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.

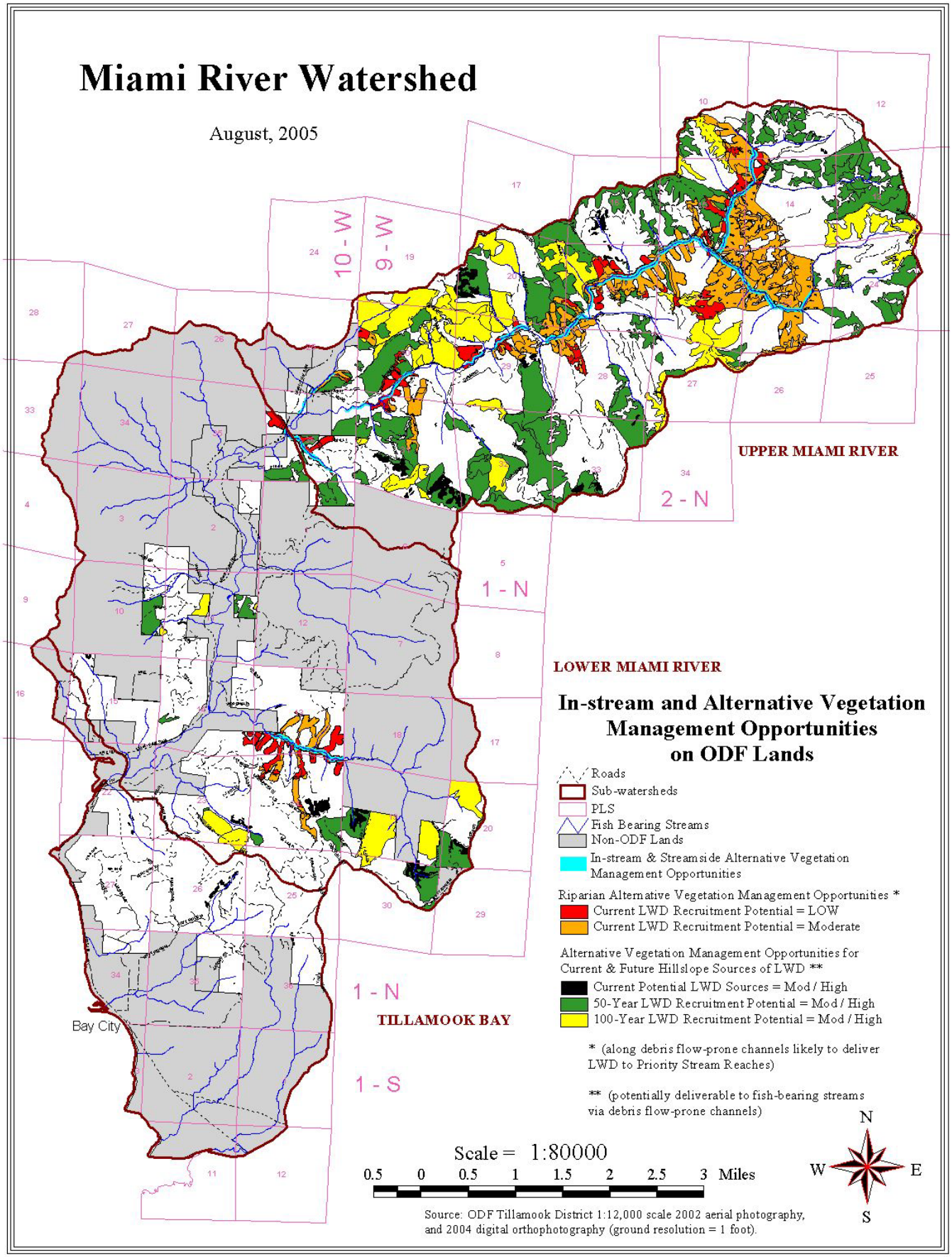

Figure 1. Stream segments and forest stands with a high priority for further study and management opportunities.

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.

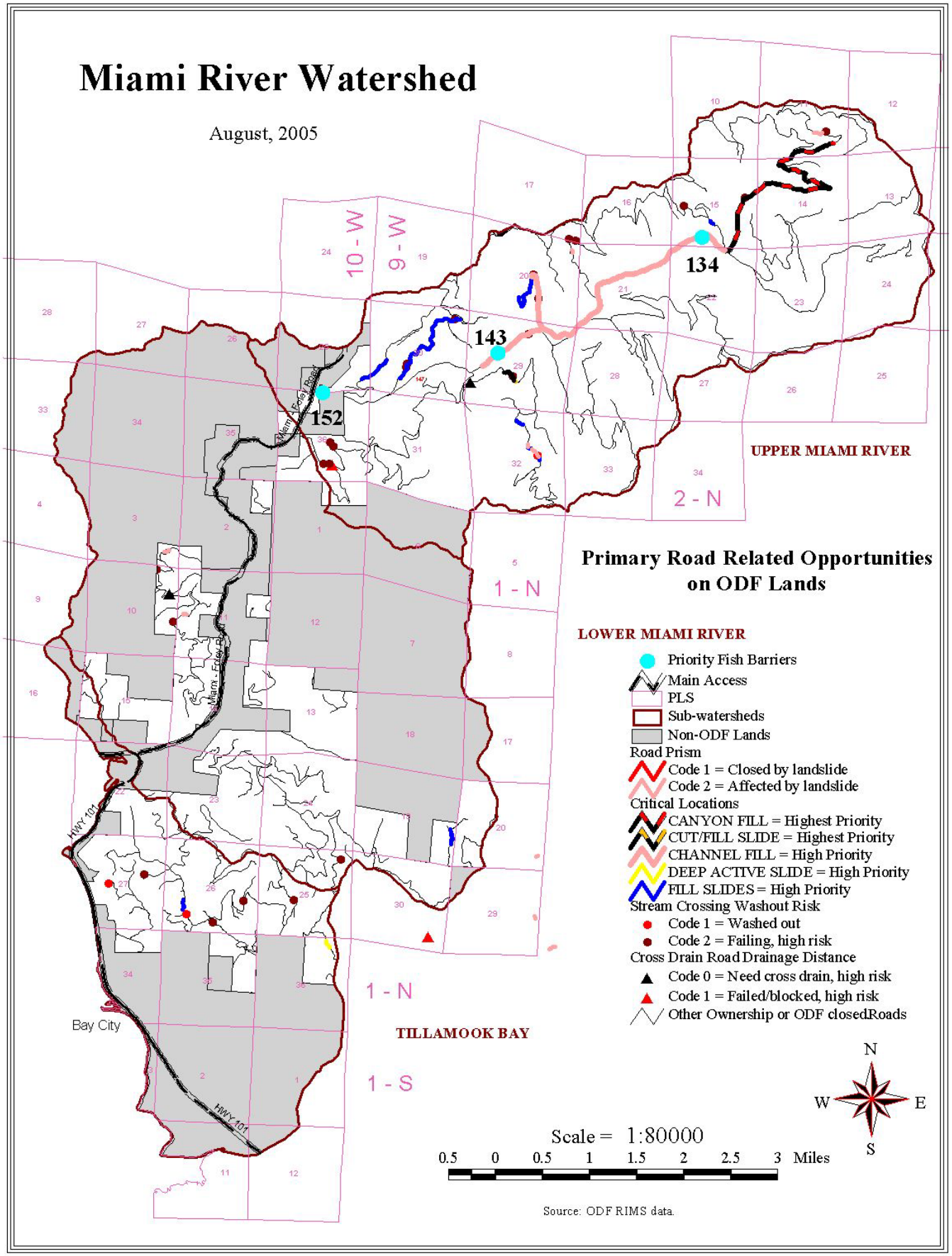

Figure 2. Road segments with a high priority for further study and management opportunities.

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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