- 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.

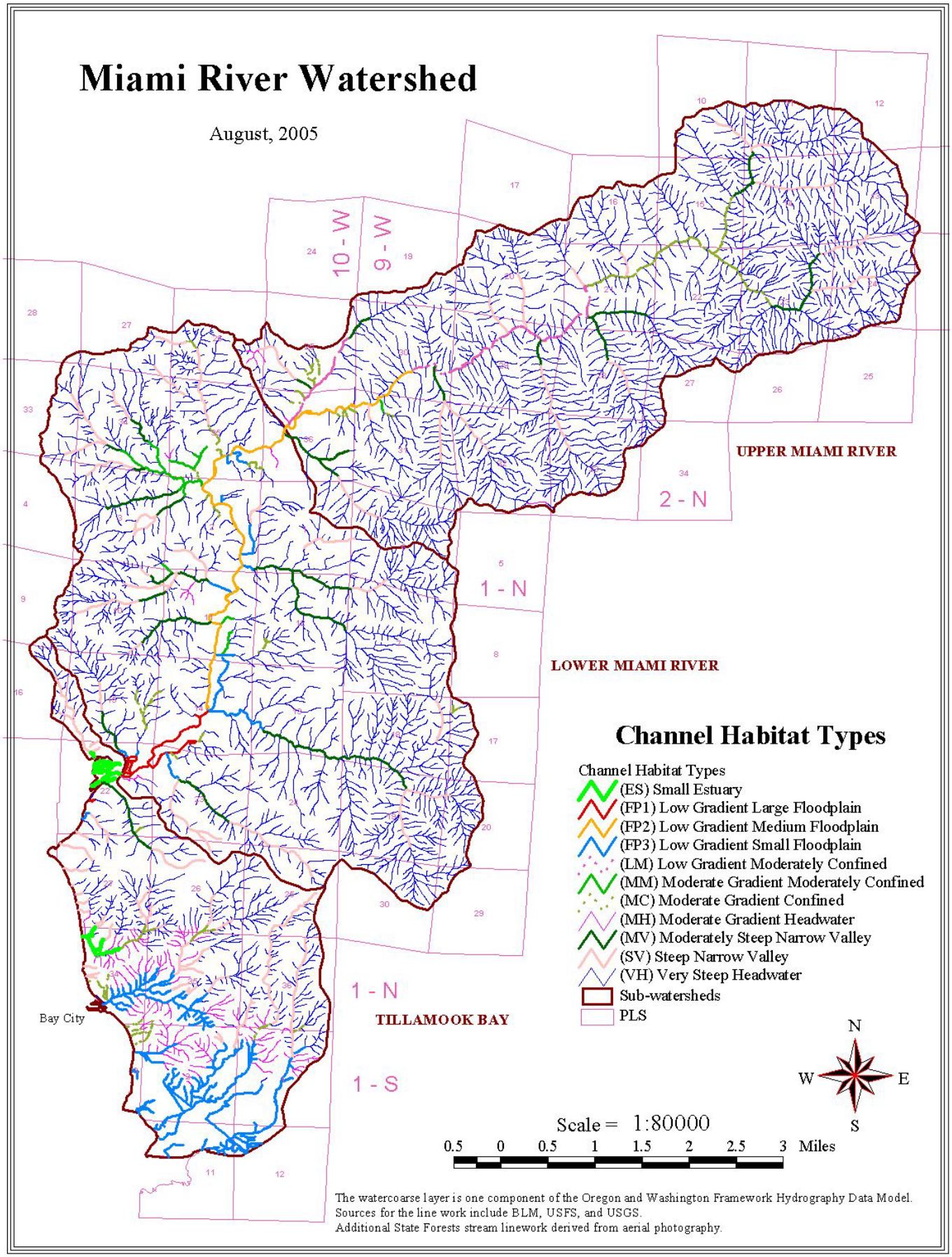

Figure 1. Channel habitat types for the Miami River Watershed Project Area.

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 (≥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).

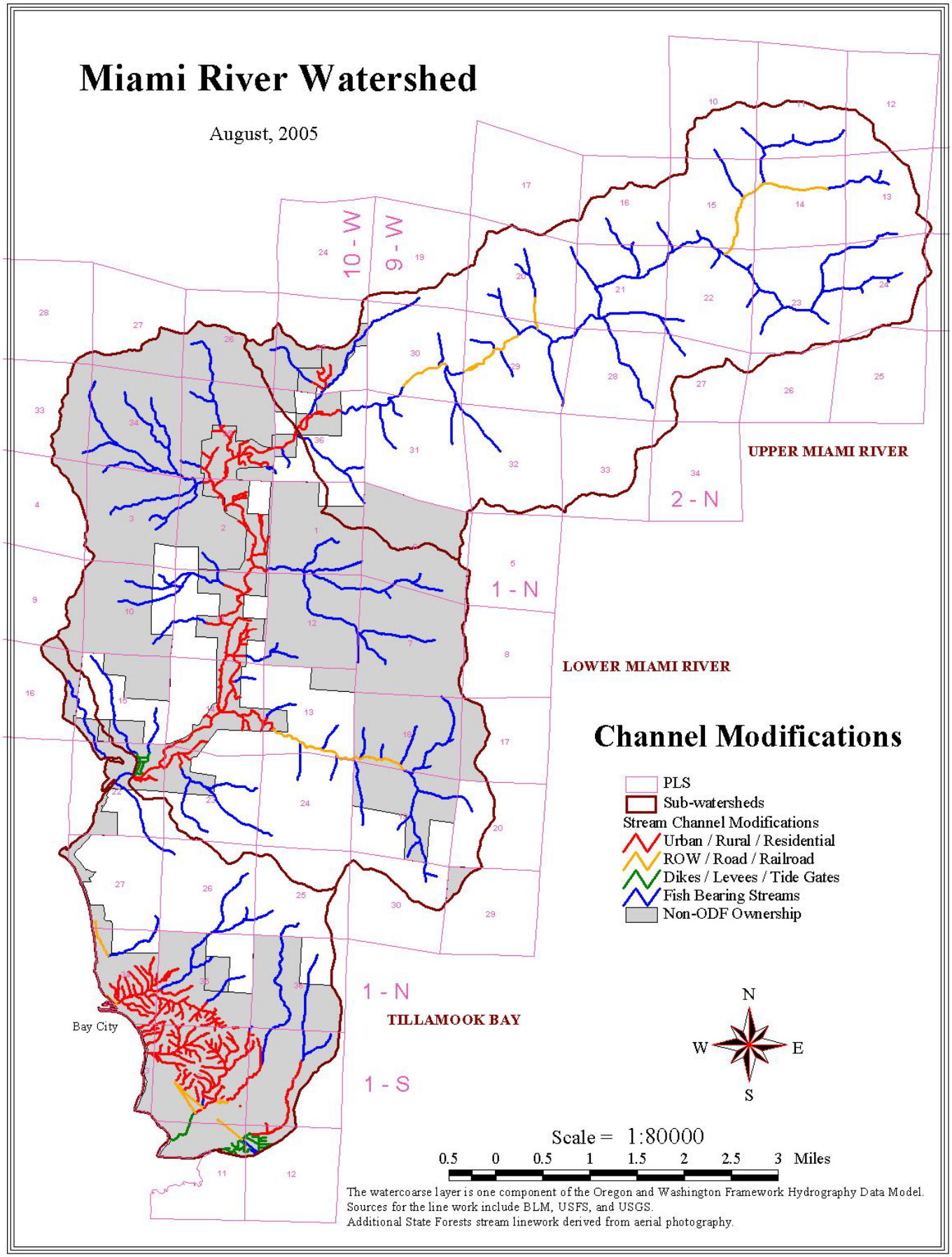

Figure 2. Map of modified channels for the Miami River Watershed Project Area.

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.

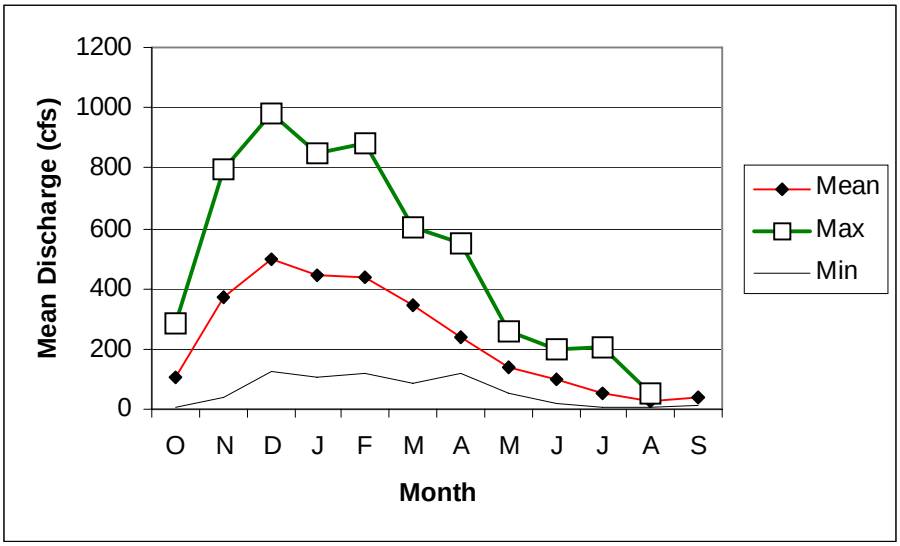

Figure 3. Hydrograph of mean daily flow for the period of record 1973-1995 for the Miami River (ODWR Gage No. 14301300) (Source: ODWR 2005).

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 9^{th,} 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 6th- or 7th-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