lands and 5.6 miles (9000 meters) of private non-industrial lands (ODFW 2005). A comparison of the large wood and shade survey variables on ODF lands versus private industrial and non-industrial lands is presented in Figure 34. Data represent the length-weighted value for all surveyed reaches. From this, we can infer that variables related to large wood and riparian condition on ODF lands and private industrial lands are essentially in the same overall condition.

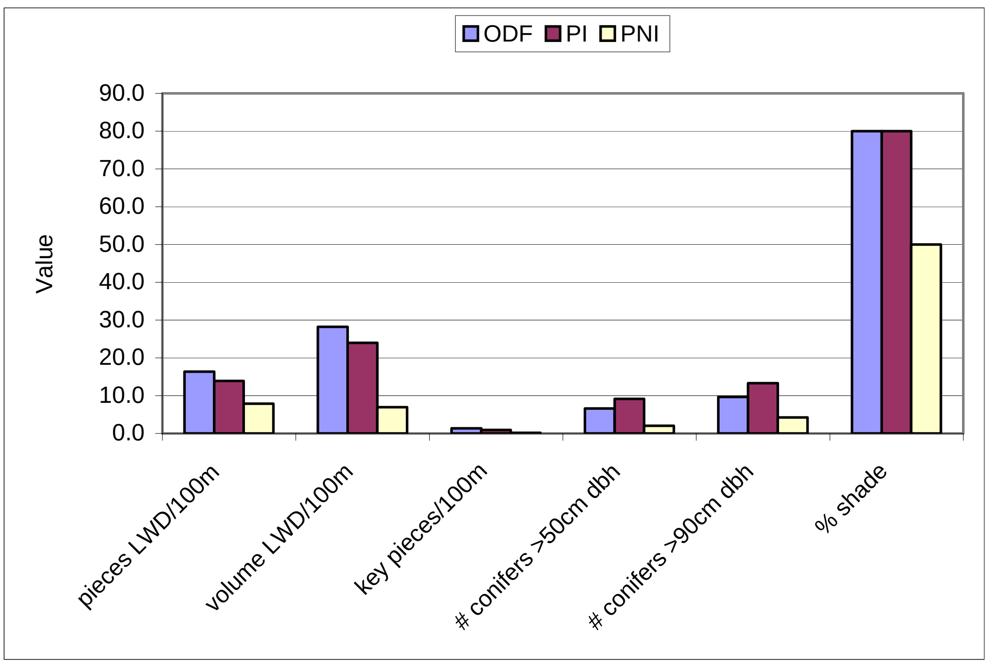

Figure 2. A comparison of large wood and shade variables (from ODFW 2005) between surveys conducted on ODF, private industrial and non-industrial lands

LWD Recruitment from Streamside Forests

The preceding discussion regarding levels of in-stream wood is not surprising, considering that the current large woody debris (LWD) recruitment potential is poor throughout the Miami River Watershed. The lack of recruitment potential is limiting the attainment of “properly functioning” condition for aquatic and riparian systems in the short and long term.

There are three ways that large woody debris is deposited in streams: 1) it falls directly in or across a stream from the adjacent riparian area, 2) it is transported into a stream segment by a landslide or debris flow, or 3) it is manually placed in the stream. The majority of large wood present in a stream is from the adjacent riparian area, and the majority of that originates from a distance less than 100 feet (Robison and Beschta 1990, Murphy and Koski 1989). For analysis purposes, only that distance within 100 feet of a stream (RA1 and RA2) was considered in detail. This is not to say that wood inputs beyond 100 feet are not important. These inputs provide floodplain structure and habitat for terrestrial species. However, in terms of in-stream habitat, the probability of reaching the stream is diminished.

Large woody debris can also be transported into a particular reach from up-channel, in-stream sources during high flow events. It is the large conifer pieces (usually defined as key pieces >24 inches) that provide the in-stream anchor points in which smaller pieces of wood are accumulated. Without these anchor points, the smaller wood pieces are simply “flushed” through the system and never accumulate into complex log and debris jams essential for complex aquatic habitats. The potential for debris flow prone channels to deliver LWD is discussed later in this chapter.

As described earlier in the assessment, only 6% (424 acres) of the mapped riparian (RA1 and RA2) acres administered by ODF currently exhibit a high likelihood of producing large wood to the adjacent stream (Figure 35)(see Figure 11 for mapped spatial distribution of riparian corridors). The majority of acres exhibit a moderate or low recruitment potential (52% and 43%, respectively). Obviously, the lack of large conifer pieces entering stream channels will continue until conifer riparian forest stands are established and mature or other sources are introduced (i.e. manual placement).

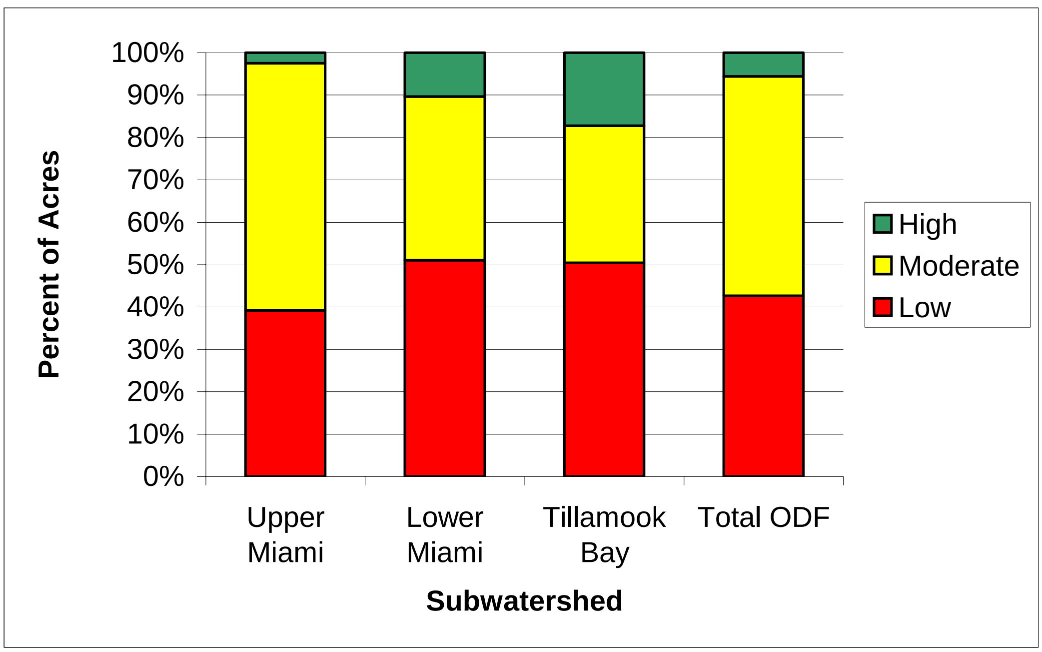

Figure 3. Estimated levels of LWD recruitment potential as a percent of total ODF lands in mapped riparian buffers (RA1+RA2).

To evaluate future LWD recruitment potential from streamside forests, the current vegetation types were rated as low, moderate or high for the 50- and 100-year timeframes (Table 25) based on general stand dynamics and criteria described in

OWAM. These provide an estimate of the future recruitment potential based solely on the vegetation cover type (i.e. presence of large conifers in a particular forest stand). For analysis purposes, it is assumed that currently identified hardwood stands remain hardwood throughout and beyond the 100-year timeframe.

Table 1. Large wood recruitment potential in 50- and 100-years for vegetation cover types in the Miami River Watershed.

Vegetation Cover Type*	LWD Recruitment Potential Over Time		
	Current	50-Years	100-Years
AG	Low	Low	Low
BNN	Low	Low	Low
CLD	High	High	High
CLS	Moderate	Moderate	Moderate
CMD	Moderate	High	High
CMS	Moderate	Moderate	Moderate
CRD	Low	Moderate	High
CRS	Low	Moderate	Moderate
CSD	Low	Moderate	High
CSS	Low	Moderate	Moderate
DV	Low	Low	Low
GNN	Low	Low	Low
HMD	Moderate	Moderate	Moderate
HMS	Low	Low	Low
HRD	Low	Moderate	Moderate
HRS	Low	Moderate	Moderate
HSD	Low	Moderate	Moderate
HSS	Low	Low	Low
MLD	High	High	High
MLS	Moderate	Moderate	Moderate
MMD	Moderate	High	High
MMS	Moderate	Moderate	Moderate
MRD	Low	Moderate	High
MSD	Low	Moderate	High
MSS	Low	Moderate	Moderate
NNN	Low	Low	Low
RNN	Low	Low	Low
ROW	Low	Low	Low
SNN	Low	Low	Low

*See Table 10 for cover type code definitions.

The overall amount of “High” LWD recruitment potential on ODF lands (RA1 and RA2) increased from 6% to 33% (424 acres to 2516 acres) in 50 years, and from 6% to 58% (424 acres to 4385 acres) in 100 years. The largest gain, in terms of acres, was in the Upper Miami Subwatershed where the amount of “High” recruitment potential increased from 132 acres (2%) to 2733 acres (51%) in 100 years. The Lower Miami and Tillamook Bay Subwatersheds showed significant increases in the percent of area in the “High” recruitment potential category, from 10% to 69% and from 17% to 80%, respectively. However, due to the low amount of ODF ownership in these subwatersheds, the amount of acres was relatively small (Table 26, Figure 36, 37, and 38).

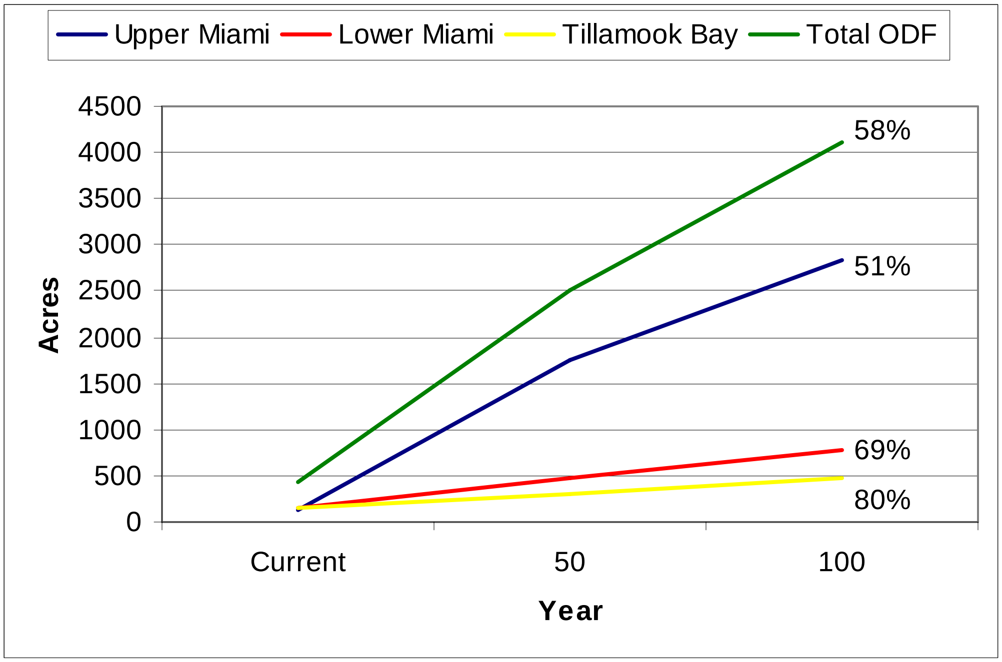

Figure 4. The amount of "High" LWD recruitment potential for ODF lands (RA1+RA2) in the current, 50-, and 100-year timeframes. Percentages indicate amount of ODF land (compared to total ODF ownership) in the subwatershed.

The presence of large conifers in riparian forest does not ensure the delivery of such wood to the stream channel. The delivery of these trees to the stream channel is dependent on factors affecting stand conditions and succession dynamics through time. In the absence of a naturally occurring large-scale disturbance (i.e. windthrow), LWD inputs will be dependent on tree mortality and the probability of that tree falling in the direction of the stream channel. In short, it may take a significant amount of time to realize LWD inputs once streamside forest stands develop large conifers.

Table 2. LWD recruitment potential on ODF lands (acres) for the current, 50-year, and 100-year timeframes. Totals for RA1 + RA2 (outlined in bold) were used in this analysis.

	Current -- LWD Recruitment Potential on ODF Lands								
		Low		Moderate		High		Total	
	Subwatershed	acres	%	acres	%	Acres	%	acres	%
RA1	**Upper Miami**	578	41%	809	57%	34	2%	1421	100%
	Lower Miami	196	52%	145	38%	37	10%	378	100%
	Tillamook Bay	112	50%	77	34%	34	15%	222	100%
	Total	885	44%	1031	51%	106	5%	2022	100%
RA1+RA2	**Upper Miami**	2084	39%	3102	58%	132	2%	5318	100%
	Lower Miami	728	51%	549	39%	148	10%	1425	100%
	Tillamook Bay	423	50%	271	32%	144	17%	838	100%
	Total	**3235**	**43%**	**3923**	**52%**	**424**	**6%**	**7582**	**100%**
ODF170	**Upper Miami**	3145	39%	4747	59%	205	3%	8097	100%
	Lower Miami	1151	50%	887	39%	243	11%	2282	100%
	Tillamook Bay	637	49%	424	33%	232	18%	1293	100%
	Total	4933	42%	6059	52%	680	6%	11672	100%

	50-Year LWD Recruitment Potential on ODF Lands								
		Low		Moderate		High		Total	
	Subwatershed	acres	%	acres	%	Acres	%	acres	%
RA1	**Upper Miami**	46	3%	959	68%	416	29%	1421	100%
	Lower Miami	6	1%	261	69%	112	29%	378	100%
	Tillamook Bay	5	2%	145	65%	73	33%	222	100%
	Total	56	3%	1366	68%	600	30%	2022	100%
RA1+RA2	Upper Miami	116	2%	3452	65%	1750	33%	5318	100%
	Lower Miami	17	1%	937	66%	471	33%	1425	100%
	Tillamook Bay	14	2%	530	63%	295	35%	838	100%
	Total	**146**	**2%**	**4919**	**65%**	**2516**	**33%**	**7582**	**100%**
ODF170	**Upper Miami**	156	2%	5101	63%	2840	35%	8097	100%
	Lower Miami	26	1%	1471	64%	785	34%	2282	100%
	Tillamook Bay	20	2%	796	62%	478	37%	1293	100%
	Total	201	2%	7368	63%	4103	35%	11672	100%

	100-Year LWD Recruitment Potential on ODF Lands								
		Low		Moderate		High		Total	
	Subwatershed	acres	%	acres	%	Acres	%	acres	%
RA1	**Upper Miami**	39	3%	729	51%	653	46%	1421	100%
	Lower Miami	4	1%	134	35%	241	64%	378	100%
	Tillamook Bay	4	2%	50	22%	168	76%	222	100%
	Total	47	2%	913	45%	1062	53%	2022	100%
RA1+RA2	**Upper Miami**	98	2%	2488	47%	2733	51%	5318	100%
	Lower Miami	13	1%	429	30%	983	69%	1425	100%
	Tillamook Bay	11	1%	158	19%	669	80%	838	100%
	Total	**122**	**2%**	**3075**	**41%**	**4385**	**58%**	**7582**	**100%**
ODF170	**Upper Miami**	135	2%	3545	44%	4418	55%	8097	100%
	Lower Miami	21	1%	647	28%	1614	71%	2282	100%
	Tillamook Bay	15	1%	232	18%	1046	81%	1293	100%
	Total	171	1%	4423	38%	7077	61%	11672	100%

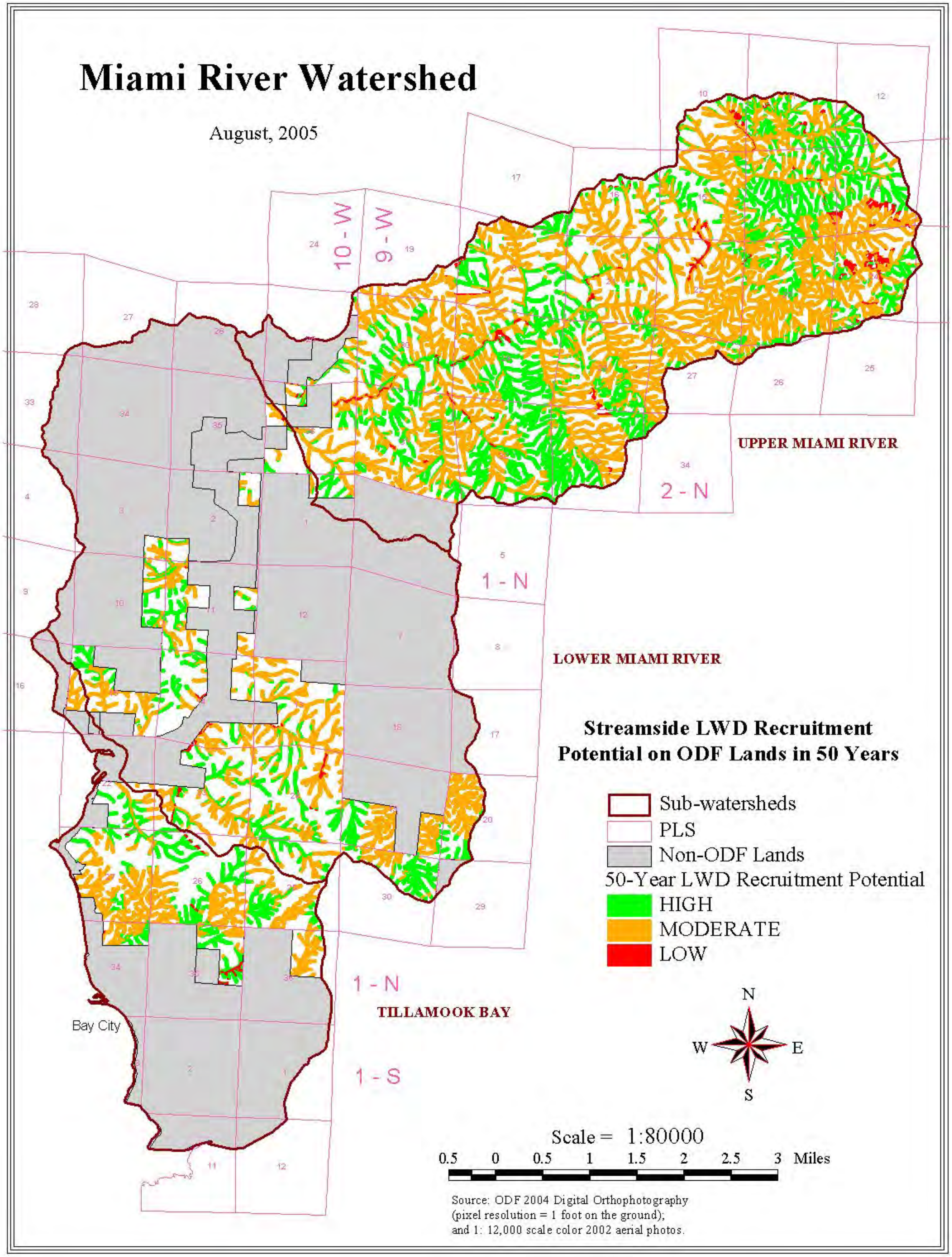

Figure 5. Estimated large woody debris recruitment potential in 50 years for the Miami River Watershed Project Area.

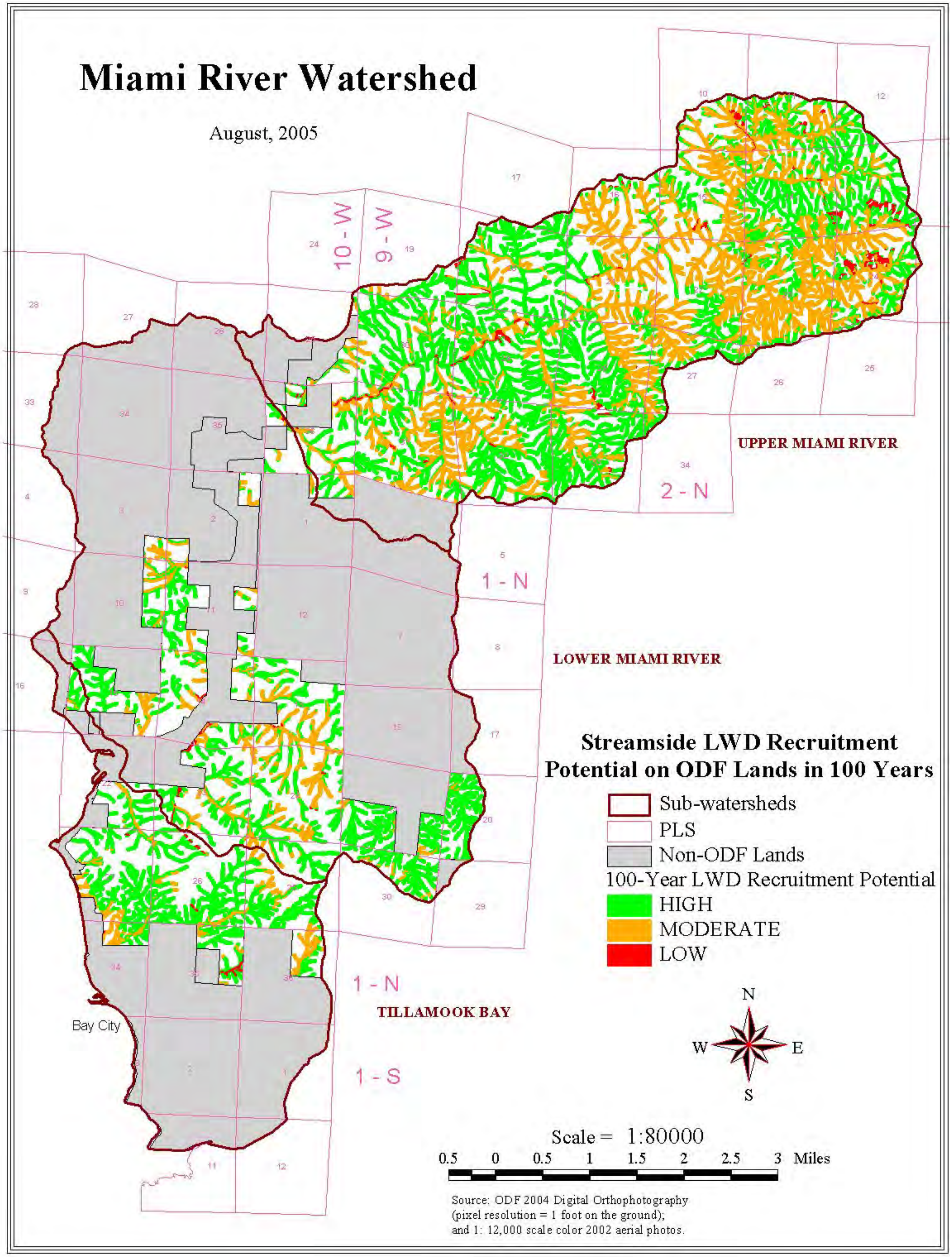

Figure 6. Estimated large woody debris recruitment potential in 100 years for the Miami River Watershed Project Area.

5.1.2 Are there subwatersheds where stream sediment deposition (associated with hillslopes and/or road erosion) is a limiting factor for achieving properly functioning aquatic systems?

Inherent rates of erosion and sedimentation in the Coast Range are well documented to be relatively high naturally, and the background sediment is highly variable. Post-fire increases in the rate of inherent surface and landslide erosion in western Oregon can be significant after large, intense fires. In the portion of the upper Miami subwatershed that was burned over by the Tillamook fire of 1933, and again in 1939, it is inferred that for a time sediment inputs increased substantially above background rates. Logging practices and road construction customary for that time period were not expressly intent on minimizing sedimentation compared to current day standards, so subsequent salvage of fire killed timber likely exacerbated accelerated erosion further, particularly in the South Fork. A high level of timber harvest and road construction continued into the late 1970's (ODF 2005).

Surveys conducted in the early 1950's noted a number of reaches with high quality substrate in the Miami River above Prouty Creek, two decades after the Tillamook Burn entered the watershed. Ocular estimates of the proportion of fine sediment consistently averaged about10 percent in observed reaches. Anecdotal observations noted fine sediment and turbid water just downstream from logging near the confluence of the South Fork, and multiple locations where large deposits of "loose logging debris" including dirt and rocks were piled across the river in the upper reaches of the South Fork (ODF 2004b).

Since the Tillamook fires and the rigorous post-burn salvage operations of the 1940's and 1950's most of the area that originally burned has developed a dense, heavy forest cover. Additionally, the high level of timber harvest in the 1960's and 1970's has declined substantially in recent decades. Thus, associated sediment production and delivery on ODF land is believed to have also declined markedly. Current sediment inputs attributable to management on ODF lands are associated primarily with roads. Based on RIMS data however, road related sediment is considered to be relatively nominal. Some problems do exist, and there are critical locations where road segments pose a risk to aquatic and riparian resources, but the majority of the road system is in good condition.

Recent data of in-stream sediment has been assessed in the project area by the DEQ in the TMDL process, in the E&S study (2001), and in habitat surveys conducted by ODFW (2005). Water quality was not listed by DEQ as impaired due to fine sediment (as indexed by turbidity). Most of the sampling occurred in low gradient reaches in the lower Miami on private non industrial lands. As summarized by the E&S study, none of the 154 samples of turbidity taken in the Miami exceeded the evaluation criteria. However the data is somewhat limited because few samples were collected during high runoff events when loading of suspended sediment is at its greatest. Additional data collection would be favorable to more clearly characterize the range of suspended sediment yield so that it could be stratified by ownership.

Based on benchmark indicators, ODFW (2005) survey data rated the level of in-stream fine sediment as moderate to high in riffles, and rated gravels in pools as moderate on ODF land. The report did not conclude that fine sediment is a limiting factor to fish production. Instead, winter habitat (i.e., complexity, side channel habitat, LWD, etc.) was identified as the primary limiting factor for fish production.

Although the surveys rate the proportion of in-stream sediment as moderate to high compared to the ODFW reference standards, it is not overwhelmingly clear as to whether or not these ratings can be directly correlated to sediment being a factor that is limiting properly functioning conditions. Correlation of the reference standards to the success of salmonid production has not been verified. In the Coast Range, the background range of in-stream sediment is naturally high. Coast Range salmonids are adapted to this variability and are subjected to intense periodic pulses of sedimentation that often result from natural disturbance (Everest et. al. 1987). Despite probable historical increases in sediment yield attributed to past wildfire, logging, and road construction, which may account for the moderate to high ratings, the level of in-stream sediment on ODF lands is not an obvious, single defining factor considered to be limiting. Although it may play a minor role, other factors such as LWD and conditions downstream on non-ODF lands are believed to be more significant and evident factors limiting achievement of PFC.

5.1.3 Given the stream temperatures that are reasonably achievable, what is the likelihood (rate as high, moderate, low, or unknown) that stream temperatures and/or shade conditions are a limiting factor for achieving properly functioning aquatic systems?

Actual measurements of stream temperature to describe the historical temperature regime in the Miami River watershed, specifically on ODF lands, are not available. The best approximation of temperature conditions can only be determined through a comparison of current and historical estimates of riparian shade. Recognize that many factors can influence stream temperatures, including but not limited to: topographic shade angle, understory vegetation and shrubs, channel complexity (bankfull width), groundwater seeps, and other land uses such as water withdrawals.

Consider the estimated historical distribution of forest types and associated shade presented conceptually in ODF (2002). Here the age of riparian forests was assigned to a range of potential shade categories from very low to very high (Table 27).

Table 1. Estimated historical distribution of forest types by age class and relative shade levels (adapted from ODF 2002).

	Age of Riparian Forests (years)				
	0-3	**4-50**	**50-100**	**100-200**	**200+**
Portion of Landscape Historically in this Age Class (adapted from Botkin et.al. 1995)	5-15%	10-15%	15-20%	15-20%	40-50%
Relative shade levels (based on forest successional dynamics)	Very Low to Moderate	Moderate to Very High	High to Very High	Moderately High to High	Moderately High

Obviously, variables affected the spatial and temporal distribution of historic vegetation patterns. Natural disturbances such as fire, windthrow, landslides, insects and disease, and floods influenced forest stands throughout the landscape. This changing landscape certainly resulted in changing shade levels through time. It appears evident, however, that there has been a shift in age-class distribution resulting in a reduction of very young (0-3 years) and very old (200+ years), and an increase in the 4-50 year category (ODF 2002). Based on Table 27, this would indicate a decrease in the “very low to moderate” shade category (age 0-3 years), and a decrease in “moderately high” shade category (age 200+ years), with an associated increase in the “moderate to very high” shade category (age 4-50 years).

The existing distribution of vegetation cover types on ODF lands was categorized into low, moderate or high shade condition depending on vegetation type, tree size, and stand density (Table 28, Figure 10).

Table 2. Acres and percent of ODF lands categorized by low, moderate and high shade levels.

RA1

	Shade Levels on ODF Lands							
	Low		Moderate		High		Total	
Subwatershed	**acres**	**%**	**acres**	**%**	**acres**	**%**	**Acres**	**%**
Upper Miami	50	3%	61	4%	1311	92%	1421	100%
Lower Miami	34	9%	29	8%	316	83%	378	100%
Tillamook Bay	22	10%	33	15%	168	75%	222	100%
Total	**106**	**5%**	**122**	**6%**	**1794**	**89%**	**2022**	**100%**

RA1+RA2

	Shade Levels on ODF Lands							
	Low		Moderate		High		Total	
Subwatershed	**acres**	**%**	**acres**	**%**	**acres**	**%**	**Acres**	**%**
Upper Miami	144	3%	234	4%	4941	93%	5318	100%
Lower Miami	142	10%	95	7%	1188	83%	1425	100%
Tillamook Bay	89	11%	95	11%	654	78%	838	100%
Total	**375**	**5%**	**424**	**6%**	**6783**	**89%**	**7582**	**100%**

ODF170

	Shade Levels on ODF Lands							
	Low		Moderate		High		Total	
Subwatershed	**acres**	**%**	**acres**	**%**	**acres**	**%**	**acres**	**%**
Upper Miami	212	3%	354	4%	7532	93%	8097	100%
Lower Miami	228	10%	168	7%	1886	83%	2282	100%
Tillamook Bay	138	11%	140	11%	1015	79%	1293	100%
Total	**578**	**5%**	**661**	**6%**	**10432**	**89%**	**11672**	**100%**

Consistent with large wood recruitment, the influence of streamside buffers diminishes farther from the stream. A comparison of current riparian shade estimates for varying buffer widths on ODF lands in the Miami River watershed showed that overall shade conditions do not change with increasing buffer width (i.e. RA1 = 89% high, RA1+RA2 = 89%, and ODF170 = 89% high; Table 28). For this analysis, shade estimates for ODF170 buffer widths was used.

The categories of historical forest type and shade level (Table 27) were modified slightly (collapsed into low, moderate and high) in order to compare with the estimates of existing vegetation cover and corresponding shade level determination (Figure 39). Results indicate that the overall shade condition across ODF lands is likely higher today than historically. Current estimated levels for the Upper Miami subwatershed and overall total acres of ODF lands are higher than those estimated historically. The Lower Miami and Tillamook Bay subwatersheds are consistent with historic levels.

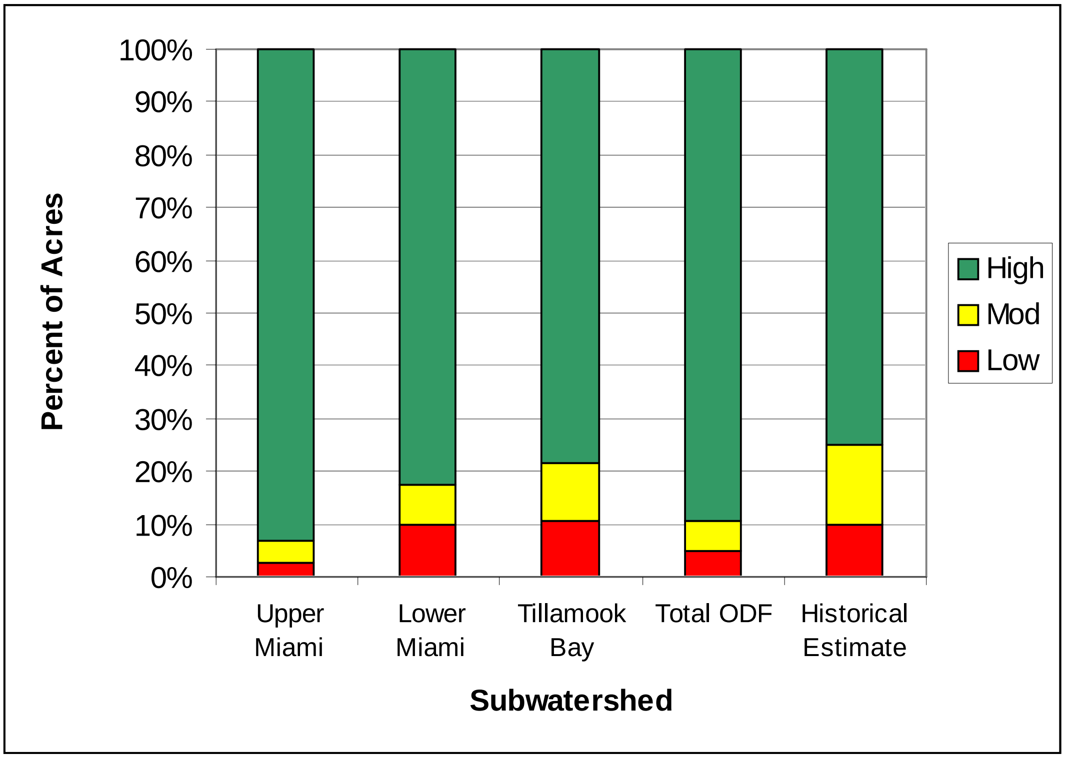

Figure 1. Estimated levels of shade as a percent of total ODF lands in mapped riparian buffers.

Given that current estimates of shade on ODF lands are higher than historical estimates, it is unlikely that streamside shade conditions are limiting the attainment of a "properly functioning" aquatic system on ODF lands. The possibility exists that the increased levels of shade could have reduced the amount of primary production, thus indirectly limiting fish production. Given that these historical estimates are interpreted at a landscape scale, there is no data or information to predict with any level of certainty that shade in this case is a limiting factor. Based on professional opinion, the shade estimates predicted here and the measurements taken during aquatic habitat surveys indicate that there are adequate levels of shade to protect water quality concerns and beneficial uses.

5.1.4 Are there any other conditions limiting the achievement of properly functioning aquatic systems?

Other conditions or factors within the watershed could be limiting the achievement of properly functioning aquatic systems on ODF lands to varying degrees:

- Current and future habitat conditions on downstream non-ODF lands are likely limiting fish production on ODF lands for a variety of reasons. Wetland and floodplain modifications have occurred in support of residential and agricultural development. In addition to simplifying habitat, these modifications have resulted in a reduction of estuarine habitats essential to both chum and chinook salmon. Channels on private lands have been heavily modified and habitat complexity is low. Water withdrawals on private lands downstream from ODF lands in the lower Miami and the frontal subwatershed have been identified as potentially affecting summer low flows. Water quality in the lower Miami is considered limited for temperature and bacteria.

- The potential for dewatering streams with documented fish presence during low flow periods is a concern. This echoes concerns of ODFW and OWRD, which designated the Miami River a state priority for streamflow restoration to support anadromous species. Considering the greater number of permitted withdrawals rates of use recorded for the Tillamook Bay subwatershed where streams are small and annual available water much less compared to the Miami River, it is logical to assume that dewatering effects to aquatic species would be a concern in the frontal streams as well.

- Current management direction on ODF lands is to avoid riparian areas that are complicated to plan or operate in, even when activities are permitted under the FMP and Salmon Anchor Habitat Strategy. There are streamside stands however, where management could benefit riparian resources if they were more actively managed. Not aggressively managing streamside forests entails a risk that streamside forests may not achieve mature conditions that according to the FMP, is desired for riparian areas.

- Fish passage barriers have been identified on and off of ODF lands that could be limiting the distribution and production of salmonids (discussed later in this chapter).

- Permitting requirements are constraining the implementation of instream aquatic habitat restoration projects. The Regional General Permit (RGP) in which ODF and ODFW conform for implementation of instream projects is limited to streams less than 42 feet wide. The priority stream reaches identified in this analysis for placement of large wood exceed 42 feet in width. Additionally, trees within 25 feet of the stream may not be used for these projects, leading to logistical difficulties in getting trees to the stream.

- Channel modifications on ODF lands, specifically along several segments of the Miami River Road where it encroaches into the mainstem river channel, have simplified and constrained critical habitat and affected floodplains and side channels used by salmonids. These include the segments between the Diamond Creek and the North Fork crossing. Other locations on ODF lands where roads that impinge on the channel have affected habitat include lower Buehner Creek and the middle reach of Moss Creek.

Based on the information presented here, levels of in-stream LWD and current and future recruitment from streamside forests combine to be the number one factor limiting the achievement of PFC in the short and long term.

Forest stands along fish bearing streams that currently have low to moderate large wood recruitment potentials are limiting the achievement of properly functioning condition. Likewise, debris flow prone channels that could be expected to deliver large wood to downstream fish bearing streams in the event of failure but do not contain large conifers in which to transport, are limiting the achievement of properly functioning condition. In addition, channel modifications due to roads adjacent to the mainstem Miami River and Moss Creek could be affecting channel functions. These locations are summarized in Figure 40 and identified on Figure 41.

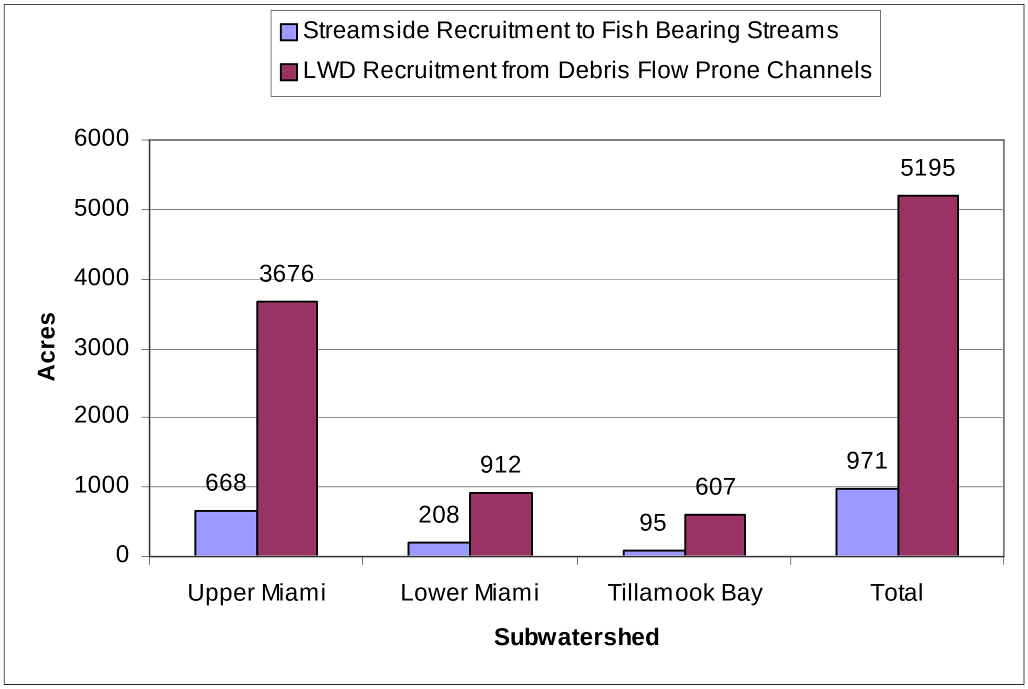

Figure 2. Acres of riparian management area along fish bearing streams and debris flow prone channels potentially limiting the achievement of properly functioning condition.

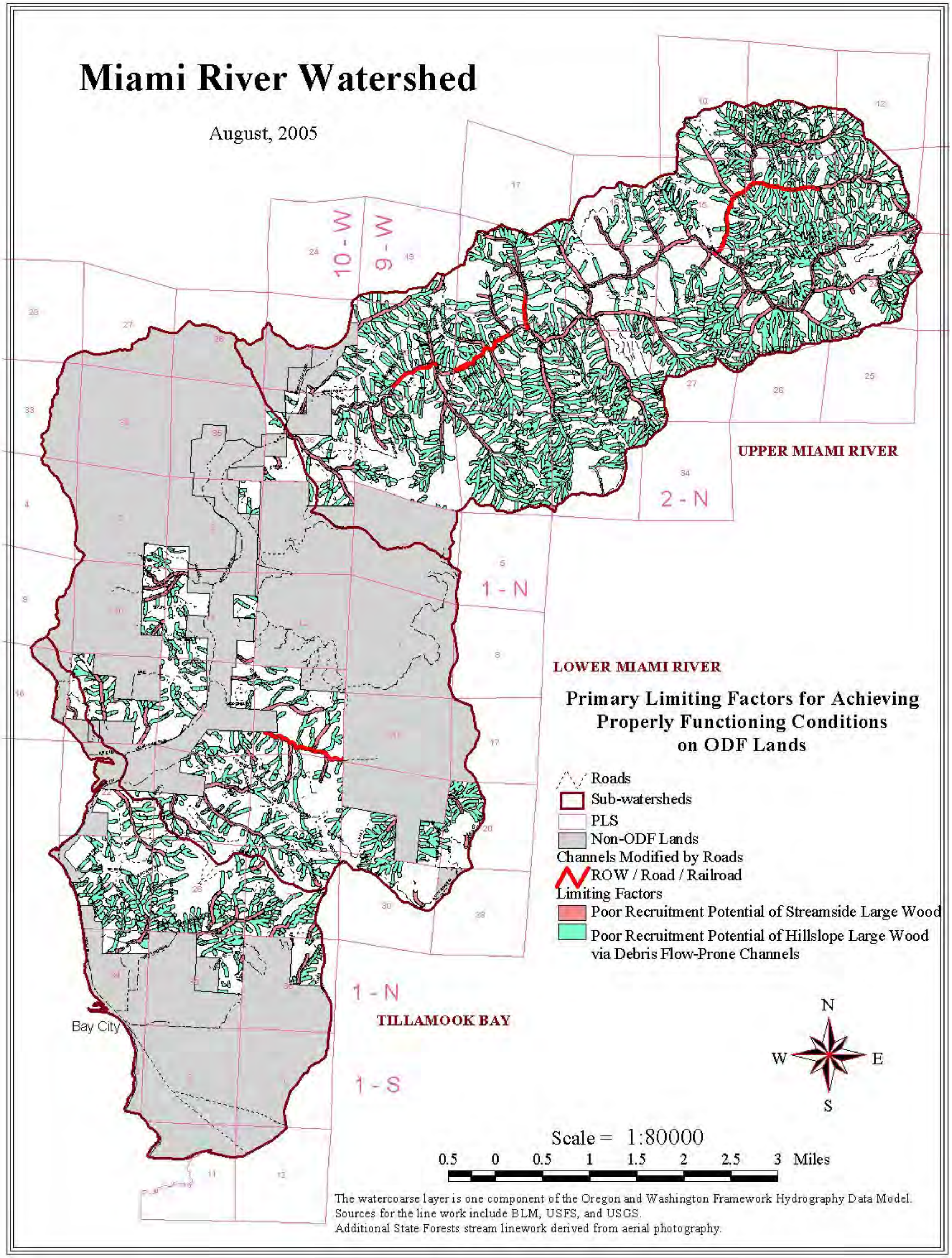

Figure 3. Limiting factors affecting the achievement of properly functioning condition for aquatic and riparian conditions.

5.2 Alternative Vegetation Management

Objective: Identify where in the project area the management standards for aquatic and riparian areas are likely to achieve properly functioning aquatic habitat conditions, and if they are not, then identify the alternative vegetation management needed to achieve this condition. The key analysis questions are addressed below. ODF defines PFC as "the range of diverse aquatic and riparian conditions over time and space that emulate the habitat conditions that resulted from natural disturbance regimes under which native species evolved; there is no one condition that is properly functioning".

The criteria used in this portion of the analysis to determine PFC achievement were:

- A focus on in-stream aquatic habitats and the adjacent upslope processes that affect them.
- Analysis results of existing data characterizing current conditions.
- Results of limiting factor analysis discussed earlier.
- Location and habitat condition of critical habitat for anadromous salmonids.

It is important to emphasize that this analysis has relied on data from surveyed streams, which are all considered fish bearing. No data exists for the other streams in the watershed, specifically headwater streams (type N). Therefore, interpretations about in-stream conditions can only be inferred from remotely sensed data about streamside forest characteristics.

5.2.1 Given current management strategies, which subwatersheds (6^{th}-field HUC) have aquatic and riparian conditions that have already achieved the properly functioning condition (PFC)?

As previously discussed, the primary limiting factor for achieving PFC is poor channel complexity due to the lack of in-stream wood and inadequate recruitment potential from streamside and upslope forests, Based on the data available for this assessment and analysis of ODF lands, the Upper Miami River Subwatershed contains two segments of stream considered to have achieved the properly functioning condition. This is approximately 1% of the total mapped streams in the subwatershed (ODF only, 2.3 miles of 232 total miles) and 0.7% of the total mapped streams in the entire watershed (ODF only, 2.3 miles of 330 total miles).

Since no aquatic habitat data exists for ODF lands in the Lower Miami or Tillamook Bay Subwatersheds, the level to which properly functioning conditions have been achieved cannot be determined with certainty. However, as discussed earlier, an examination of aquatic habitat data on ODF compared to private industrial and non-industrial lands indicates that overall aquatic conditions are similar (Figure 34). The lack of large wood recruitment potential through time provides evidence that overall subwatershed conditions may not be conducive to achieving PFC at a watershed scale. It is expected that specific stream reaches or locations on ODF lands within the watershed have achieved a condition of properly functioning. They are just not detectable given the data currently available.

5.2.2 Which subwatersheds have aquatic and riparian conditions suitable for the development of the PFC in a 50-year timeframe? In a 100-year timeframe? Longer than a 100-year timeframe?

The development of streamside forests that contain large conifer trees were projected in 50 and 100 year timeframes (Figure 37 and 38) in order to provide an estimate of potential recruitment through time. Even though streamside forests are projected to develop large conifers in 50 and 100 years, large wood is not immediately recruited to the stream. Recruitment of large wood (key pieces) in sufficient amounts to achieve a functional aquatic and riparian condition could lag behind stand development by decades or even longer.

Figures 42 and 43 illustrate the likely development of PFC in 50-, 100-, and >100-year timeframes. This map was constructed by overlaying criteria used to develop woody debris recruitment estimates from streamside forests and debris flow prone channels through time. In addition, there is considered a time lag between when a streamside forest is capable of large wood recruitment and when that wood actually reaches the stream or floodplain. Specifically,

- Forests along fish bearing streams that currently have a high LWD recruitment potential and those debris flow prone channels that are likely to deliver large wood to downstream fish bearing streams over 50 years will likely exhibit conditions suitable for PFC development in the 50-year timeframe.
- Fish bearing streams projected to have high LWD recruitment potential in 50-years and where debris flow prone channels that are likely to deliver large wood to downstream fish bearing streams over 100 years will likely exhibit conditions suitable for PFC development in the 100-year timeframe.
- Streamside forests that reach a high recruitment potential in 100-years and beyond in conjunction with debris flow prone channels that are capable of delivering large wood to downstream fish bearing streams beyond 100 years are estimated to develop PFC beyond the 100-year timeframe.

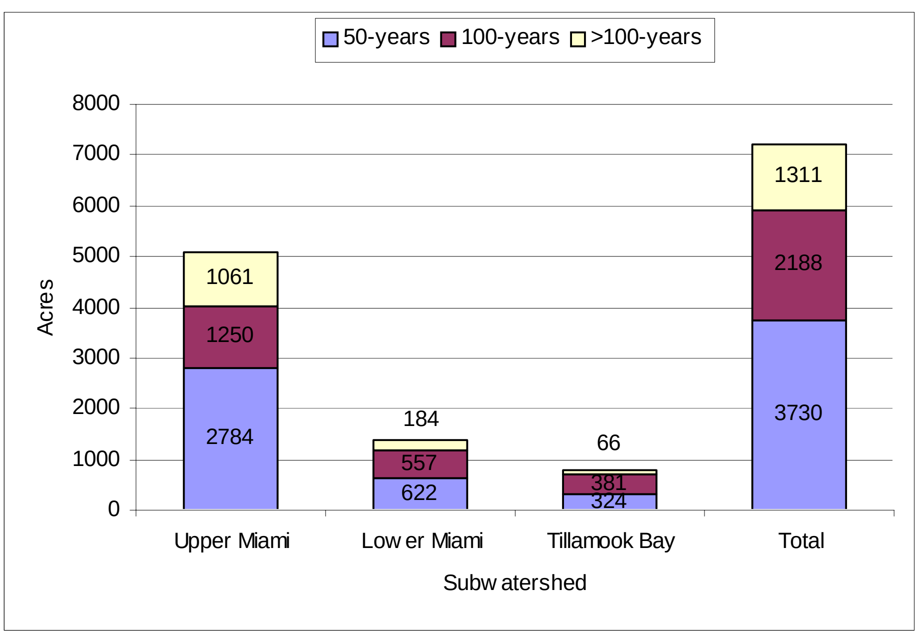

Figure 4. Mapped riparian acres of ODF lands projected to achieve PFC over the 50-, 100- and >100-year timeframes.

The calculations used to predict PFC (and LWD) through time assume that all riparian stands grow forward along a stand succession trajectory without accounting for future management in riparian areas. Appendix J, Management Standards for Aquatic and Riparian Areas, of the FMP provide direction to manage the inner RMA (25 – 100 feet) for mature forest conditions in all type F and large and medium type N streams. By FMP definition, desired mature forest conditions consist of stands dominated by large conifer trees, unless the natural plant community is expected to be hardwood-dominated (FMP 2001). This desired condition is consistent with the goal of producing large wood in streams and if actively implemented through time, would likely eliminate large wood as the primary limiting factor on ODF lands in the watershed. Site specific prescriptions would focus on achieving these conditions in the shortest timeframe possible.

If riparian stand management were actively implemented, the PFC and large wood recruitment projections presented here would likely look different depending on the temporal and spatial distribution of such activities. Current management in RMAs, however, is directed by the SAH strategy. SAH watersheds are a high priority for restoration projects in order to expedite fish recovery.

ODF's current management appears to be "hands off" and in most cases increases buffer widths to minimize risk near riparian areas. This interpretation means that limited management activities will be conducted in RMAs and therefore will have no effect on projections of PFC (and LWD) through time. Table 29 describes the potential outcomes, at least conceptually, of treatment activities in RMAs under direction of the SAH. The site specific effects can be determined at the project planning and implementation phase.

Table 3. Potential LWD and PFC outcomes under Salmon Anchor Habitat Strategy.

Stream Type	RMA (FT)	Treatment	Potential LWD and PFC Outcome Compared to the No Management Assumption*
F, Large N	0-100	No Harvest	Same as no management
Small N (Perennial)	0-50	Inner Zone: No Harvest	Same as no management
	50-100	Outer Zone: Retain 15-25 conifers, snags per acre	Fewer trees per acre remain for LWD than no management but trees get larger faster**
Small N (Seasonal)	0-50	Inner Zone: Retain 15-25 conifers, snags per acre	Fewer trees per acre remain for LWD than no management but trees get larger faster**
	50-100	Outer Zone: No restrictions on harvest	Potentially, no LWD contributions from this zone.**
Small N (Seasonal)	0-50	Inner Zone: No Harvest	Same as no management
(special case)***	50-100	Outer Zone: No restrictions on harvest	Potentially, no LWD contributions from this zone.****

*The calculations used to predict LWD and PFC through time assume that all riparian stands grow forward along a stand succession trajectory without future management in riparian areas.
**As with other Type N streams and RMAs, this will only matter if the stream is capable of transporting LWD downstream (likely through debris-flow channel processes) See Figure 45-47.
***Direct contributor to type F stream, AND one of the following: a seasonal high energy stream, OR potential debris flow track reach.
****By definition, this type of stream is likely to transport wood to a Type F stream. Thus, this is a potentially significant impact.

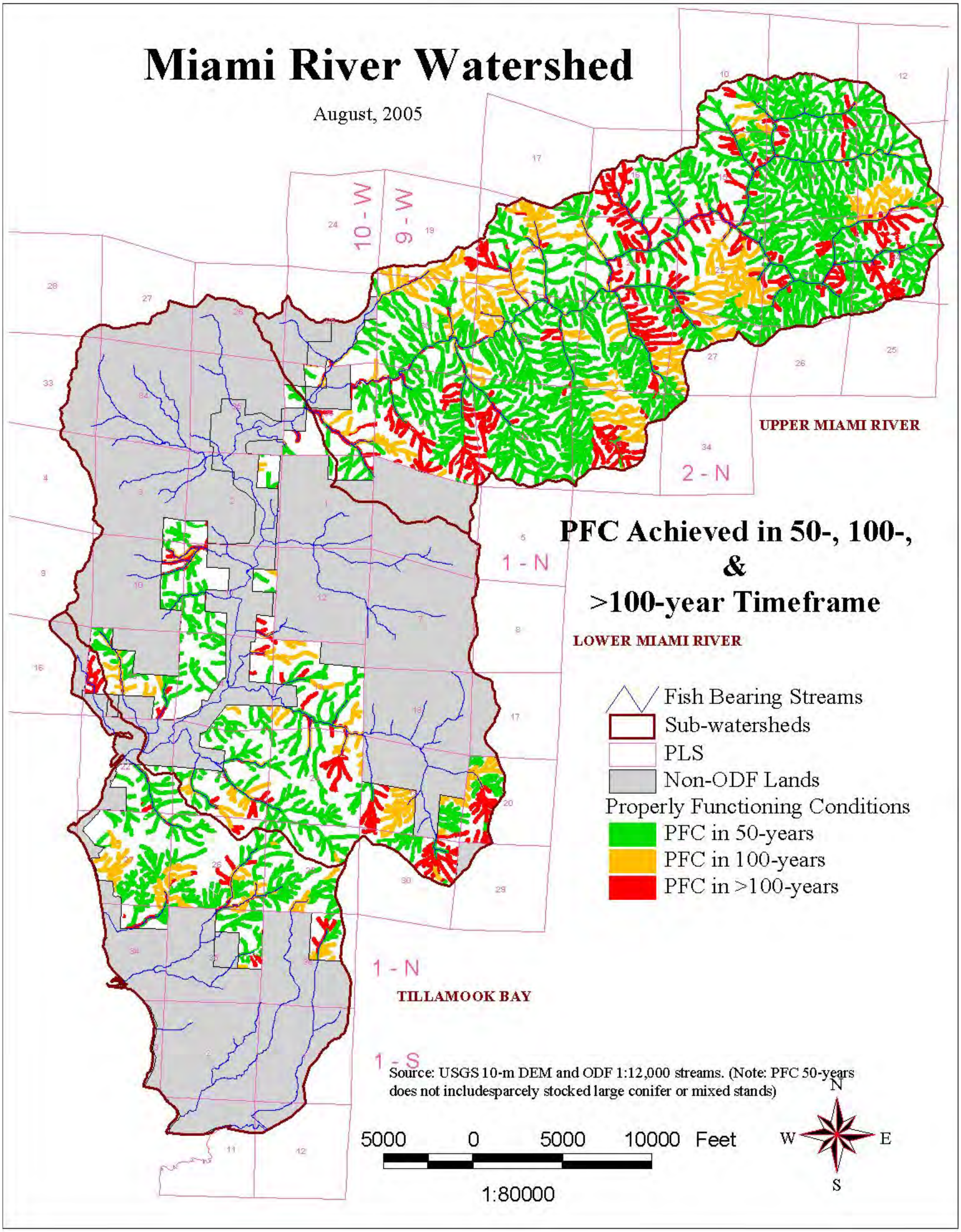

Figure 5. Projected achievement of PFC on ODF lands over the 50-, 100- and >100-year timeframes.

5.2.3 For those subwatersheds where it will take longer than 100 years to develop PFC, prioritize by stream reach (and map) for alternative vegetation management to achieve the PFC.

The areas likely to achieve PFC at a time beyond 100 years (Figure 43) were stratified with critical habitat reaches (Figure 28) as a means to prioritize their need for additional investigation and likely alternative vegetation management. **The areas with the longest timeframe to develop PFC conditions are also the most critical habitats for anadromous salmonids on ODF lands in the watershed.** These areas include 141 acres of the mainstem and North Fork Miami River and Stuart Creek in the Upper Miami Subwatershed and 23 Acres of Moss Creek in the Lower Miami Subwatershed (Figure 44).

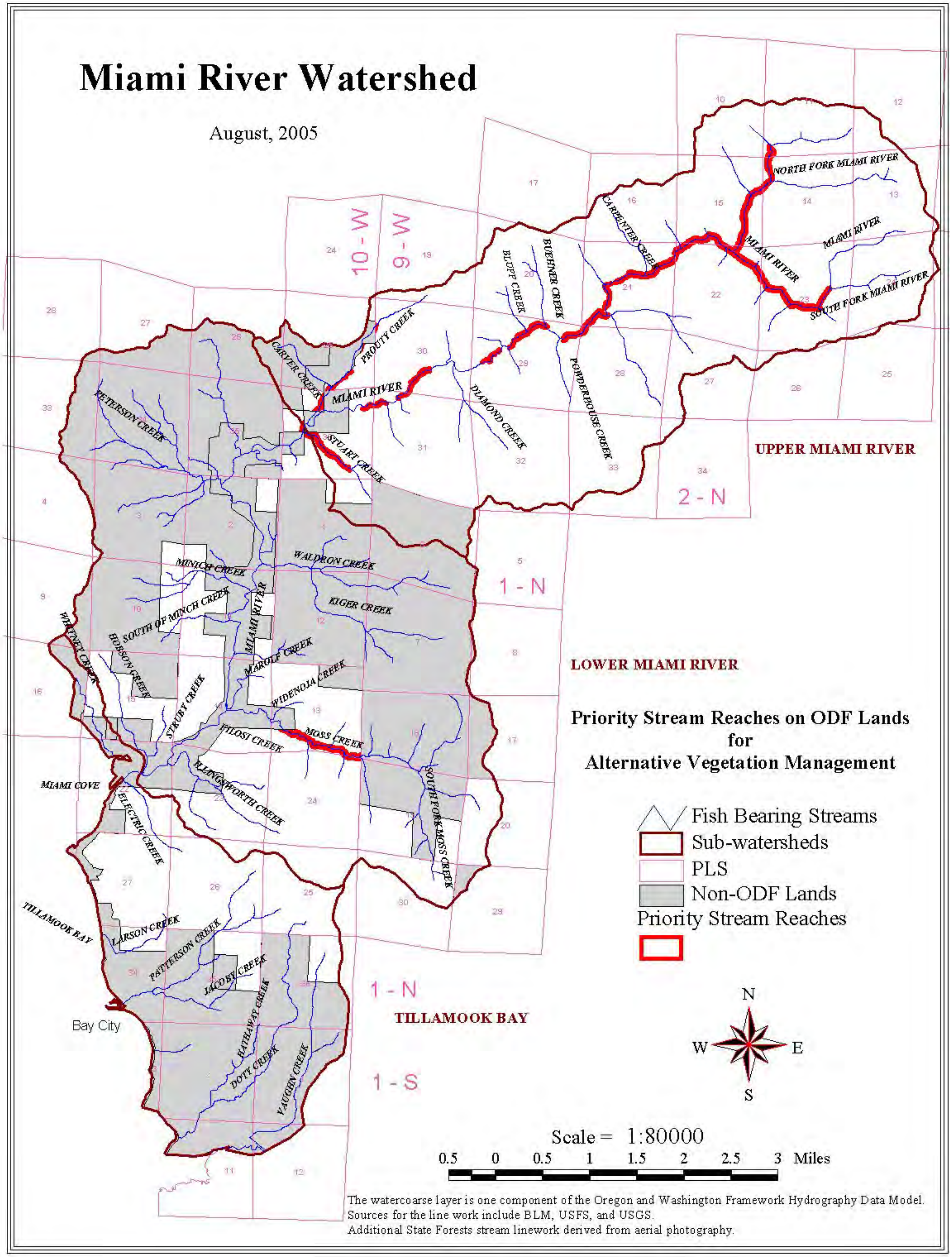

Figure 6. Areas with a high priority for further study and likely vegetation management opportunities.

5.3 Slope Stability

Objective: Produce a map of the project area that categorizes landslide hazards into high, moderate, and low hazard categories, as defined by the ODF. Identify if the project area is unusually prone to landslides. If so, identify where these landslides occur and their effect on delivery of wood and sediment to streams, channel scour, and aggradation. The key analysis questions are addressed below.

5.3.1 Are there landslide-prone hillslopes that pose a high risk of downstream sediment or scour impacts? If so, identify the specific hillslopes and stream reaches, describe why they pose a high risk to streams, and describe how management will affect possible stream sediment or scour impacts.

The relative extent of landslide prone terrain in the project area is analogous to other neighboring watersheds such as the Kilchis, Wilson, and Trask; and considered to be characteristic to the region. Steep (60-79% slopes) and very steep (>79%) slopes are rated as exhibiting a high, and very high landslide hazard respectively. Where these hillslopes are in association with steep ($\geq$60% channel gradient), confined, headwater channels they pose a potential risk of downstream impacts. In the steep, highly dissected Coast Range, the association between steep slopes and steep drainageways is inextricable and widely accepted as areas prone to shallow, rapid landslides (i.e., debris flows).

Figure 14 illustrates that debris flow prone features are abundant on ODF land in the project area. They are most common in the Upper Miami subwatershed and are present in every principle tributary, particularly upper headwater reaches where first and second order streams originate. They are also common on ODF land in the Lower Miami, namely the middle reaches of the Illingsworth drainage, and in the Moss Creek canyon. In the Tillamook Bay subwatershed, they are primarily in the upper most reaches of the Larsen, Patterson, and Vaughn drainages. These naturally occurring debris flow-prone channels are considered to pose an inherent high risk of downstream sediment and scour impacts in the project area. The majority of these features are Type N streams.

Landslide processes and the occurrence of debris flows in western Oregon have been documented at length. Their temporal occurrence is primarily related to periodic intense precipitation events, and they serve as natural mechanisms for transporting and delivering large wood, coarse substrate, and fine sediment to the fluvial system. They typically can cause extensive scour to moderate and steep gradient channel types, and deposit large volumes of material at tributary junctions or in reaches where there is an appreciable decline in channel gradient. These effects can have profound impacts on channel morphology, and can have both positive and negative influences on aquatic and riparian resources.

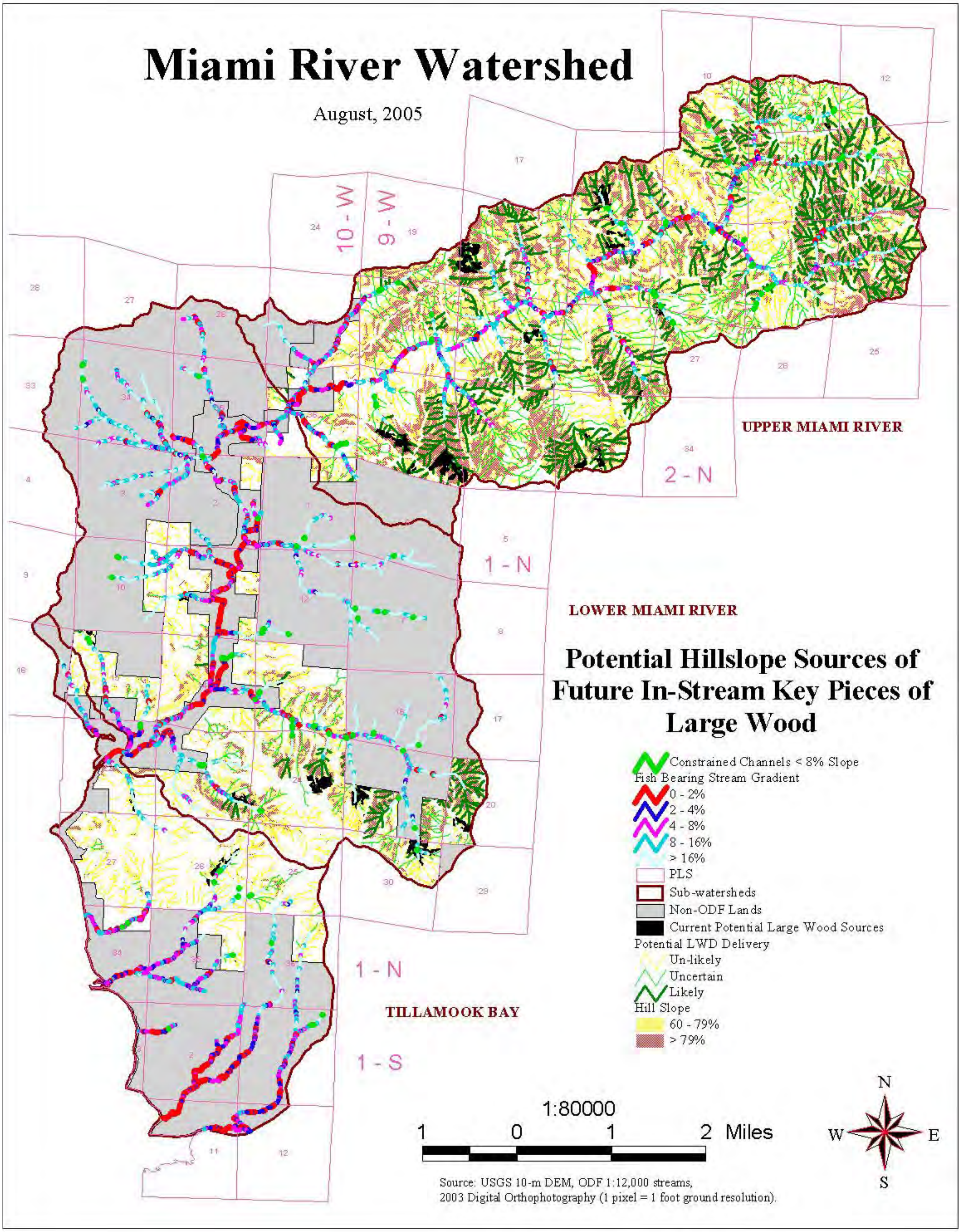

Figure 7. Potential hillslope sources of future in-stream key pieces of large wood debris.

Channels where potential scour impacts can be expected on ODF land in the project area are estimated to include all of the debris flow-prone channels. These are the very steep gradient headwater channel types (see Figure 14). Debris flows initiating in these channels could be expected to result in considerable downstream scour to a point where channel gradient and confinement decline (Figure 45).

First- and second- order Type N, debris flow-prone headwater channels that are directly tributary to the Miami River in the upper subwatershed are direct links between potential hillslope sources of large wood and critical habitat. An abundance of these channel types are located in the upper reaches of the North and South Forks. Evidence of excessive scour in some of these channels was observed in the field, along with debris fan features at their mouths in the bottom of the canyon. However, LWD recruitment potential along these channels is currently poor because of the predominance of hardwood and young forest cover types on the contributing hillslopes. Hence, the function of these Type N streams in particular to deliver large wood directly to critical habitat via shallow-rapid landslides is diminished.

Reaches represented by channel habitat types exhibiting a low (<2%) or moderate (2-8%) gradient that are downstream from steep channels, represent locations where slide deposits could potentially accumulate (Figure 45). These are the lowest reaches of many of the primary tributaries in the upper Miami that connect with the main valley floor, and are reaches where the potential for channel aggradation is high. Most are Type F streams that are directly tributary to critical habitat.

Examples where bedload deposits and debris fans were observed during field reconnaissance and in habitat surveys included the lower reaches of Diamond and Moss Creeks, and the base of several steep, first-order tributary channels to the North and South Forks. Such deposits can act as barriers to fish movement during periods of low flow in the smaller tributaries. Additionally, critical habitat in the Miami River is also where slide deposits can accumulate. Slide materials, particularly LWD originating from first- and second order debris flow-prone channels are often transported directly to the main river where they may become incorporated and provide key structural components beneficial to the complexity of aquatic habitat.

There is no inventory data specific to the project area that evaluates the natural range of landslide occurrence compared to the incidence of slides attributable to human disturbance. An inventory of landslides in the nearby West Fork of the Wilson River after the1996 flood concluded that the incidence of road-related landslides and washouts represented an elevated rate of occurrence above the natural range. On ODF lands past wildfire and timber harvest activities (including road construction) are inferred to have increased the incidence of shallow-rapid landslides where the forest cover was removed, particularly on the steep and very steep slopes in the upper Miami. Since then, the elevated rate of occurrence is believed to have declined markedly because of the reestablishment of a dense forest cover and refinements to timber harvest and road construction practices (Robison et al 1999).

At present, landslide initiation on ODF lands attributable to management is associated primarily with roads on steep slopes. The RIMS data identifies critical road locations considered to be a high potential of impending failure or washout and the relative risk to aquatic and riparian resources. These represent sites where unwanted sediment impacts could affect fish-bearing streams and critical habitat (see following sections for locations of high risk road segments).

6.0 ANALYSIS SUMMARY AND CONCLUSIONS, MANAGEMENT CONSIDERATIONS AND DATA GAPS

6.1 Analysis Summary and Conclusions

To understand the context of aquatic and riparian conditions on ODF lands, overall conditions at the watershed scale were considered. Conditions of aquatic and riparian resources in the project area are distinctly related to land use and topography. There is a marked contrast between conditions in the uplands where forest and natural resource uses are dominant and the lowlands and valley bottoms where agricultural, rural residential, and urban uses prevail. In general aquatic and riparian resources are the most heavily impacted in the lowlands, while conditions are the best in the uplands.

The degree of undesirable effect to aquatic and riparian resources in the project area is the greatest along the middle and lower reaches of the primary streams in the Tillamook Bay subwatershed and the middle and lower reaches of the Miami River, all of which are downstream from ODF lands. Many of these reaches, particularly those in the Miami, are low gradient channel types sensitive to disturbance and considered to be critical habitat for anadromous salmonids. The types of impacts to these reaches are many and include land conversion from forest to non forest, the conversion of naturally occurring meadows and wetlands to pasture, channel modifications, degraded water quality, elevated stream temperatures, low habitat complexity, lack of LWD, water withdrawals, and human created migration barriers. Cumulatively, these impacts are considered to be limiting overall properly functioning conditions in the project area, and have diminished the complexity and diversity of aquatic and riparian resources.

The overall conditions of aquatic and riparian resources in the project area are considered to be better on ODF lands, principally in the upper Miami subwatershed where the majority of the mainstem river is considered to be critical habitat. Despite heavy disturbance historically as a result of the Tillamook Burn, road building, salvage logging, and timber harvest, conditions are not as degraded as the reaches located further downstream on non-ODF lands. In general, overall conditions on ODF land have the potential for trending toward recovery from past impacts.

Factors such as current shade and stream temperature are not believed to be limiting the attainment of properly functioning conditions on ODF lands. The shade estimates predicted in this analysis and the measurements taken during aquatic habitat surveys indicate that there are adequate levels of shade to protect water quality concerns and beneficial uses.

While the hydrologic regime may be affected to some degree in individual small tributary drainages such as Moss Creek, at the watershed scale, indicators such as the extent of created openings and the extent and hydrologic connection of the road system indicate that alterations to the hydrologic regime are not likely detectable and that the potential for accentuated peak flows is low. Depleted base flows however, are a concern, but the condition is not considered to be a major limiting factor. The ODFW and OWRD designate the Miami River as a state priority for streamflow restoration to support anadromous species. Affected reaches are downstream of ODF lands, and are associated with withdrawals for private users that are potentially dewatering streams with documented fish presence during low flow periods.

Though current data is somewhat limited, in-stream sediment is also not considered to be a primary limiting factor on ODF lands. ODFW habitat surveys rated existing in-stream sediment as being moderate to high compared to reference reaches; however the survey did not conclude that sediment was limiting. As previously mentioned, these reaches were established by ODFW (2005) based on "reference" values collected from reference sites between 1992 and 2003. Low, moderate and high represent the 25th, median, and 75th percentile, respectively, of the reference values. ODFW (2005) does not present correlations between these percentages and what would be expected in a natural range of variability. Therefore, a value (i.e. high >75%) does not necessarily represent a goal or target value.

The primary inherent disturbance regime that affects the project area, namely heavy winter precipitation events, generates a high degree and a wide variable range of background sediment naturally. Aquatic and riparian dependent species that inhabit Coast Range watersheds like the project area, have adapted to these conditions. Current sources of sediment on ODF lands that are attributable to human disturbance are primarily associated with roads. Road related sediment however, is considered to be relatively nominal since most of the road system is in good condition. Some problems do exist however, and there are critical locations where road segments pose a risk to aquatic and riparian resources, but the majority of the road system is in good repair or is currently being upgraded.

Levels of in-stream LWD and current and future recruitment from upslope and streamside forests are the primary factor limiting the achievement of PFC in the short and long term on ODF lands. Based on aquatic habitat survey data, only two stream reaches are considered to have adequate pieces or volume of LWD on ODF lands. The absence of LWD is directly related to findings in the ODFW surveys, which conclude that the degree of habitat complexity in the project area is poor.

Future levels of in-stream wood are dependent on recruitment from streamside and upslope forests. Current large wood recruitment potentials are limiting the achievement of properly functioning conditions for aquatic systems on ODF lands. This condition serves as the primary basis in determining the degree to which properly functioning conditions are being achieved on ODF lands. Currently, only 6% of riparian management areas on ODF lands exhibit a high LWD recruitment potential. In a hundred years that is expected to increase to 58 percent. Most importantly, nearly all of the streamside riparian stands along reaches that are considered to be critical habitat will take greater than 100 years to develop a high potential for LWD recruitment. Unfortunately, there are no quick fixes for restoring wood to priority reaches.

There are several other factors that are considered to be potentially limiting to the attainment of PFC on ODF lands. First, due to aquatic and riparian conditions downstream from ODF lands, strategies to restore, enhance, and maintain properly functioning conditions and to manage for Salmon Anchor Habitat objectives on ODF land is somewhat hindered. Conditions along most of these reaches are impaired. So the effectiveness of efforts on state lands to enhance aquatic and riparian conditions could be limited by conditions downstream that are outside the jurisdiction of the ODF.

Another factor to consider is current management on ODF lands. Recent vegetation management and stand-level treatments in the project area have been focused on non-riparian objectives such as forest health. Existing guidance provides for aquatic and riparian protection by means of standardized prescriptive measures, principally stream buffers where vegetation management activities are restricted. Strategies provide for protection and are intended to prevent adverse impacts, and support natural recovery of aquatic and riparian systems. While these strategies do not impair natural recovery, they do not explicitly provide for options to accelerate recovery of streamside forest stands. Existing strategies reliant on natural rates of recovery at successional timeframes may not result in the attainment of properly functioning, and future desired conditions in a shorter timeframe.

6.2 Management Considerations

The following management considerations represent those strategies with a high potential for successfully achieving and maintaining PFC for aquatic and riparian resources.

Alternative Vegetation Management to Improve LWD Recruitment Potential (Figure 48)

- Consider the potential for proactive management of riparian areas that could promote the fastest recovery of large conifers as future inputs of large wood. Figure 48 identifies potential areas to consider designing and implementing in-stream and riparian vegetation restoration opportunities.
- Hardwood dominated stands along priority reaches should be considered for conversion to conifer or mixed conifer and managed to accelerate their development into mature stands in the shortest timeframe possible. Conversion strategies to consider include conifer release, clearing of hardwoods and brush followed by conifer regeneration and planting, or partial treatment of hardwood stands (i.e. girdling) followed by underplanting with shade-tolerant conifer species.
- Ninety-five percent of the large conifer riparian patches in the watershed are located on ODF land. Several of the largest more prominent patches are located on ODF land on the frontal highlands above the coastal plain in the Tillamook Bay frontal subwatershed. Other large notable patches on ODF land are located in the upper headwaters of Moss Creek, above the north bank of the Miami River across from Diamond Creek, and in the steep headwaters of Bluff Creek. Examination of the “Desired Future Conditions” GIS layer indicates ODF’s intent to build larger patches of older forest structure adjacent to these existing large conifer patches. Consider stand treatments to increase the size of existing old forest structure patches and focus on those that would benefit the potential for LWD recruitment via debris flow-prone channels. These will have an added benefit to wildlife (i.e. spotted owls and marbled murrelets).
- The development of large conifers in debris flow prone channels likely to deliver to priority reaches will facilitate inputs of large wood. These processes may take decades or even longer to manifest. Nevertheless, it should be considered as part of the long-term strategy. This may be constrained by direction not to operate on steep slopes as part of the SAH strategy, or may be operationally infeasible.

- Look for potential opportunities to treat stands that are on steep and very steep slopes adjacent to existing patches of old forest to promote the development and increase the patch size of large wood sources potentially deliverable to fish-bearing streams via shallow-rapid landslides.
- Consider stand treatments on steep and very steep slopes along the upper reaches of the South Fork, North Fork and the mainstem to promote the development of future sources of LWD potentially deliverable to critical habitat via shallow-rapid landslides. In conifer stands, consider thinning into the inner riparian buffer. In mixed stands, consider thinning into the outer buffer to favor conifer. In pure hardwood stands, consider options for establishing conifers in the understory or potential stand conversion.

In-Stream Enhancement to Improve Habitat Complexity (Figure 48)

- Opportunities in the short-term are limited to adding logs to priority reaches. Pulling or yarding selected streamside trees directly into the channel may be the most efficient and cost effective. Trees within 200 feet (or further if feasible) of the stream with the lowest chance of falling into the stream on their own should be targeted. If logs are placed in the stream, rootwads should be attached. Other options could be to retrieve and stockpile large wood deposited on road surfaces from landslides for later in-stream use (see Figure 48 for opportunities).The Regional General Permit in which ODF and ODFW conform for implementation of instream projects is limited to streams less than 42 feet wide. The priority stream reaches identified in this analysis for placement of large wood exceed 42 feet in width. Additionally, trees within 25 feet of the stream may not be used for these projects, leading to logistical difficulties in getting trees to the stream.
- Consider implementing restoration opportunities listed in the ODFW (2005) habitat survey report, which include reaches on the upper Miami, as well as others of Minich, Moss, Prouty, and Stuart Creeks. Also revisit opportunities listed in the North Coast Project Guide to Restoration – Site Selection Phase II.

Enhance conditions on lands downstream from ODF lands.

- Explore partnering with watershed councils to address conditions downstream of ODF lands where conditions are likely affecting fish production on ODF lands. Focus on improving habitat complexity, and restoring wetlands at the mouths of the Miami River, Doty Creek, and Vaughn Creek.
- Coordinate with ODFW and OWRD to develop strategies that will address the restoration of low flows on reaches downstream of ODF lands.

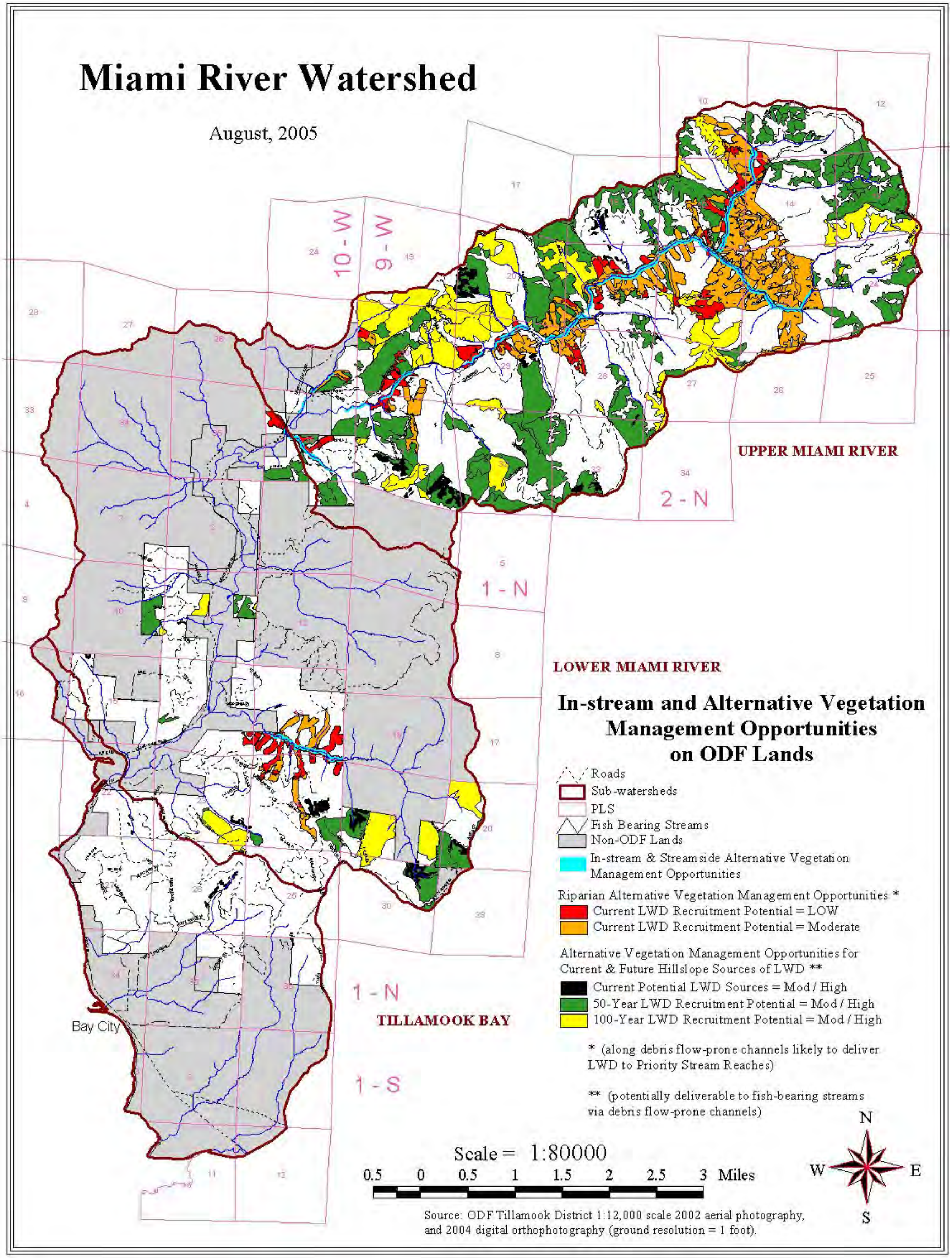

Figure 1. Stream segments and forest stands with a high priority for further study and management opportunities.

Upgrades to Further Minimize Potential Road Related Risks to Aquatic and Riparian Resources (Figure 49)

- Consider decommissioning the Buehner Creek Road and the Miami River Road between the South Fork confluence and the North Fork crossing.
- Look to upgrade critical locations rated as a high risk to aquatic resources but which are primary access and haul routes to be retained into the future.
- Miami River Road – Upgrade the 3.4 mile segment along the river between Powderhouse Creek and the South Fork confluence. In places the fill slope of this road encroaches upon the channel or is located directly in the active floodplain. It is located immediately adjacent to critical habitat reaches.
- Diamond Creek Road – Improve the steep 0.2 mile grade that traverses up a wet and narrowly confined small drainage at about milepost (MP) 0.8 where three cut/fill slide locations have been identified. Sediment from road related failures along this segment are deliverable to a stream that is tributary to river reaches designated as critical habitat.
- Foley Road – Repair a 160 foot segment of road at the first switchback up from the bottom where a cut/fill slide is located adjacent to a stream crossing. The subject drainage is a tributary to critical habitat on the river.
- Foley Peak Road – Improve several cut/fill slides along a 0.1 mile long segment that traverses across a steep dissected slope in the headwaters of Buehner Creek near the top of the ridge. It is located about 0.9 miles west of the Foley Road intersection. Sediment from failures would be deliverable to contributing headwater tributaries to the fish bearing reaches of Buehner Creek.
- The last mile of Diamond Creek Road – Eroded fill slopes high up a very steep, highly dissected hillslope near the upper terminus needs repair. Sediment deliverable to fish-bearing reaches of Diamond Creek. Also includes the first 100 feet of spur route 15200. Possible opportunity for trail and trailhead development to Tilden Bluffs.
- Electric Creek Road – An eroded fill slope on a steep headwater slope that is tributary to Larsen Creek needs to be repaired. Sediment potentially deliverable to fish-bearing reaches. An opportunity to reduce hydrologic connection was missed during recent road upgrades.
- Fire Break 3 Road – Site of eroded fill slope, caused by a log truck that drove off the road which initiated a fill failure needs repaired. Sediment deliverable to critical habitat.
- Miami North Road – About a 1.2 mile segment of potentially unstable fill on steep highly dissected slopes needs improvement. Sediment deliverable to critical habitat.
- Miami West Road – About a 0.3 mile segment of potentially unstable fill on steep highly dissected slopes should be upgraded. Sediment deliverable to critical habitat.
- MRG Road – A small fill failure where eroded sediment is deliverable to South of Minich Creek should be repaired, a tributary to critical habitat in the lower Miami.

- Vaughn Creek Road – A deep seated landslide feature continually causes deformation of the road prism and should be upgraded. High failure potential. Sediment is deliverable to Vaughn Creek and fish-bearing reaches downstream.
- Miami River Road – The segment between Diamond and Powderhouse Creeks is immediately adjacent to the river and has undergone repair and armoring, as well as some relocation in the recent past to prevent damage from high flows. Although these upgrades should minimize impacts and erosion from high flows, several sections still impinge upon the channel and most of the entire segment is located within the floodplain. The potential for inundation and future impacts from high flows is high and the segment should be reviewed for further upgrade.
- Road segments with over 500 feet connection, with cross drains assigned a RIMS attention priority code of 0, 1, or 2, are in need of immediate repair and should be candidate locations for a new culvert or waterbar.
- Fish migration barriers – Barriers number 134, 143, and 152 were identified as priority for repair (Figure 49). Eight stream crossings identified as potential barriers in the RIMS database need field verification to confirm their barrier status. These are identified on Figure 26 as “ODF Barriers Unconfirmed (RIMS)” and are locations 8, 9, 18, 32, 35, 43, 83, and 139. ODFW (2005) identified five (5) barriers (Streamnet barriers 10, 11, 12, 5, 6) located on private land that are potentially limiting fish access to streams on ODF lands. ODF should seek opportunities to further investigate and remedy these potential barriers. Correcting these barriers could access as much as 3.6 miles (5.8 kilometers) of habitat.

Other Potential Opportunities

The following road segment is an opportunity to minimize the effects of related sources of sediment that are adjacent to critical habitat and priority reaches.

- Minimize ground disturbance caused by OHV users on the abandoned South Fork Road and its tributary 2-9-22.2 road system. Additionally, this could be an opportunity for developing a foot trail.

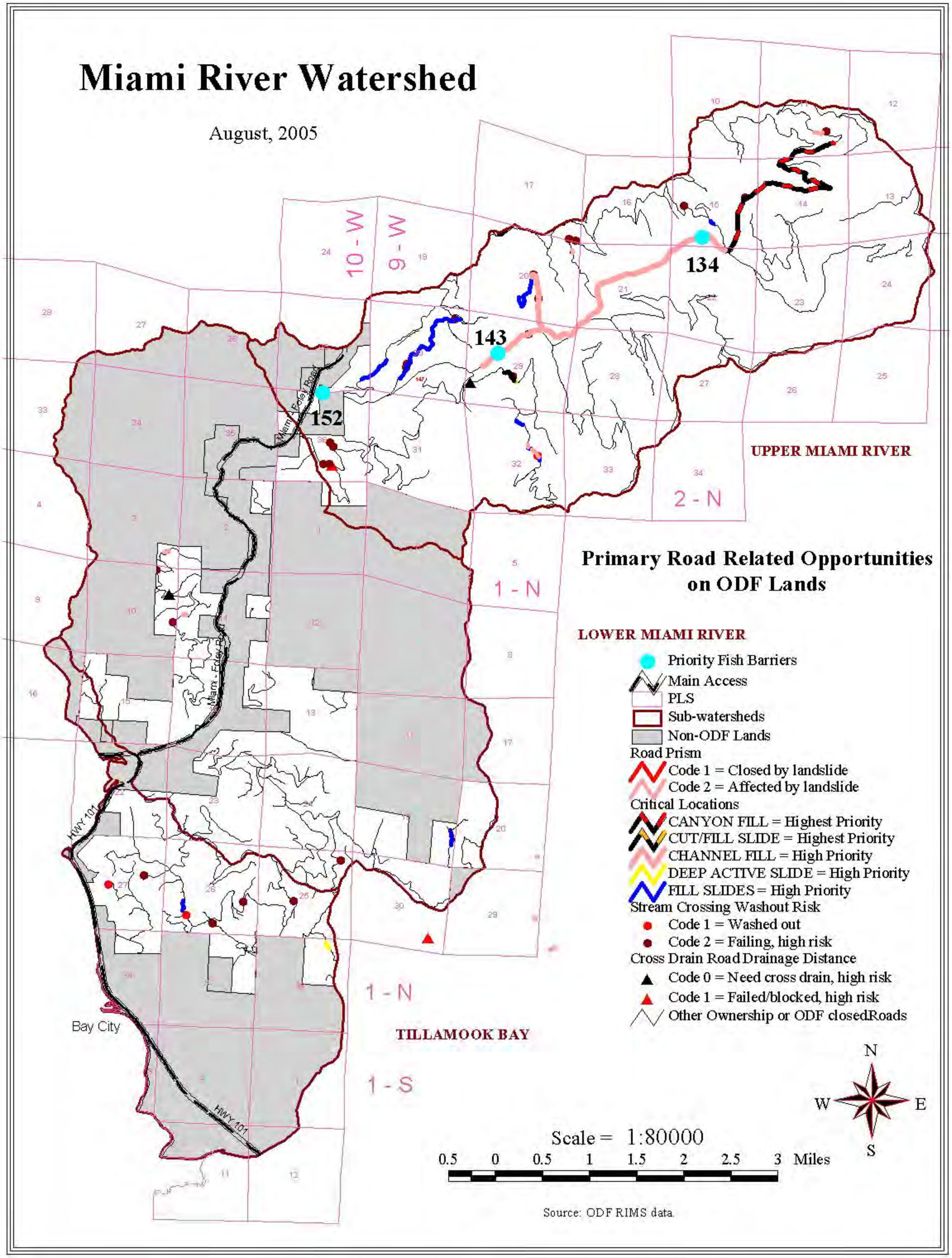

Figure 2. Road segments with a high priority for further study and management opportunities.

6.3 Data Gaps

In the process of this analysis several needs were identified for the collection of additional data, either to validate remotely sensed data interpretations or to fill a data gap. The following are recommended data needs that ODF should prioritize based on importance, operational feasibility and funding.

- Stream temperature and water quality monitoring. Inferences regarding stream temperature were actually derived in the analysis using current and historical estimates of shade. As discussed in the analysis, no stream temperature data exist in order to stratify ODF lands. ODF should consider a temperature monitoring program that stratifies ODF lands at confluences with major tributaries as well as ownership boundaries. In addition, ODF should consider reinstating water quality monitoring at Moss Creek Bridge for fecal coliform bacteria, total suspended solids, and nutrients.
- Aquatic habitat surveys. Data collected during ODFW aquatic habitat surveys was used extensively in this analysis to characterize habitat conditions. One reach was resurveyed post 1996 flood. ODF should consider resurveying the other reaches and possibly expanding the surveys to include other fish bearing streams not yet surveyed.
- Noxious weeds inventory and control plan. No explicit data exists on the species, location or density of competing and unwanted vegetation. ODF should consider a noxious weed inventory to collect data, develop a system in which to track it, and develop and implement a program in which to manage noxious weeds, particularly for Japanese knotweed.
- Amphibian surveys. No amphibian surveys have been conducted in the Miami River Watershed. Inferences regarding habitat requirements were used to map potential habitat in this analysis. ODF should consider conducting amphibian surveys, targeting Columbia Torrent Salamander and Tailed Frogs.
- Hydrologic units. Delineate existing subwatersheds further into 7th-field hydrologic units (i.e., catchments) according to USGS protocol to facilitate better stratification of drainage scale analysis and conditions.
- Digital stream coverage. The current densification of the streams coverage is variable across the project area and needs to be standardized. The uppermost extent of streams should be refined and consistent so that accuracy is improved because the current coverage overestimates the extent of the stream network.

A lengthy list of recommendations and data gaps was identified in the OWEB Miami River Watershed Assessment (E&S 2001). Recommendations pertinent to ODF lands were incorporated and addressed as a part of this analysis or incorporated in the list of data gaps identified above.

7.0 OWEB Critical Questions/ODF Supplemental Questions

Stream Channels

OWEB Critical Questions

What is the distribution of channel habitat types (CHTs) throughout the watershed?

- Eleven different CHT'S as defined by OWEB are represented in the project area (see Figure 5 and Tables 4 and 5). They differ primarily by size, gradient, and confinement.
- The majority (90%) of CHTs are small, steep, and confined channels, the steepest of which are prone to shallow, fast moving debris slides and flows. The majority (63%) of these channel types is located on ODF lands. Low and moderate gradient, unconfined, and moderately confined sensitive channel types comprise only about 9 percent of the miles mapped. Most (86%) are located on non-ODF lands, only 14 percent occur on ODF lands.

What is the location of CHTs that are likely to provide specific aquatic habitat features?

- These are the low gradient (less than 4%) stream reaches. They include all of the FP1, FP2, FP3, LM, MM, and MC channel habitat types in the project area, and are considered to be critical or important to a species or specific life stage.
- The majority of these comprise the lower and middle reaches of the main Miami River valley. About 12 miles of these channel types are located on ODF lands, primarily in the upper Miami subwatershed (see Figure 28).

What is the location of areas that may be the most sensitive to changes in the watershed condition?

- Approximately 37 miles of stream in the project area are considered to be sensitive to disturbance (see Table 6). The most sensitive CHTs include the low gradient reaches of the main stem Miami River that extend from its mouth upstream to about Foley Peak Road. They also include the lowest reaches of the Miami's small and medium sized tributaries in the lower subwatershed.
- Eighty-four percent of the sensitive reaches are located on non-ODF land in the Lower Miami and Tillamook Bay subwatersheds. There are five miles (14%) of sensitive reaches that occur on ODF lands. They are all located in the Upper Miami subwatershed and extend from Prouty Creek up to Foley Peak Road.
- In the Tillamook Bay subwatershed, sensitive reaches are located where the majority of agricultural, rural residential, and urban land use occur. These reaches include the lower portions of Patterson, Jacoby, Doty, and Vaughn Creeks.

Where are channel modifications located?

- Roughly 8 percent (43 miles) of the total stream miles in the project area have been modified; nearly all (90%) are located on non-ODF lands (see Figure 6).
- The majority of modified channels in the project area are in the Tillamook Bay subwatershed. These include all of the low and moderate gradient reaches of Patterson, Jacoby, Doty and Vaughn Creeks. The lower and middle, low gradient reaches of the Miami River are also included.
- Thirty-six of the thirty seven miles of sensitive stream reaches in the project area have been modified. About four and a half miles are on ODF lands. They include

portions of the sensitive reaches on the upper Miami, and the lower reach of the North Fork. One other includes the middle reach of Moss Creek.

Where are historic channel disturbances located (ex. splash dams, stream cleaning, withdraws/diversions)?

- Historic data is limited, but extensive disturbance in the uplands over the last hundred years included large forest fires, subsequent salvage harvest, obsolete and less cautious harvest and road construction practices of the past, yarding through riparian corridors, and prodigious stream clean out. Undoubtedly, channel modifications that have occurred in the past still persist along many reaches in the project area.
- Notes from stream surveys conducted in the early 1950's identify several notable channel modifications on ODF reaches in the project area, including dams for urban and domestic water supply in Electric and Struby Creeks. Additionally, channelization and diking along the Miami river between Diamond and Powderhouse Creeks was conducted in 1958.
- There are seventy four permitted withdrawals in the project area. Most (66) are located in the Tillamook Bay Streams and Lower Miami subwatersheds. They are primarily for public domestic water supply, private domestic water supply, industrial water supply, and irrigation (see Figure 8 and Table 9).
- There are no known occurrences of splash dams in the project area.
- Specific location data is limited, but observed locations of log jams were noted in old survey notes from the early 1950's. Stream cleanout activities likely took place where some of these occurred (see Section 3.4).

What CHTs have been impacted by channel modifications? What are the types and relative magnitude of the past and current channel modifications?

- All of the low gradient CHT's in the project area which are considered to be critical habitat have been heavily modified, primarily by land conversion for urban, rural, and agricultural uses (see Figure 6).
- On ODF lands, the moderate gradient channel types of the upper Miami between Prouty and Diamond Creek, the lower reach of the North Fork, the lower reach of Buehner Creek, and the middle reach of Moss Creek have been partially modified by roads, which impinge upon the river channel. These too are identified as critical habitat.

Hydrologic Conditions and Water Use

OWEB Critical Questions

What land uses are present in the watershed?

- Natural resource management and timber production are the dominant land uses across the majority of the project area (92%). Agricultural, rural residential, and urban land use account for slightly less than 8 percent of the entire project area (see Table 2)

What is the flood history in the watershed?

- For the 22-year period of record between 1973 and 1995 on the Miami River, the five largest peak events occurred in 1977, 1983, 1986, 1990, and1994. For

Patterson Creek in the frontal subwatershed, the five highest peaks for the 17-year period of record between 1952 and 1968 occurred in 1953, 1955, 1961, 1964, and 1965. The flood of 1996 was another event of significance known to have impacted the Miami watershed.

Is there a probability that land uses in the watershed have significantly affected peak/low flows?

- Overall, peak flows are not considered to have been affected significantly in the project area. However, the greatest potential for accentuated peak flows is associated with the Tillamook Bay frontal subwatershed, primarily as a result of the conversion of forest cover types to a non forest condition (see Tables 7 and 8).
- Data indicates that on average, the potential for low flows to be significantly depleted is low (see Section 4.2.2). However, the ODFW and OWRD rated the Miami as a high priority for summer low flow restoration. There is a potential for dewatering streams with documented fish presence during low flow periods, particularly the lower Miami and the primary streams in the Tillamook Bay subwatershed.

For what beneficial use is water primarily used in the watershed?

- The primary beneficial uses designated for reaches on ODF land are for anadromous and resident fish, aquatic life, wildlife and hunting, fishing, water contact recreation, and aesthetic quality.
- Other beneficial uses in the project area include public domestic water supply, private domestic water supply, industrial water supply, irrigation, livestock watering, and boating.

Is water derived from groundwater or surface water source?

- There are four permitted withdrawal sites in the Upper Miami subwatershed. Two are on ODF land and originate from several small unnamed tributaries to Prouty Creek, and two originate from Carver Creek (see Figure 8).
- In the Lower Miami subwatershed there are fifteen surface withdrawals from the Miami River, Hobson Creek and Minich Creek, Whitney Creek, or unnamed tributaries. There are two wells and one reservoir, which is on ODF land up Struby Creek.
- There are seventeen permitted surface water withdrawals in the Tillamook Bay subwatershed. Four are located on ODF lands in the vicinity of Hobsonville Point. There are two groundwater wells near the mouth of Vaughn Creek. The surface water sources are primarily Vaughn Creek, but also Doty, Patterson, and several unnamed tributaries. There are five permitted storage reservoirs in the subwatershed associated with Vaughn Creek, Electric, Jacoby, and Patterson Creeks.

What type of storage has been constructed in the watershed?

- On ODF land in Struby Creek there is one municipal storage reservoir (tank).
- There are five permitted storage reservoirs in the Tillamook Bay subwatershed. Two are ponds that draw from Vaughn Creek, one is the water treatment facility for Bay City, one is an impoundment on Jacoby Creek, and the other is a storage tank on Electric Creek.

Are there any water withdrawals for use outside of the watershed?

- There are no known significant permitted withdrawals exported for use outside of the project area, although several that are used for irrigation purposes are located on the southern boundary and may serve pastures that may drain away from the project area.

Is any water being imported into the watershed?

- There are no known significant permitted withdrawals importing water into the project area, although one used for irrigation is located on the southern boundary is recorded as drawing from a surface source noted as the Kilchis River.

Is there any illegal water use?

- There is anecdotal information about an un-permitted withdrawal on ODF land on an unnamed tributary in the upper reaches of the lower Miami subwatershed.

Do water uses have an effect upon peak/base flow?

- The potential for dewatering streams with documented fish presence during below average low flow periods is a concern in the Miami. The greatest potential for dewatering streams with documented fish presence is associated with the primary frontal tributaries.

Riparian Conditions and Wetlands

OWEB Critical Questions

What are the current conditions of the riparian areas in the watershed?

- Only about 4 percent of the riparian network is comprised of large conifer dominated stands (see Figure 9 and Tables 11, 12, 13). They are fragmented and widely distributed. Under more natural conditions, there would have been a much greater proportion of large conifer cover types. The current condition is considered to be outside the natural range of variability.
- Most of the Upper Miami, which is predominantly ODF land, is comprised of hardwood and mixed components; conifer dominated stands comprise the smallest percentage. The medium and small tree size classes dominate.
- Ninety-five percent of the large conifer riparian patches are located on ODF land, their acreage nearly evenly distributed across all three subwatersheds. The largest more prominent patches are located in the Tillamook Bay subwatershed, in the upper headwaters of Moss Creek, above the north bank of the Miami River across from Diamond Creek, and in the steep headwaters of Bluff Creek.
- Overall, about thirty-nine percent of the riparian network is comprised of conifer dominated stands in the project area, 27 percent is hardwood dominated, 27 percent mixed, and about 8 percent is non forest. The majority (81%) of the riparian network is comprised of medium and small tree size classes (45% and 36% respectively). Only 6 percent is comprised of the large tree size class, and 5 percent is in the regeneration size class.

How do the current conditions compare to those potentially present or typically present for this ecoregion?

- Only about 4 percent of the riparian network is comprised of large conifer dominated stands. Under more natural conditions, there would have been a much greater proportion of large conifer cover types. The current condition is considered to be outside the natural range of variability.

How can the current riparian areas be grouped in the watershed to increase our understanding of what areas need protection and what the appropriate restoration/enhancement opportunities might be?

- An evaluation of potential factors limiting achievement of properly functioning condition was conducted (see section 5.1 and 5.2).
- Figures 44 and 48 identify priority stream reaches where protection and enhancement through instream and streamside forest management are appropriate.
- The low and moderate gradient channels of the mainstem Miami River are where the majority of sensitive reaches considered to be critical habitat occur (see Figure 28).
- On ODF land, critical habitat has been identified as priority reaches for restoration and enhancement (see Figure 44).

ODF Supplemental Questions

What are the current riparian vegetation characteristics on State Forest lands in the watershed?

- Overall, conifers stands comprise roughly 36 percent of the riparian network on ODF lands, 35 percent are hardwood dominated, and 28 percent are mixed (see Table 13). Only 8 percent of the riparian network on ODF lands is comprised of the large size-class cover types, 50 percent is in the medium size-class, 37 percent in the small class, and 3 percent in the regeneration class.
- Fifty-two percent of the riparian network on ODF lands in the upper Miami is comprised of either hardwood dominated or mixed cover types, and 66 percent is comprised of small and medium size-class stands. Only 3 percent is comprised of large size-class trees.
- Ninety-five percent of the large conifer riparian patches that currently exist in the project area are located on ODF land.

Which riparian areas will provide high LWD input potential for key conifer pieces under 50- and 100-year scenarios? Map these areas as well as those where potential under each scenario would be low and moderate.

- Figures 37 and 38 identify mapped riparian areas on ODF lands with low, moderate, and high LWD recruitment potential in 50- and 100-year scenarios.
- The overall amount of “High” LWD recruitment potential on ODF lands increased from 6% to 33% (424 acres to 2516 acres) in 50 years, and from 6% to 58% (424 acres to 4385 acres) in 100 years. The largest gain, in terms of acres, was in the Upper Miami Subwatershed where the amount of “High” recruitment potential increased from 132 acres (2%) to 2733 acres (51%) in 100 years.
- LWD recruitment potential is a key variable in attaining properly functioning conditions for aquatic resources. Figures 42 and 43 identify mapped riparian areas on ODF lands that are likely to achieve PFC in 50, 100, and >100-year timeframes. The areas with the longest timeframe to develop PFC conditions are also the most critical habitats for anadromous salmonids on ODF lands in the watershed.

Are there known concentrations of noxious weeds in riparian areas? Where?

- There is no known inventory of the types and extent of invasive plant species in the project area.
- Anecdotal observations from field reconnaissance (conducted in early March) noted the presence of Himalayan blackberry, English ivy, and Scotch broom. The former

two species were abundant along the lower and middle reaches of the Miami valley (see Section 4.3.2). They also were abundant along the roads and certain lower and mid reaches of all the primary streams in the Tillamook Bay subwatershed. It is also highly likely that tansy ragwort and Scotch thistle are abundant too.
- There are no known documented or anecdotal observations of Japanese knotweed in the project area. However, the Nehalem basin immediately adjacent to the project area has a known infestation.

Where are the wetlands in the watershed? NWI, others unmapped
- The most prominent inventoried wetlands are located on non-ODF lands, and are estuarine types at the mouths of the Miami River, and Doty, Larson, Patterson, and Vaughn Creeks (see Figure 12). There are two small inventoried palustrine type wetlands at the mouth of Peterson Creek, which are also on non-ODF land.
- There is no known inventory of wetlands on ODF lands. However, wetland features were observed during field reconnaissance along portions of the lower reaches of the valley bottom of Larson Creek.

What are the general characteristics of wetlands in the watershed?
- Most are estuarine types that have been heavily modified, primarily by agricultural and rural land use and the presence of roads, dikes, levees, and tide gates.

What opportunities exist in the watershed to restore wetlands?
- Since, all of the known significant wetlands are located on non-ODF lands enhancement opportunities are dependent upon the landowner and other watershed stakeholders.

Sediment Sources

OWEB Critical Questions

What are the important current sediment sources in the watershed?
- Inherently, landslide erosion and fluvial erosion are the dominant sediment producing mechanisms in the project area. Surface erosion is another process of concern, but generally is not considered a dominant factor unless there is a loss of vegetation resulting from disturbances that exposes soil to erosive forces.
- Steep and very steep slopes associated with high gradient, confined, headwater drainageways where debris flows originate. They represent the primary sources of sediment in the project area, and are abundantly distributed on ODF land in Illingsworth and Moss Creeks, and in every principle tributary of the upper Miami.
- Certain road segments are also known sources of sediment. On ODF lands these are certain inventoried segments where sediment generated from road-related erosion is potentially deliverable to a water body (see Figures 16 - 20 and Tables 19 and 20).

What are important future sources of sediment?
- Debris flow-prone channels (see Figure 14). Fluvial erosion as a consequence of annual peak flows or periodic flood events.
- On ODF lands, certain road segments where sediment is deliverable to a water body (see Figures 18, 19, and 20, and Figure 49). These are mainly critical locations and

crossings where there is a high washout risk as identified by RIMS. There is no similar data pertaining to non-ODF lands.

Where are the most severe erosion problems? Which ones are high priority for remedying watershed conditions?

- On ODF lands, critical road locations inventoried by RIMS and crossings where there is a high risk of washout (see Figures 18, 19, and 20, and Figure 49).
- There is no known data pertaining to non-ODF lands.

ODF Supplemental Questions

What is the distribution of slopes prone to shallow, rapidly moving landslides on State Forest lands? Map high, moderate, and low hazard areas

- It is estimated that roughly 36 percent of the project area is rated as exhibiting a high or very high hazard for shallow, rapidly moving landslides. Of the total area rated as a high or very high hazard, 74 percent is located on ODF land 24 percent on private industrial lands, and 2 percent on private non-industrial lands (see Table 15 and Figure 13).

What is the distribution of debris flow-prone channels on State Forest lands? Map certain channels as likely, unlikely, or uncertain to deliver wood to fish-bearing streams.

- The majority (65%) of channels potentially prone to debris flows are in the Upper Miami subwatershed, 32 percent are within the Lower Miami subwatershed, and only 3 percent are in the Tillamook Bay frontal subwatershed. Debris flow-prone channels are located in every primary drainage in the upper Miami. About 75 percent of the channels identified as prone to debris flows are located on ODF lands (see Figure 14 and Figure 46).
- Of the debris flow-prone channels identified, roughly half are rated as capable (likely) of transporting large key pieces of wood from upslope sources to fish bearing streams. The capability of approximately another 35 percent is rated as uncertain, and about 15 percent are rated as unlikely (see Figure 46).
- Of the debris flow-prone channels rated as capable of transporting LWD from upslope sources to fish bearing streams, only a small percentage are near existing standing hillslope sources. Because of the current lack of standing large wood within close proximity to debris flow-prone channels, it is estimated that only 6 percent of those channels are current potential pathways for the potential recruitment of key pieces of in-stream wood (Figure 47).

Where are the locations where gullies or active surface erosion is evident?

- The critical locations identified in RIMS (see Figure 18 and Table 18).
- RIMS inventoried washouts in the Electric and Larson drainages.
- The lower segment of the closed 2-9-22.2 road off of the South Miami road.
- A stream crossing on the decommissioned 2-9-11 road where the culvert has failed and the remaining fill has been deeply eroded.
- There is no known data for non-ODF lands.

Are there active or recently active deep-seated landslide features? Where?

- There are eighteen features, or portions of features mapped on ODF lands (see Figure 15). Ten of these features are located in the Upper Miami subwatershed, five in the Lower Miami, and three in the Tillamook Bay Streams subwatershed. One of the eighteen features is identified as being active. It is located in an unnamed drainage between Buehner and Carpenter Creeks in the Upper Miami subwatershed.

Are there any notably erosion prone soils on steep slopes?

- The existing digital mapping of soil resource in the project area is somewhat outdated, and did not contain any related characteristics or interpretations regarding limitations. So soil information was not used to identify where erosion prone slopes occur. Rather, debris flow-prone channels and steep and very steep slopes were used to determine areas of high risk of landslide erosion.
- An ongoing soil survey for Tillamook County is being prepared by the NRCS, but is not projected for completion anytime soon.

What is the road length in the watershed within 100' of a stream? Stratify by stream type and size. Map where they are.

- Assuming that "stream parallel" is, by definition, a road segment within 100 feet of streams. The RIMS inventory accounted for a total of 12,410 feet of "stream parallel" road on ODF lands, along with 38,750 feet of roads lying within 100 feet of streams at stream crossings (totaling 9.7 miles of stream between both classes). Road segments identified as "canyon fill", "channel fill", and "stream in ditch" classifications accounted for another 7 miles of stream within 100 feet of streams. Notable road segments adjacent to and parallel to streams that encroached on channel or floodplain features that were identified in RIMS as critical locations include portions of the Miami River Road, the Buehner Creek Road, and the closed Moss Creek Road (see Figure 18 and Table 17). No data was compiled for road length and hydrologic connectivity on non-ODF lands. Compared to the field-based inventory of RIMS (about 17 miles), a standard GIS based analysis resulted in about 40 miles of roads within 100 feet of a stream on ODF lands. Part of this discrepancy is due to a highly densified stream coverage, which overestimates the stream network and has not been refined and correlated to actual field conditions. Hence, the field-based inventory of RIMS is a more accurate measure of road segments parallel to streams.

Do any recreation trails contribute to erosion or sedimentation problems?

- Heavy ground disturbance and bare soil conditions were observed in areas where high OHV use occurs, and where potentially illegal off-road recreation trails are located. These included: powerline access roads in the Electric, Larsen, and Patterson Creek drainages, unnamed spurs off the Electric Creek road just north of Bay City, the closed segments of the South Miami road, and closed spur 2-9-22.2 off of the South Miami road (see Section 4.4.3.4).

Are road sidecast/fill landslides present? Map their location. Identify road segments in critical locations.

- On ODF lands, critical locations identified in RIMS include individual locations of the Buehner Creek Road, Diamond Creek Road, Electric Creek Road, Fire Break 3 Road, Foley Road, Foley Peak Road, Miami North and West Roads, Minich Creek Road, East Moss Road, and the Vaughn Creek Road (see Figure 18 and Table 17). There is no known data of road-related failures non-ODF lands.

Are road washouts present? Map their location.

- Two separate individual sites on ODF land in the Electric and Larson drainages (see Figure 19 and Table 19). There is no known data of washouts on non-ODF lands.

What percentage of the road system is the ditch serving as a direct flow route to a stream? Map their location.

- An estimated 20 percent of the road system on ODF lands is connected to the stream network. Most of this connection occurred at stream crossings, with 149 out of 157 of stream crossings having hydrologic connection. Of the 335 cross drain culverts, only 50 had hydrologic connection to streams. (see Figure 20 and Table 21). There is no known data of hydrologic connection related to non-ODF lands.

Water Quality

OWEB Critical Questions

What are the designated beneficial uses by stream reach?

- For all streams in the project area, the following beneficial uses are designated: public domestic water supply, private domestic water supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetic quality (see Table 21).

What are the water quality criteria that apply to each stream reach?

- For all reaches, the parameters are temperature, dissolved oxygen, pH, nutrients, bacteria, turbidity, and organic and metal contaminants (see Section 4.5)
- For an in-depth evaluation of water quality in the Miami see the E&S report (2001).

Are the reaches identified as water quality limited on the 303(d) list?

- The Miami is limited due to temperature from the mouth to Moss Creek and from the mouth to Stuart Creek for bacteria.

Are any reaches identified as sources of high-quality water or designated as Outstanding Resource Waters?

- The Miami River is a State priority watershed for stream flow restoration, otherwise no other special designations are known.

Do water quality studies or evaluations indicate that water quality has been degraded or is limiting listed beneficial uses?

- Potentially, temperature in the reach between the mouth and Moss Creek could be limited for salmonid spawning and rearing, and bacteria could be limiting to water contact recreation.

ODF Supplemental Questions

What stream temperatures are reasonably achievable? Evaluate by subwatershed.

- Actual measurements of stream temperature to describe the historical temperature regime in the Miami River watershed, specifically on ODF lands, are not available.

The best approximation of temperature conditions can only be determined through a comparison of current and historical estimates of riparian shade.

How do current shade levels along streams compare to historic levels? Evaluate by subwatershed and stream type.
- The existing distribution of vegetation cover types on ODF lands was categorized into low, moderate or high shade condition depending on vegetation type, tree size, and stand density (Table 28, Figure 10).
- Categories of historical forest type and shade level (Table 27) were compared with the estimates of existing vegetation cover and corresponding shade level determination (Figure 39).
- Results indicate that the overall shade condition across ODF lands is likely higher today than historically.
- Current estimated levels for the Upper Miami Subwatershed and overall total acres of ODF lands are higher than those estimated historically. The Lower Miami and Tillamook Bay Subwatersheds are consistent with historic levels of shade.

How do the current stream temperature levels compare to historic levels? Evaluate by subwatershed and stream type.
- No historical stream temperature data was available to compare to a limited amount of current data. Existing data does not stratify ODF lands so there is no data in which to evaluate temperatures on ODF lands.
- An approximation of temperature conditions was determined through a comparison of current and historical estimates of riparian shade. The estimates indicate that stream temperatures could be lower or comparable to historical levels.

Fisheries, Aquatic Habitat and Amphibians

OWEB Critical Questions

What fish species are documented in the watershed?
- Coho, fall Chinook, chum, winter steelhead, resident and anadromous cutthroat, and Pacific lamprey. The occurrence and distribution of other native fishes is not documented.

Are any of these species currently state- or federally listed as endangered, threatened, or candidates?
- Coho salmon are listed as threatened (http://www.nwr.noaa.gov/). However, the listing status of Oregon coastal coho salmon is currently under review. Steelhead are considered a species of concern. The State of Oregon does not list any species in the Miami study area.

Are there any fish species that have been extirpated from the watershed?
- There is no evidence that any species have been extirpated from the Miami study area.

What is the distribution, relative abundance and population status of salmonid species in the watershed?
- Coho salmon, fall Chinook salmon, chum salmon, winter steelhead, and cutthroat trout are distributed throughout the watershed to varying degrees. Chum and

Chinook salmon spawn and rear in the low gradient portions of the Miami River and into the lower reaches of some tributaries. Coho salmon and winter steelhead are found throughout the mainstem and larger tributaries (Figures 21-24).

- Tillamook basin coho salmon, chum salmon, steelhead trout and sea-run cutthroat trout populations are depressed (TBNEP 1998). At least part of these species' decline can be attributed to recent changes in oceanic conditions that, since about 1975, have been less than favorable for the survival of anadromous salmonids along the northern California, Oregon and Washington coasts. Coho salmon have been particularly hard hit by the poor ocean conditions. Over harvesting of coho salmon when ocean conditions were poor exacerbated the problem.
- Spawning surveys were conducted from 1996 to 2003. Peak spawning counts in the Miami River were 39 chum per mile in 2003. Prouty Creek had an average of 53.7 fish per mile for the years 1996 to 2003 (ODFW 2005).
- The number of coho salmon seen during surveys averaged approximately 16.7 per mile throughout these reaches with a range of 0 to 60 fish per mile. Surveys for juvenile coho salmon were limited to one or two sites per year. Densities ranged from zero to 1.2 m^2 (ODFW 2005).
- Peak counts of Chinook salmon were 18 fish per mile in 1996 (ODFW 2005).
- No surveys for winter steelhead, cutthroat trout and Pacific lamprey have been documented for the Miami River watershed.
- Recent population trends for Tillamook Bay anadromous salmonids: fall Chinook salmon – stable or increasing; coho salmon – declining; chum salmon – declining; winter steelhead – declining; sea-run cutthroat trout – possibly declining (TBNEP 1998, Nicholas and Hankin 1988).

Which salmonid species are native to the watershed, and which have been introduced?

- The salmonid species discussed are native to the watershed. Non-native fish, including non-native salmonid stocks, may be present but have not been documented.

Are there potential interactions between native and introduced species?

- Because no introduced species have been documented, there are no known interactions between native and introduced fish.

According to existing survey data, what is the condition of the fish habitat in the watershed? Evaluate by subwatershed.

Tillamook Bay Frontal Subwatershed:

- Summer and over-winter habitat capacity and quality was rated low for juvenile coho salmon in Vaughn Creek. The amount of pool habitat, number of deep pools, and amount of secondary channels was low providing for poor rearing habitat. This is likely due to extensive channel alterations caused by agriculture, rural residential and urban development. The lower reaches of Vaughn Creek, which are sensitive, low gradient channel types, are the most extensively modified reaches in the project area.

Lower Miami River Subwatershed:

- Summer and over-wintering habitat capacity and quality was rated poor to fair for juvenile coho salmon in tributaries to the Miami River. Despite moderate to good levels of large wood, the amount of pool habitat, number of deep pools, and amount of secondary channels was relatively low.

- The lower Miami River had an abundance of pool habitat, including deep pools and the amount of secondary channel habitat was high. The amount of gravel in the streambed was low and the amount of fine sediments was moderate. Structural complexity was low in the surveyed reaches, primarily due to the lack of large pieces of wood. Riparian zones lacked large conifer trees in all of the surveyed reaches, and shade levels were low. This can be expected since the lands adjacent to the lower reaches of the Miami River have a grass/meadow composition.
- Summer habitat capacity and quality was rated fair for juvenile coho salmon in the lower Miami River. The amount of pool habitat, number of deep pools, and amount of secondary channels provide good rearing habitat. The number of low gradient stream miles in the tributaries also indicates good rearing potential.
- Over-winter habitat capacity for coho salmon was rated as fair because of the abundance of pool habitat and size of stream, but the quality was low to fair. The streams lack slow-water pool habitat and few of the pools contained sufficient large wood to create complex habitats.

Upper Miami River Subwatershed:

- The surveyed reaches had an abundance of pool habitat, including deep pools and the amount of secondary channel habitat was high. The amount of gravel in the streambed was moderate, but the amount of fine sediments was high, except in the most recent survey of reach 10 (Figure 27). Structural complexity was low to moderate in the surveyed reaches, primarily due to the lack of large pieces of wood. Riparian zones lacked large conifer trees in all of the surveyed reaches, and shade levels were low in the wider reaches of stream.
- Summer habitat capacity and quality was rated fair to high for juvenile coho salmon in the mainstem Miami River. The amount of pool habitat, number of deep pools, and amount of secondary channels provide good rearing habitat. The number of low gradient stream miles in the tributaries also indicates good rearing potential.
- Over-winter habitat capacity for coho salmon was rated as fair to high because of the abundance of pool habitat and size of stream, but the quality was low to fair. The streams lack slow-water pool habitat and few of the pools contained sufficient large wood to create complex habitats.
- Winter rearing habitat is the most limiting component for coho salmon in the Miami study area. This is largely caused by low pool complexity (lack of large wood) and little slow-water pool habitat (beaver ponds and off-channel pool habitats such as alcoves).

Where are the potential barriers to fish migration?

- There are five (5) barriers known to occur naturally. One of these is on the upper reach of the mainstem Miami River. This waterfall has a fishway and both coho and winter steelhead have been found above the falls, illustrating it is not a complete barrier. There are 19 barriers identified by Streamnet depicted on Figure 26. ODFW (2005) identified five (5) barriers (Streamnet barriers 10, 11, 12, 5, 6) located on private land that are potentially limiting fish access to streams on ODF lands. Possibly as much as 3.6 miles (5.8 kilometers) may be potentially blocked.

- Eight stream crossings identified as potential barriers in the RIMS database need field verification to confirm their barrier status. These are identified on Figure 26 as “ODF Barriers Unconfirmed (RIMS)” and are locations 8, 9, 18, 32, 35, 43, 83, and 139. Twelve stream crossings were identified as likely barriers and identified on Figure 26 as “ODF Barriers Confirmed (RIMS)”. They are further described in Table 23.

ODF Supplemental Questions

What stream reaches have high, moderate, and low levels of key pieces of large woody debris in the channel.

- One reach (Site 1878, Figure 27) on the mainstem Miami River has high number of key pieces of large wood. Levels of large wood increased in reach 10 following the 1996 flood. Other surveyed reaches have low to moderate amounts of key pieces of large wood. Overall, key wood pieces are lacking relative to reference conditions (ODFW 2005).

Did any splash damming occur in the watershed? Where? Are the effects still apparent?

- While splash damming and log-drives occurred in watersheds throughout the Tillamook Basin, there is no recorded evidence of splash damming in the Miami River, nor is there any evidence of effects from undocumented splash damming.

What is the distribution of fish species by life stage in the watershed? For each species of interest, map current and historic fish distribution.

- The distribution of anadromous fish varies depending on the species habitat needs at various life stages. Fish distribution by general life stage category is illustrated in Figures 21-24 (www.streamnet.org).
- Current fish distribution is similar to historical distribution (ODFW 2005). Streamnet estimates fish distribution based on a 1:100,000-scale streams layer. It is likely that fish distribution is more extensive than portrayed by Streamnet, particularly for winter steelhead and coho salmon.

How many miles of fish-bearing or potentially fish-bearing streams are blocked by culverts? Where are these barriers? Categorize and map barriers by blockage class and determine length of affected channel.

- Throughout the entire watershed ODFW (2005) reported that approximately two miles of habitat are blocked by all types of barriers, particularly culverts. If partial restrictions are included, this amount increases to 8.8 miles throughout the study area.
- Streamnet barrier locations 5, 6, 10, 11, and 12 should be inventoried to determine if they really are fish barriers. If they are barriers, correcting these obstacles could provide access to potentially 3.6 miles of instream habitat (ODFW 2005).

Are tailed frogs and Columbia torrent salamanders potentially present in the watershed? Map areas of potential habitat.

- It is likely that the two species could be present in any reach of the Upper Miami or Moss Creek sub-basins based on their proximity and similarity to the Kilchis watershed (Figures 29-32).

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