THE USE OF MOTOR CARRIER WEIGH STATION REPORTS IN COMMODITY FLOW ANALYSIS OF THE OREGON FOREST PRODUCTS INDUSTRY - 1976

by

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To my parents, George and Dorothy Howes, and my sisters, Pam and Sue, I wish to express my loving appreciation for their continued support throughout the many years of my educational career. Without this support, it would have been a rough road to travel.

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THE USE OF MOTOR CARRIER WEIGH STATION REPORTS IN COMMODITY FLOW ANALYSIS OF THE OREGON FOREST PRODUCTS INDUSTRY - 1976

Abstract: Data on motor carrier commodity weights collected in 1976 at Oregon weigh stations by the Public Utilities Commission and the Department of Transportation are not in a form that readily allows for commodity flow analysis. A methodology is presented that reduces existing forest product commodity data into a graphically displayed form showing size and direction of commodity flows within the state. Existing information on the forest products industry is used to determine whether the adjusted flows are representative of what took place within the industry during that year. The timber commodity flows examined in this study correlate well with existing data on this portion of the industry. A less significant relationship, however, exists for the lumber and plywood commodity flows also examined.

INTRODUCTION

Problem Statement

The Department of Transportation (D.O.T.) and the Public Utilities Commission (P.U.C.) of Oregon developed a program for analyzing the flow of commodities transported by motor carriers over Oregon highways.

The program is designed to record commodity type, weight, and direction of travel data on all motor carriers required to stop at existing weigh stations for vehicle, driver, and weight load inspection. From the data that have been stored in the P.U.C. computer, the D.O.T. and P.U.C. have produced computer printouts that list the data collected at each weigh station during 1976. Until this time, no attempt has been made to analyze the data since it requires further processing before it can be used in any type of commodity flow analysis.

Objective

The objective of this study is to determine the feasibility of using motor carrier weigh station reports for commodity flow analysis of the forest products industry of Oregon. The study will:

1) develop the factors necessary to adjust the commodity weights recorded at each weigh station;
2) graphically display the adjusted data to show size and direction of commodity flow; and
3) determine if the resulting commodity flows correspond to existing information on the forest products industry in Oregon.

The study examines three commodity groups that are representative of the forest products industry. These include (1) logs, poles and piling; (2) lumber; and (3) plywood. The logs, poles and piling commodity group

represents the portion of the industry where harvested timber is transported to where it is consumed or processed. The lumber and plywood commodity groups represent that portion of the industry where intermediate products are made at the processing centers from the raw material or timber and are transported to forest products industry markets.

Background Information

P.U.C. operations. The motor carrier weigh station reports that are used in this study were provided by the D.O.T. The reports were generated upon special request by the D.O.T. to the Motor Carrier Enforcement branch of the P.U.C. (from here on referred to as P.U.C.). The P.U.C. has the responsibility of safety and legal weight load inspections of motor carriers traveling on Oregon roads.[1] To do this, the P.U.C. has established 65 motor carrier weigh stations throughout the state where inspection and weighing take place. The Weighmasters Office is responsible for maintaining the stations by shifting teams of personnel from station to station at its discretion.

Weigh station reports. Motor carriers under the P.U.C. ($\geq$ 8000 lb. loads) and commercial licensing are required to stop at each operating weigh station. Private companies who own their own vehicles are also required to stop at any operating weigh station.[2] When a motor carrier stops at a weigh station, it is routinely checked for weight, vehicle, and driver related violations by the Weighmaster personnel

who operate the weigh stations. During this time, record is also made of the particular commodity the motor carrier is hauling, its weight, and the cardinal direction of travel. The data are recorded on field sheets at each weigh station, collected by the P.U.C., and later processed and stored in the P.U.C. computer system under individual operator files. The data recalled from these files and used in this study include the weigh station number, direction of travel, type of commodity being hauled, and the year-end weight totals for each commodity (Appendix I).

Weigh station locations. There are 65 motor carrier weigh stations located on the interstate, U.S., and state highways in Oregon (Figure 1, Appendix II). Each weigh station was located with respect to where it intercepts the main traffic flows. The amount of traffic expected is reflected in the length of time each weigh station is operated, i.e., greater traffic flows result in longer operating times for an individual weigh station. There is a noticeable difference in the distribution of weigh stations located in Eastern and Western Oregon. Eastern Oregon, due to lower population density, has a less concentrated road network than Western Oregon and thus requires fewer weigh stations to cover it. On the other hand, Western Oregon, with its higher population density, has a more compact road network and therefore a greater number of weigh stations.

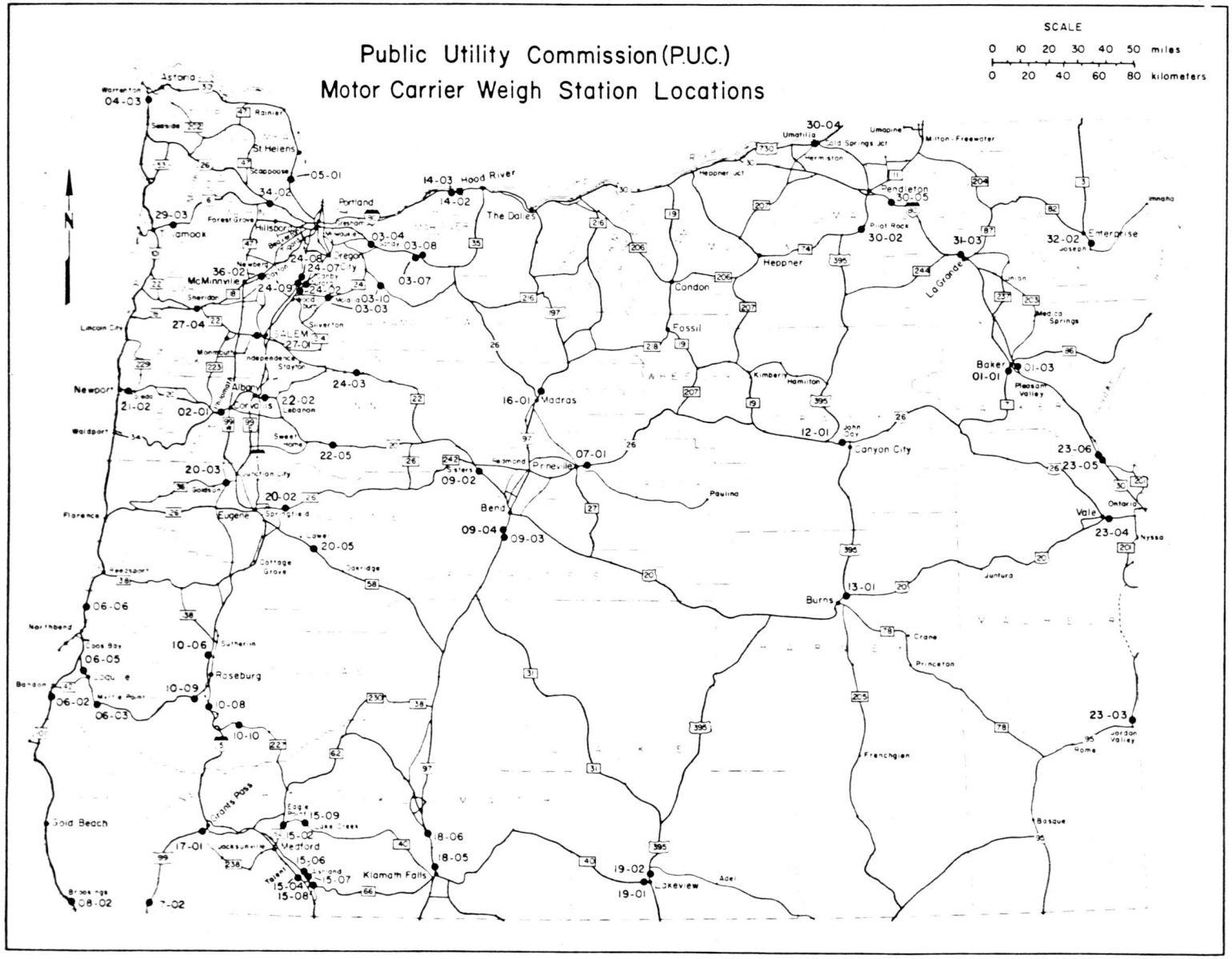


Figure 1. Public Utility Commission (P.U.C.) Motor Carrier Weigh Station Locations.

Most weigh stations are located along roads oriented in only two directions, but in some instances they are also located at or near road intersections. Depending on the type of weigh station set-up being used, the recorded directions of travel from the weigh station reports are in single directions or in any combination of the four cardinal directions.[3] Certain weigh stations may also record in only one direction if the Weighmasters decide to operate the weigh station in only the direction of major traffic flow. The direction of flow recorded can vary from the orientation of the road that the weigh station is located to the direction of an intersecting road within approximately five miles of the weigh station. Weighmaster personnel reroute motor carrier traffic from the intersecting road to the nearby weigh station where it is then inspected, weighed and recorded on the Weighmaster field sheets.[4]

RESEARCH PROCEDURE

Forest Product Commodity Adjustment

The first step in using weigh station reports for commodity flow analysis is to develop the necessary adjustment factors that are applied to the recorded commodity weights from each weigh station. Direct use of commodity weight data is not possible due to the way it was collected. None of the weigh stations in Oregon operated on a continual basis during 1976. Operating hours for a

weigh station range from a low of 81 to a high of 8351 hours out of a total possible of 8760 -- the number of hours in a year. All commodity weights have to be adjusted as if each weigh station is open the same length of time. In this case, the length of operating time includes the most likely time periods of forest product hauling.

The adjustment of the commodity weights obtained from the weigh station reports is based on a relationship between the length of time that a weigh station is operating during the year and the total amount of time that motor carriers are likely to be hauling forest products during that same year. The relationship used to adjust the commodity weights is expressed in the following manner:

$$\text{adjusted weight} = \left[\text{recorded hundred wt. by direction} \times \left(\frac{\text{no. of hours available for hauling}}{\text{the total no. of hours the weigh station is operating by direction}}\right)\right]$$

The recorded hundred weight by direction for each commodity is taken from the computerized weigh station reports. The total number of hours by direction that each weigh station was operating came from the D.O.T. records (Appendix III). The value for the total number of hours available for hauling is derived by taking the total number of hours in a year (8760), and subtracting from this the time limitations that apply to the hauling of forest products in Oregon. For the logs, poles and piling commodity group, this includes legal holiday time, certain Saturday and all Sunday hauling restrictions,

and night hours when probably no hauling takes place (Table I). The value of 4183 hours available for hauling is put into the formula along with recorded hundred weight by direction and the year-end total hours the weigh station is operating by direction for each weigh station. The resultant hundred weights are the adjusted values that represent the total commodity weight that is recorded at each weigh station as if it is operating at the times available for hauling (Appendix IV). If the total number of hours the weigh station is operating for each direction is greater than the 4183 value, then the adjustment factor used is equal to 1.0. The 1.0 value is based on the assumption that the operating times of the weigh stations are the same times determined to be available for the hauling of the commodity. The lack of readily available data prevented this relationship from being determined.[5]

One point that is illustrated at this stage of the research is the difference in units of measure used by the Weighmasters and those of the forest products industry. The Weighmasters use the hundred weight unit to record the commodity weights, while the Forest Products Industry's harvest and consumption figures commonly are measured in board feet. A general conversion factor is available for converting weight to board feet, i.e., one ton

TABLE 1. DETERMINATION OF THE NUMBER OF HOURS AVAILABLE FOR THE HAULING OF LOGS, POLES AND PILING.

Total number of hours in a year	8760
Limitations:	
Legal holidays:[a]	-144
Saturdays:[a]	-180
Sundays:[a]	-1248
Night hours when hauling is unlikely:	
8 PM - 6 AM = 10 hours,[b] 10 hours x 300.5 days[c] =	-3005
Total hours available for hauling	4183

[a]Oregon Administration Rules, Chapter 860, Section 36-090(2).

"(2) The hauling of logs over or across any state highways is prohibited on Saturdays after 12:00 noon between May 23 and September 24, inclusive, Sundays and the following holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; and Christmas Day; providing when any of said holidays falls on Sunday, the hauling of logs is prohibited on Monday following said holiday."

[b]The hauling of logs usually begins at about 6 AM (daylight) and will last on the average of from 10-11 hours (Dykstra and Garland, 1978). Depending on whether the destination will accept logs after dark, a hauler may take on a last load in the late afternoon and be driving until early evening. Thus, the assumed 8 PM - 6 AM period when it is likely that no hauling is in progress.

[c]The 300.5 day figure used here is derived from the following: 257 week days (less holidays) + 43.5 Saturdays (less the restricted time) = 300.5 days.

equalling 500 board feet.[6] The conversion of the adjusted commodity weights to tons and then to board feet makes it possible to obtain the commodity flow in units common to the forest products industry. But it must be stressed that this is a general conversion factor only. The weight of logs, poles and piling being hauled varies with species type, moisture content, and wood density.

A comparison is made between the adjusted commodity board feet values and the actual amount of timber harvested in Oregon during 1976. Totaling the adjusted values for all the weigh stations, a value of just over 15 billion board feet (bbf) is obtained. When this value is compared to the 1976 Oregon harvest total of just over 8 bbf, it appears to be unusually high. This discrepancy suggests that the adjustment of the weigh stations operating for limited lengths of time was responsible for the differences in these figures. Taking the 4183 hour total for the available hauling time, dividing it by the low number of hours that a weigh station is operating by direction, and finally multiplying this value by the recorded hundred weight hauled in that direction, will result in a very large adjusted commodity weight. Whether this is actually the cause of the discrepancy is revealed in a breakdown of the total number of hours that the weigh stations are open for individual directions of hauling (Table 2). This breakdown of individual directions into classes covering all times that weigh stations are operating shows that the directions operating for less than 1000 hours

TABLE 2. BREAKDOWN OF THE NUMBER OF INDIVIDUAL DIRECTIONS OF TRAVEL BY TOTAL NUMBER OF HOURS OPERATING.

Breakdown 1	Breakdown 2	Breakdown 3	Breakdown 4
>4000 - 3	750 - 1000 - 5	200 - 250 - 1	40 - 49 - 5
3000 - 3999 - 2	500 - 749 - 9	150 - 199 - 3	30 - 39 - 4
2000 - 2999 - 16	250 - 499 - 9	100 - 149 - 4	20 - 29 - 4
1000 - 1999 - 25	< 250 - 83	50 - 99 - 4	10 - 19 - 17
<1000 - 83		< 50 - 48	< 10 - 18

TABLE 3. ADJUSTED TOTAL BOARD FOOT VALUES USING DIFFERENT CUT-OFF POINTS OF THE NUMBER OF HOURS OPERATING BY DIRECTION.

Number of hours operating by direction		Adjusted total board foot values (billion board feet)
> 1000	-	4,823.84
> 250	-	5,751.09
> 50	-	6,153.51
> 20	-	6,851.18
> 10	-	7,697.31
> 0	-	15,711.92

vastly outnumber the values for the other classes. The breakdown of individual directions into classes covering the operating times less than 1000 hours and less than 250 hours exhibited similar results in that the smallest time class recorded the greatest number of directions. The breakdown of individual directions into classes of operating time less than 50 hours reveals the last two time classes having an almost equal number of directions recorded, but the numbers are still greater than the three larger time classes. An analysis of this breakdown implies that the directions operating fewer hours have a significant effect on increasing the board feet total (Table 3). Subsequently, when the adjusted figures for the weigh stations operating by direction for less than 10 hours are added to the total, the board foot total becomes too high. This is understandable, for when a less than 10 hour value is divided into the 4183 value, a very large adjustment factor is obtained. The factors for the less than 10 hour operating directions are a power of 10 greater than the over 10 hour directions and thus have a greater influence when multiplied by the recorded hundred weight recorded at each weigh station.[7] Basing such high hundred weight totals on such a small operating time span (less than 10 hours out of 4183) does not seem warranted, thus, all directions operating for less than 10 hours are eliminated from the commodity flow analysis of the forest products industry.

The total value of 7,697.31 bbf of logs, poles and piling determined to be hauled in Oregon still seems low. A large volume of timber was imported from both California and Washington, and should be added to Oregon's harvest value to give the amount of timber that was hauled on Oregon roads during 1976. A portion of the timber hauled may not be recorded at any weigh station. This is not due to weigh stations being closed, but because no weigh stations exist between the harvesting area (source) and the forest products industry processing site (destination).[8]

The adjustment of the recorded commodity weights for lumber and plywood is accomplished using the same relationship as for the logs, poles and piling commodity group. The recorded hundred weights used are from weigh station reports and the total hours the weigh stations operate are from D.O.T. records (Appendix III). Due to the different marketing structure of the lumber and plywood industries and the lack of any hauling time limitations, the hours available for hauling differ.

The lumber and plywood industry marketing situation is essentially interstate, with extensive exporting to other state and foreign markets. Much of Oregon and Washington lumber and plywood production is exported to southern, midwestern and eastern U.S. markets and is likely to be hauled on an irregular basis.[9] But, there may be an increase in deliveries during the spring and early summer

as the result of the beginning of housing construction in March. There is presently no way of knowing when the recorded commodities are taken because the data are not readily available. Therefore, there exists little substantative data as to what times might be included in the number of hours available for hauling. For these reasons, the number of hours available for hauling is left at a full years time (8760 hours), but this figure may be too high.

The adjustment of the commodity weights is achieved with the use of the 8760 hour figure, and the results of the data manipulations are presented in a manner similar to that used for the logs, poles and piling commodity group (Appendices V and VI). Based on the problems with the less than 10 hour operating directions mentioned earlier, these directions are not included in these commodity weight adjustments. Calculations comparing what is produced to what is hauled were not done for these two commodity groups. Although Oregon production figures are available, there is insufficient evidence to determine what portion of the total being hauled on Oregon raods is produced in which state. Also, the mode of transportation for the lumber industry is different than that for logs, poles and piling. Whereas the latter commodity is hauled by motor carrier, only 29% of the lumber produced in Oregon was hauled by motor carrier in 1976.[10] Sixty per cent of the production is hauled by rail and 11% by water. The percentages for the hauling of plywood are not available, but it is

assumed that the hauling by motor carriers is roughly similar. The amount of lumber and plywood determined to be carried on Oregon roads does not represent a large enough percentage of the entire commodity flow of the industry to justify doing these calculations.

The lumber and plywood adjusted hundred weights are also converted to units that commonly are used in the discussion of the industries. Again, a general conversion factor is applied to the adjusted weights, with the lumber weights converted using the same conversion factor as for the logs, poles and piling commodity group. A different set of conversion factors is used for the plywood weight conversions.[11] The hundred weight figures are first converted to tons (x 0.05 tons/hd. wt.), then to board feet (x 500 bf/ton), then to cubic feet ($\div 6$ bf/ft^3), and finally to square feet on a 3/8 inch basis (x 32 ft^2, 3/8" basis/ft^3). This simplifies to a conversion factor of 133 1/3 that is multiplied by each of the adjusted weights figures for plywood. As mentioned before, these are only general conversion factors used to portray adjusted commodity data in units that are common to the forest products industry. The weight of lumber varies depending on whether it is rough or finished, green, air dried, or kiln dried. The weight of plywood varies depending on the type of veneer from which it is made and the amount of adhesives used.

Data Limitations

The method used to adjust the commodity weights still has certain inherent problems due to the type of data collected and the way it was

recorded. First, the commodity weights on the computer printouts list the recorded weights on a year-end total basis only and there are no data readily available as to what amounts of commodity are collected at what times. The Weighmaster field sheets collected by the P.U.C. are entered into their computer in 2-3 month batches with no categorization, even on a monthly basis. Daily or even monthly totals of commodity weights recorded at the weigh stations would aid in a more justifiable value for the amount of time available for the hauling of all commodity groups on an individual basis. Seasonality is a factor in the temporal distribution of forest product hauling in Oregon, and if data were available, this could be included in the adjustment relationship and applied to individual weigh stations based on their location.

Second, the specific hours that the weigh stations operate during the year are not available, only the total number of operating hours over the entire year are given. Data are available for the number of days per month that the weigh stations are operating, but not which days or how many hours per day (Appendix VII). The objectives of the P.U.C. (safety inspection and weighing of motor carriers) do not include a rigid time frame and thus there is no set schedule for conducting regular hours at each weigh station.[12]

Generation of Graphics

The adjusted million board feet values for (1) logs, poles and piling; (2) lumber; and (3) the million square feet, 3/8 inch base values for plywood are combined into individual commodity flow maps for the state of Oregon. The individual maps are presented with their respective analysis sections. The maps represent the quantity of logs, poles and piling, lumber and plywood that will be recorded if all the weigh stations are operating during the times available for hauling. At the map scale used, there are two areas where the weigh stations are too close to each other and interfere with graphic clarity of the data being presented. For this reason, these two areas are enlarged into insets for each commodity flow map. Respective inset pairs (Insets A and B) are combined under one figurehead and placed with the other map figures.

Commodity flow is presented using arrows of varying sizes to represent the different size classes for each commodity group. The commodity flow arrows are placed with respect to the nearest road in the direction the commodity is recorded traveling. Minor roads are not included on the base map to prevent loss of clarity in data presentation and for this reason, flow arrows are located where no roads are shown on the map, although the roads do exist in reality.

The data provided by the weigh station reports are now in a useable analytic form. These data will be used to determine whether or not the resulting commodity flows correspond to existing data on

the forest products industry in Oregon during 1976. Reports from the Pacific Northwest Forest and Range Experiment Station, O.S.U. Forest Research Laboratory, Oregon Department of Forestry, Western Wood Products Association, and American Plywood Association were used to gather data on the harvest, consumption, production and marketing situation in the state.

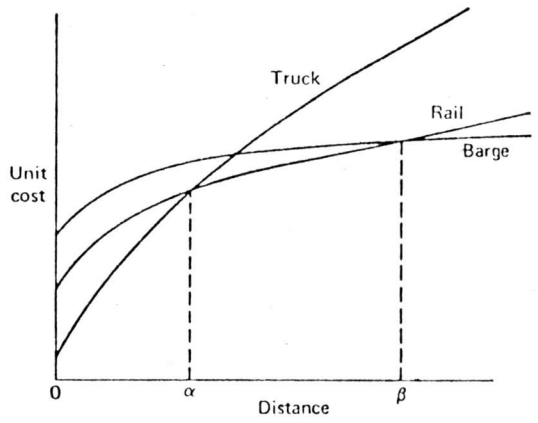
COMMODITY FLOW ANALYSIS

Analysis of commodity flow structure involves identifying origin and destination of the flows.[13] Commodity flow between origin and destination locations is based on three factors of material interaction: complementarity, intervening opportunity, and transferability.[14] Complementarity requires demand in one area and supply in another before interaction between them takes place. Intervening opportunity takes effect when a nearby third area draws some of the interaction or complementarity away from the other two areas, resulting in commodity flow to and from the third area as well. Transferability is a measure of the distance between two areas in terms of transfer and time costs. If this distance is too great and too costly to overcome, interaction will not take place, even though complementarity is perfect and intervening opportunity is lacking.

A number of factors affect the cost of overcoming the distance between origin and destination and thus effect the mode of transportation chosen. Two types of transport costs that can accrue are fixed,

the terminal costs of handling and storage of the goods; and variable, the costs of transporting the goods over the route.[15] Distance traveled and mode of transportation greatly affect these costs (Figure 2),

FIGURE 2: Relationship Between Cost of Movement and and Distance, by Mode



Source: Lowe, John C. and S Moryadas, (1975).

For short distances, the motor carrier is by far the cheapest mode of transporation, but as the distance increases, rail transport becomes the cheaper mode based on unit cost.

Additional cost factors relate to volume and weight of shipment, trafficability of terrain, and the type of goods being transported (e.g., perishibility).[16] As the weight or volume of the shipment

increases, rail is more likely to be chosen as the transportation mode. Rough terrain usually favors the motor carrier because roads are often the only transportation structure available. If the shipment is fragile, valuable or perishable, the mode of transportation will be the motor carrier because of the more rapid delivery time than for rail.

Flow maps are used in commodity analysis to graphically display the interaction or material movement between the flow's origin and destination.[17] The volume of material interaction is measured as the number of repeated trips made to the same location or a single flow of large volume.[18] In this study, commodity flow is measured as the specific volume passing a point during a particular interval. Usually in commodity flow analysis, the origin and destination of the volume are known, but in this case they are not. The origin and destination can only be inferred from existing production and consumption data of the forest products industry.

Logs, Poles and Piling

The transportation cost factors mentioned previously, and other economic factors including energy and labor availability, are reasons the forest products industry in the Pacific Northwest is a material, rather than a market oriented industry. The industry uses the raw material or timber and converts it into finished products at its processing centers located throughout the state. The extra weight

and volume of the timber, trafficability of the terrain, and difficulty in handling, have all favored the motor carrier as the mode of transportation used to haul the timber over the short distances from forest to mill.

The commodity flow of logs, poles and piling during 1976, represents the movement of timber harvested at the forest locations to the primary processing facilities within the state. Beuter et al. (1976), analyze timber availability in Oregon and depict future conditions if specific forest management practices are used. In the study, timber production is related to economic areas of the state. The economic areas are referred to as timbersheds, and are a modification of two previous studies that divide the state into economic or resource areas used in the analysis of the state's timber based employment.[18] The timbersheds defined by Beuter et al., include seven Western and three Eastern Oregon units (Figure 3). Each timber shed contains at least one major processing center that is dependent on the timber harvested within it. At least two thirds of the timber processed in each timbershed is harvested within the same timbershed.[19]

The source of the timber is presented as a ranking of Oregon's timber harvest data that is done on a county basis with the idea that the higher producing counties will be the source of the greatest flows of timber (Figure 4). The harvest data and respective rank numbers reveal that Western Oregon counties produce the greatest combined

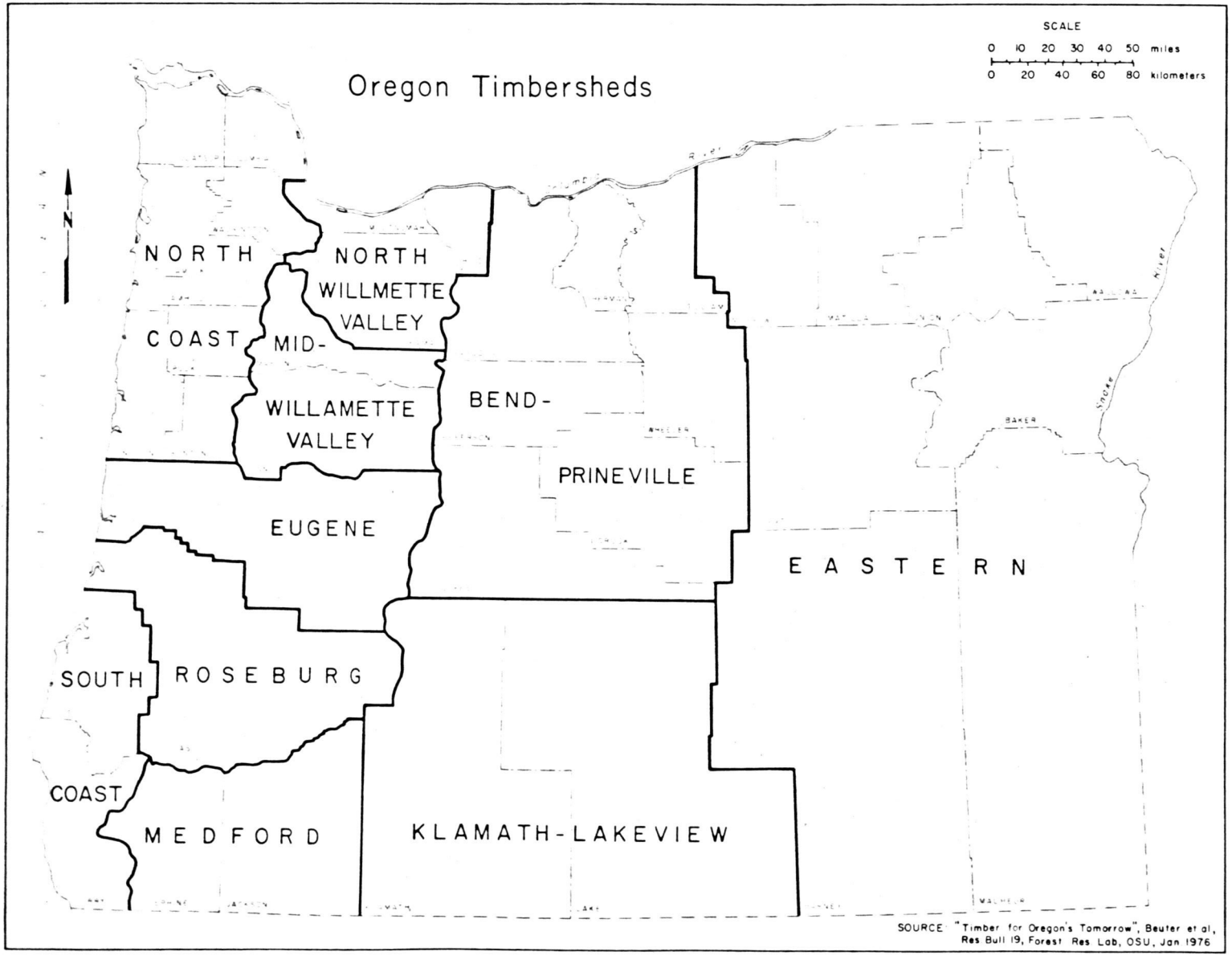


Figure 3. Oregon Timbershed Units.

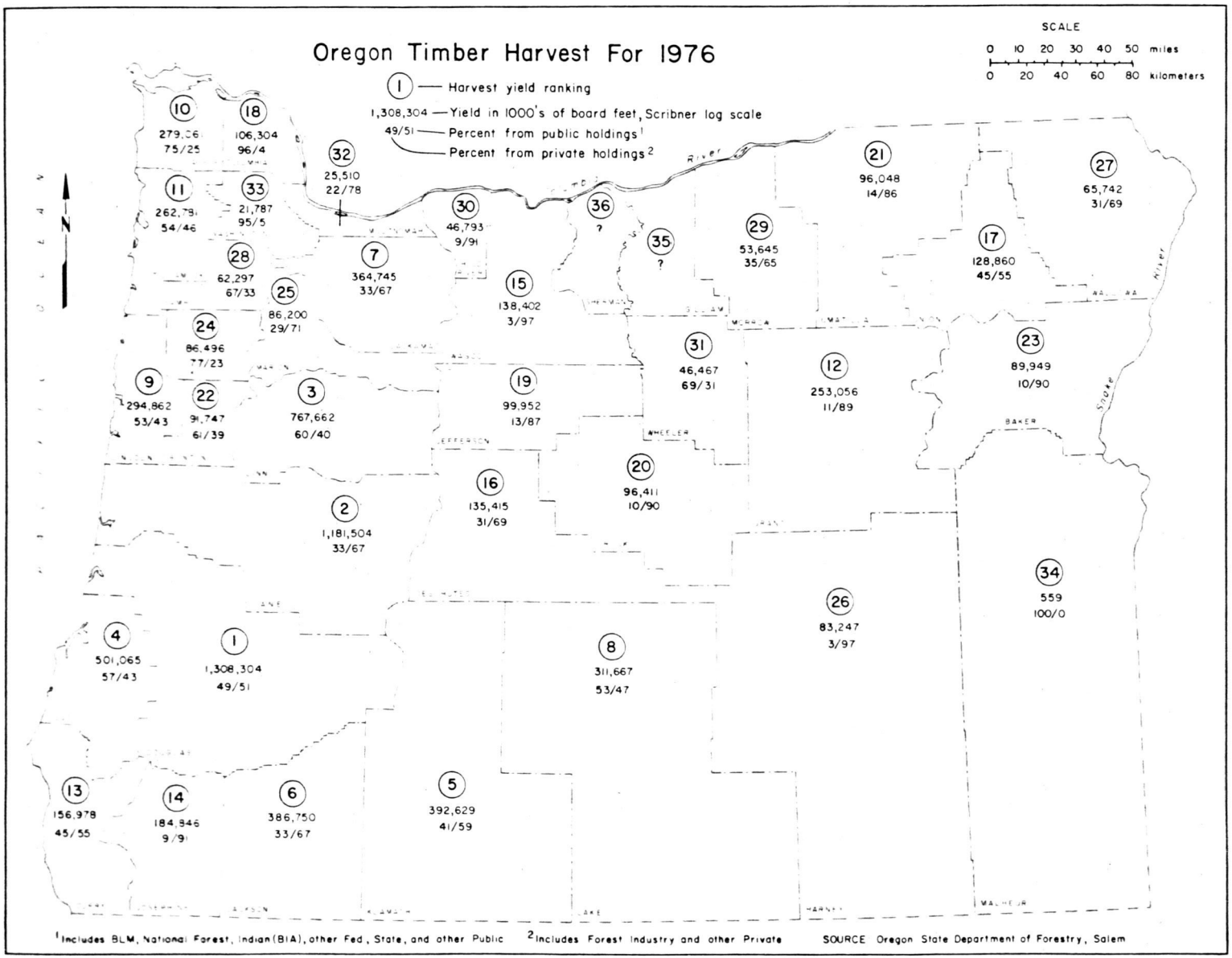


Figure 4. Oregon Timber Harvest Data for 1976.

volume of timber in the state. Douglas, Lane, Linn, Coos, and Clackamas counties lead the others by a wide margin. Klamath, Lake and Grant counties have the highest harvest volumes for Eastern Oregon, but a number of other counties there are also ranked in the top 20. A comparison of the logs, poles and piling commodity flow map with data on timber harvest for 1976 show that weigh stations located in these larger timber producing counties have the largest flows of timber (Figures 5, 10). Large flows are also seen at weigh stations in Polk, Benton and Cook counties even though they do not have respectively large timber harvests. This discrepancy is because these counties are located between counties having larger timber harvests, and the processing centers, all of which are located within a single timbershed unit.

Another source of the timber hauled on Oregon roads is imported timber from Washington and California. During 1976, 83 million board feet (mbf) of timber entered the southwest section of the state (Medford and South Coast timbersheds), 278 mbf into the northwest section (North Willamette Valley timbershed), 46 mbf into the south central section (Klamath-Lakeview timbershed), and 1 mbf into the north central section (Bend-Prineville timbershed).[20] Import volumes appear in the timber flows recorded at the weigh stations near Oregon's state boundary and on it's major highways. Data from the port of entry weigh station at Ashland show a large volume of timber flowing north, as

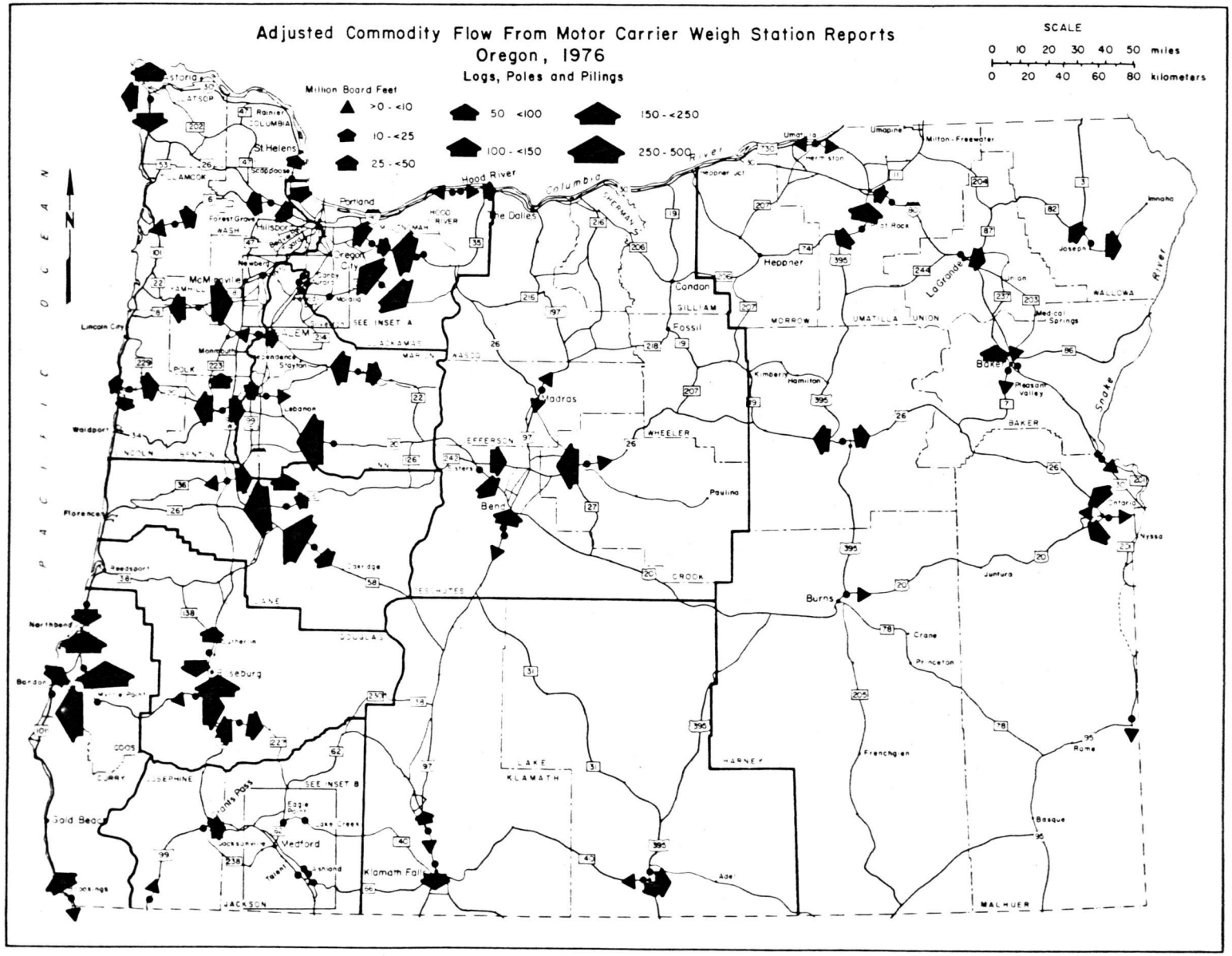


Figure 5. Adjusted Commodity Flow From Motor Carrier Weigh Station Reports, Oregon, 1976 - Logs, Poles and Piling.

does the weigh station located at Brookings. A large southern flow occurs at the weigh station near Astoria, while the weigh station near Portland, however, does not show a similar large flow also heading south.

The quantity and location of timber consumption must also be estimated from existing data. The forest products industry of Oregon consists of essentially four types of timber consuming operations; these are: sawmills, plywood plants, veneer mills, and board plants (Figure 6). Timber consumption is greatest in the lumber operation, with declining consumption in the veneer, plywood, and board operations respectively.[21] Mill consumption in this study is presented in terms of production capacity and the density of mills in an area. Mills or plants possessing a large output capacity require large volumes of timber to sustain them. The greater number of mills located in a processing center, e.g., Eugene, the greater the flow of timber that is expected to move towards that area. A number of distribution differences can be seen from this map of forest product producers. A large number of all four types of operations are found in Western Oregon, while sawmills dominate Eastern Oregon. The difference in distribution can be credited to the availability of large volumes of timber and mill residue consumed. Western Oregon has sufficiently large volumes of these materials to supply a large number of mills, while Eastern Oregon does not.

The concentration of forest product producers in one location, whether a large number of concentrations as in Western Oregon, or

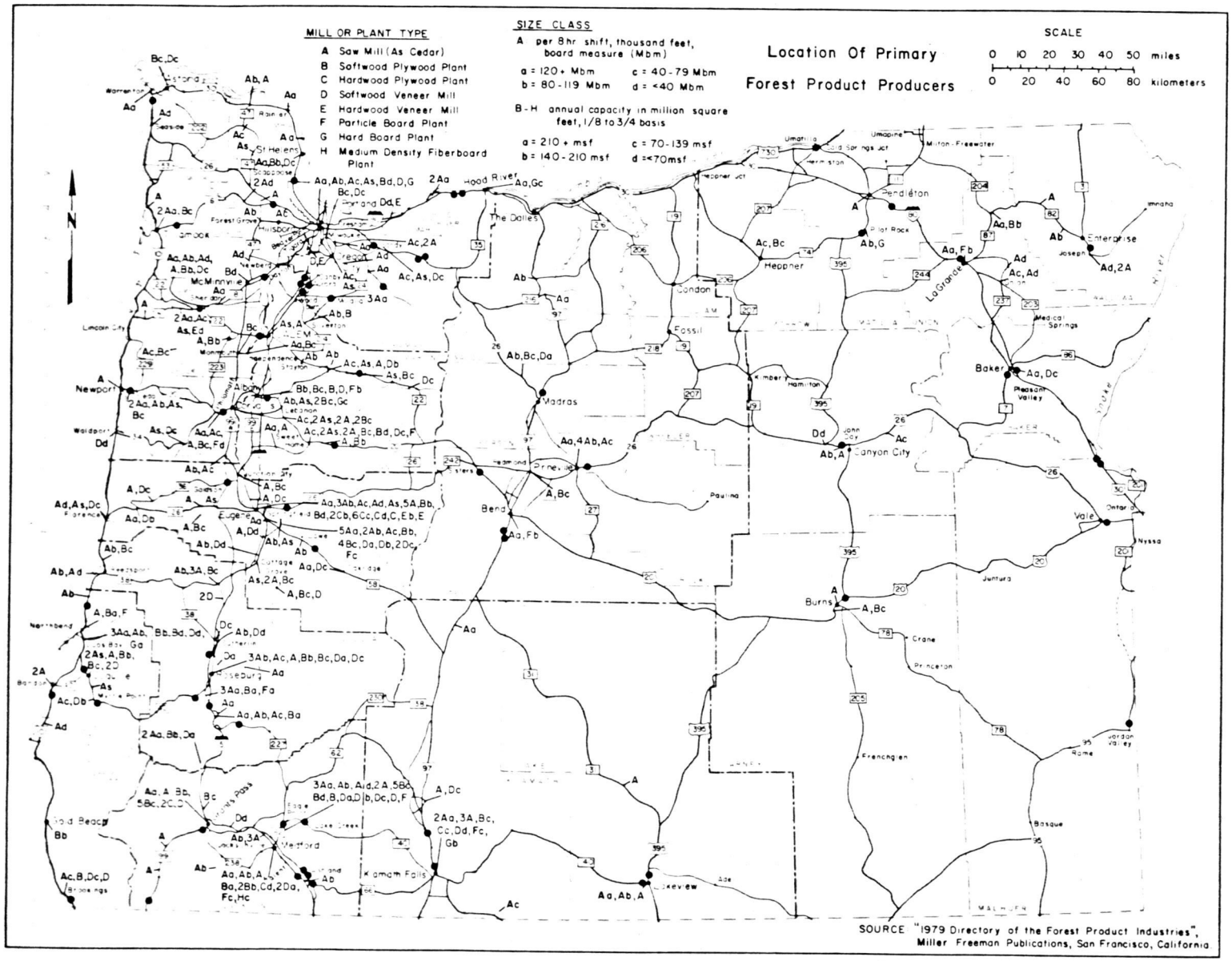


Figure 6. Location of Oregon Primary Forest Product Producers.

only a single concentration within a large area as in Eastern Oregon is reflected in the adjusted timber flows. Western Oregon has large flows towards Portland, Salem, Corvallis, Lebanon, Eugene, Springfield, Coos Bay and Medford where the processing centers for the timbersheds are located. Eastern Oregon also has timber flows towards its processing centers (Klamath Falls, Prineville, Pilot Rock, La Grande, and Baker), but the timber flows are of a smaller magnitude than those in Western Oregon.

Other possible destinations for timber flows are Oregon ports handling the state's exports. Oregon export data from 1976 includes 272.2 mbf exported from Astoria, 144.6 mbf from Coos Bay, 99.5 mbf from Portland, and 28.0 mbf from other ports.[22] The timber flow to these ports show up in the volumes recorded at weigh stations operating near Astoria, Coos Bay, Scappoose, and those in Clackamas county.

There is one additional factor that affects the flow of timber within the state, i.e., the timber sales contracts between land owner, logging operator, and consuming industry mill or plant. Whether the timber is privately owned or public, parcel size, and quality, all determine the timber's destination. Even though the timber may be near a processing center, it may be hauled to some other processing center farther away resulting in a two-way timber flow recorded at local weigh stations. Such flows occur at a number of weigh stations including those near Astoria, Yamhill, Philomath,

Pilot Rock, Joseph, Canyon City, Ontario, Ashland, and in Clackamas County.

Lumber and Plywood

The analysis of the commodity flows for the lumber and plywood industries is not as clear as for the timber industry. The difficulties arise from the lack of production and destination data, the industry's market structure, and the mode of transportation.

Data giving production values on a county basis, such as exist for timber, are not available. Lumber production data are available, but based on only a 5 area division of Oregon (Table 4). Plywood data are also available, but they are combined with the production figures from Washington.[23] Due to this lack of data, the location and quantity of production can only be obtained by using the location of the lumber mills and plywood plants and their respective production capacities when available (Figure 6). The majority of plywood and veneer plants are located in Western Oregon because of the accessibility of the "right" types and quantities of timber used to make the plywood veneer. Western Oregon has a large number of saw mills located within it, more so than in Eastern Oregon. In Eastern Oregon, however, sawmills make up the majority of the operations in the processing centers of the timbersheds.

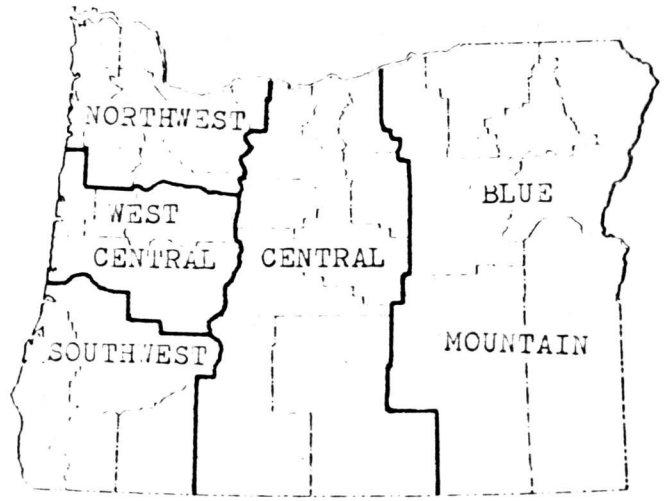
Data are limited on where lumber and plywood are shipped, other than general locations of the industry's markets within other states

TABLE 4--LUMBER PRODUCTION BY SAWMILLS BY DEGREE OF MANUFACTURE AND RESOURCE AREA, OREGON, 1976*

Resource Area	Green	Kiln-dried	Air-dried	Total	Rough	Surfaced
Northwest	1,064,169	689,323	14,798	1,768,290	276,862	1,491,428
West Central	1,231,401	800,506	3,770	2,035,677	369,484	1,666,193
Southwest	1,195,228	601,593	108,173	1,904,994	375,111	1,529,883
Central	107,589	897,129	44,023	1,048,741	74,811	973,930
Blue Mountain	68,592	515,183	73,244	657,019	59,801	597,218
All Areas	3,666,979	3,503,734	244,008	7,414,721	1,156,069	6,258,652

*Thousand board feet

Source: Howard and Hiserote (1976)



(Table 5). Only a small percentage of the lumber and plywood produced in Oregon is actually consumed here.[24] The majority of it is exported to southern, midwestern, and eastern U.S. markets, and to the industry's foreign markets.[25] So much depends on sales contracting, pricing, and demand of different users, that the destinations from particular production centers are likely to vary considerably with time.

Within the plywood market, commodity flow is from the producing centers to the wholesalers, distributors, and retailers buying from the centers, or it may flow between the wholesalers, distributors, and retailers buying and selling among themselves (Figure 7). A similar complicated market arrangement exists for lumber (Table 5). Lumber and plywood wholesalers are of two types: (1) the office based wholesaler, who does all transactions by phone, and (2) the distribution yard which handles large volumes of the products. The wholesalers and distribution yards may be Oregon based or out of state, thereby making a difference in where the lumber and plywood is shipped. The western wholesalers and distribution yards deal more with the southern markets, while those in the midwest deal more with the eastern markets. Another factor is whether the distribution yards are owned by a lumber or plywood producing company, of if they are independently owned. Company owned yards are supplied by their parent mill, while independent yards may purchase from any mill, wholesaler, or other distribution yard willing to sell to them.

TABLE 5.--OREGON FOREST PRODUCTS STATISTICS: 1976

Total Commercial Forest Land *		Total Volume of Sawtimber *	
25,673,000 Acres		457,735,000 M Feet	
Ownership		Ownership	
Federal	56.8%	Public	73.5%
Other Government	3.7%	Private	26.5%
Private	39.5%	* As of January 1, 1970	
Lumber Production	7,335,000 M Feet		
Source of Timber		Mode of Transportation	
Company owned	28.6%	By rail	59.9%
Federal	54.8%	By truck	29.2%
Other	16.6%	By water	10.9%
Species Cut		Principal Markets	
Douglas Fir	56.0%	California	28.4%
Ponderosa Pine	18.8%	Other West	29.1%
Hemlock	14.7%	Midwest	22.2%
White Fir	4.5%	Northeast	4.3%
Western Red Cedar	1.9%	South Central	5.2%
Sugar Pine	1.1%	Southeast	5.7%
Lodgepole Pine	1.0%	Export	5.1%
Sitka Spruce	0.1%	Distribution Channels	
Incense Cedar	0.7%	Direct to user	2.7%
Idaho White Pine	0.1%	Direct to retailer	15.7%
Engelmann Spruce	0.2%	Wholesaler	63.2%
Other	0.9%	Company owned distri. yards	8.4%
		To factory for further mfg.	10.0%

Source: Western Wood Products Association (1977).

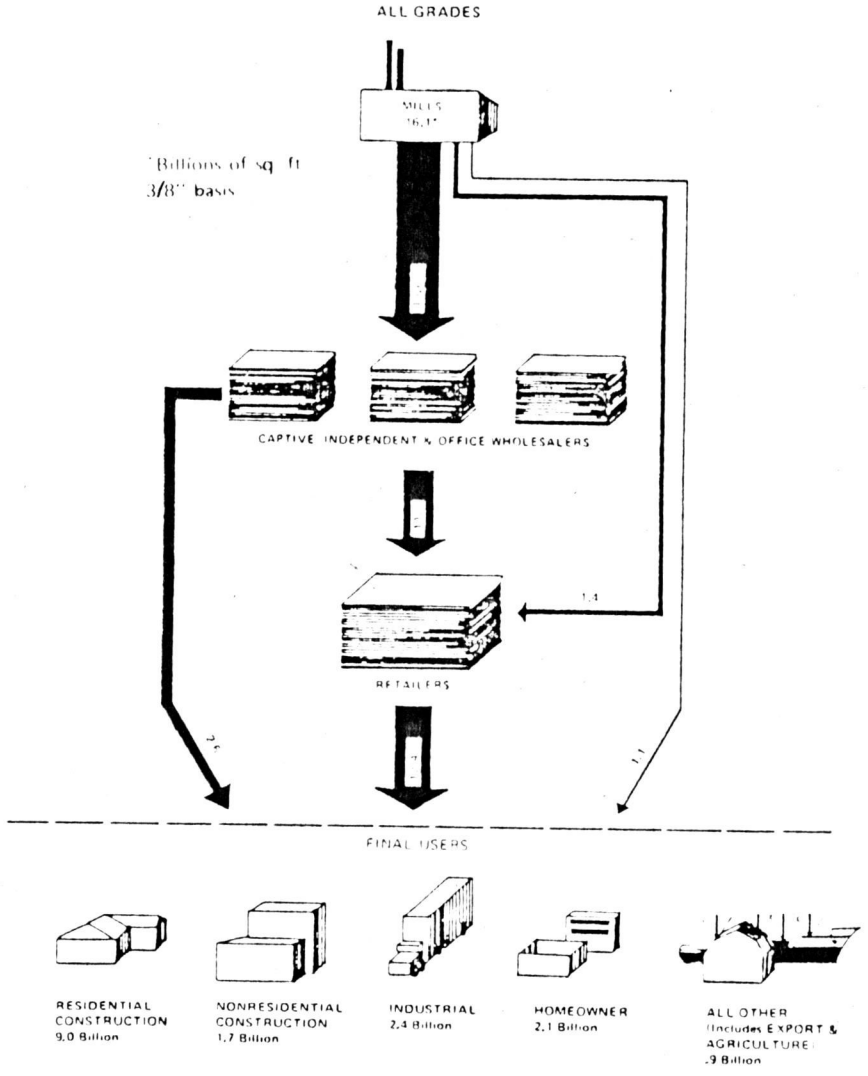


FIGURE 7: The Pattern of Plywood Distribution for 1975

Source: Carney (1976)

With lumber and plywood primarily carried by rail, the adjusted commodity flows will not represent this portion of the forest products industry. The flows recorded will probably be that hauled to rail depots, and small shipments going to interstate and intrastate markets. With the increased use of motor carriers that has taken place since 1976, future adjusted flows will probably show this increase.

The adjusted commodity flows of lumber and plywood are in an opposing direction to those of timber, i.e., the flows are away from the processing centers rather than to them (Figures 8, 9, and 10). Commodity flows of Western Oregon are toward or along the state's main transportation artery, Interstate 5, and presumably head to southern markets as shown by the large southern flows recorded at the Ashland weigh station. Washington's lumber and plywood production are also shipped to the same markets as Oregon's, and southern flows recorded at Ashland include much of this. Large flows are also recorded going north at the Ashland, Klamath Falls, Roseburg, and Portland weigh stations, possibly to Oregon port facilities in Portland and to Washington ports at Vancouver, Longview, and Seattle. The north bound flows at Ashland may be composed of Northern California redwood lumber for export through an Oregon or Washington port, or for use in Oregon. The flows of Eastern Oregon are not as large as

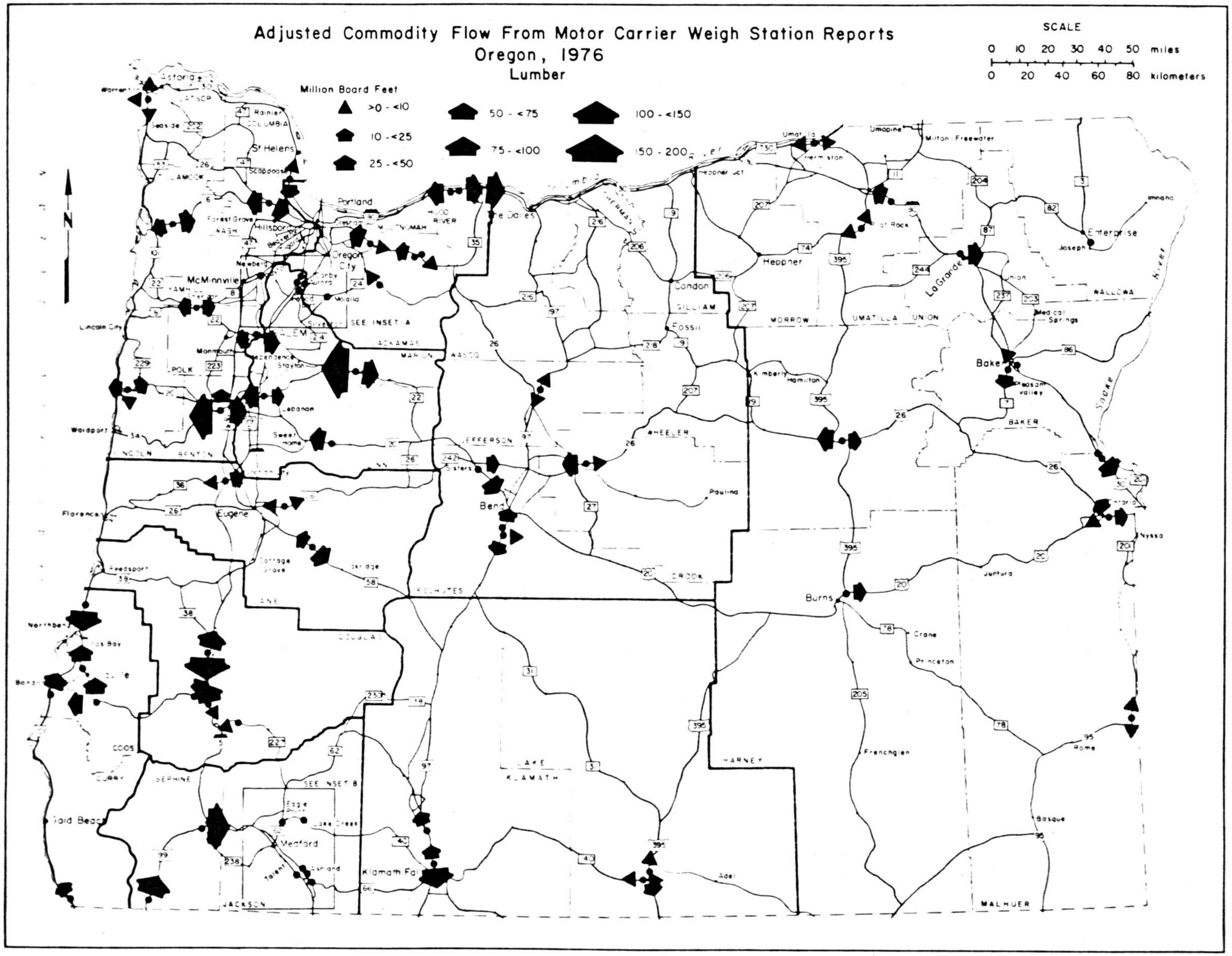


Figure 8. Adjusted Commodity Flow From Motor Carrier Weigh Station Reports, Oregon, 1976 - Lumber

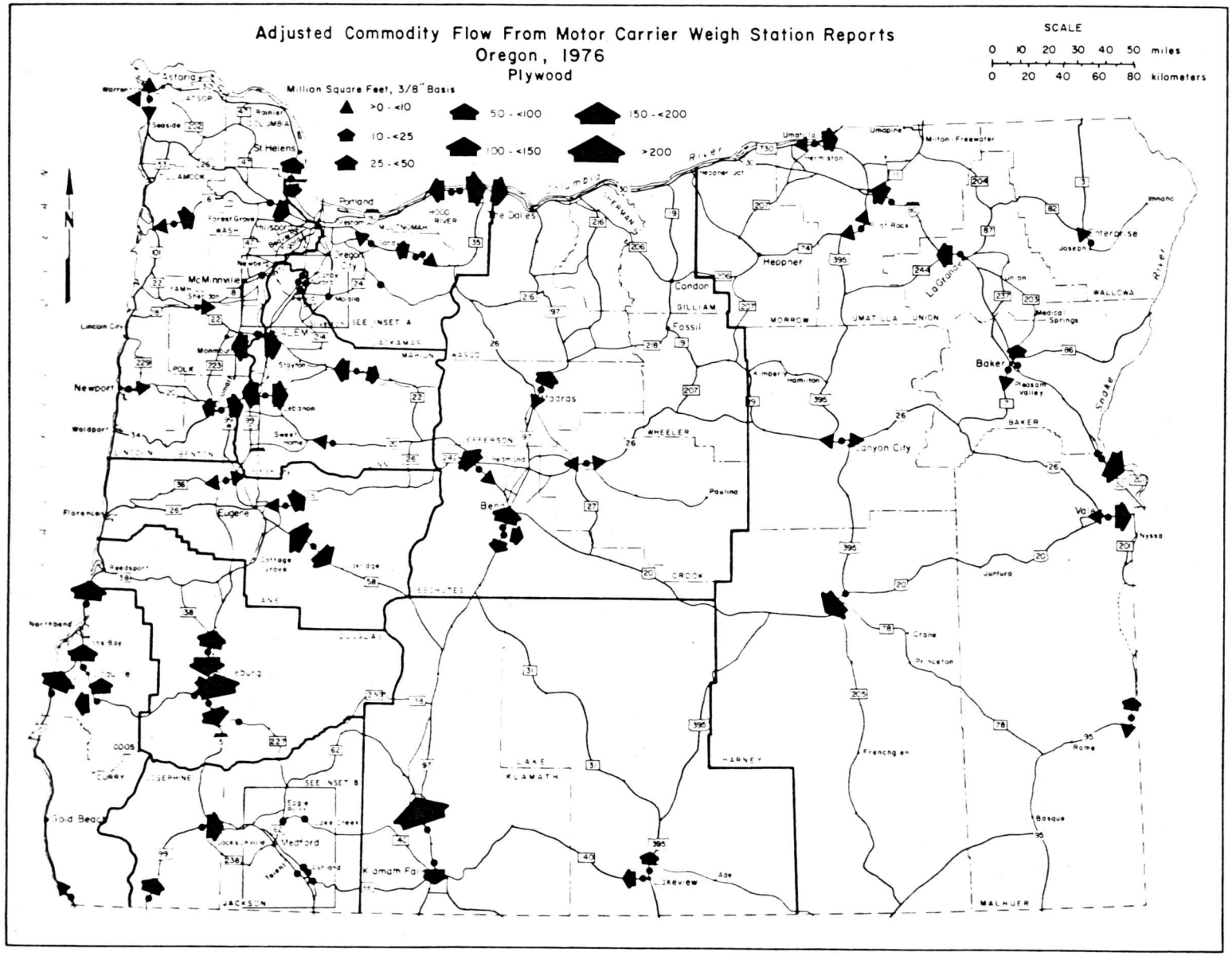


Figure 9. Adjusted Commodity Flow From Motor Carrier Weigh Station Reports, Oregon, 1976 - Plywood.

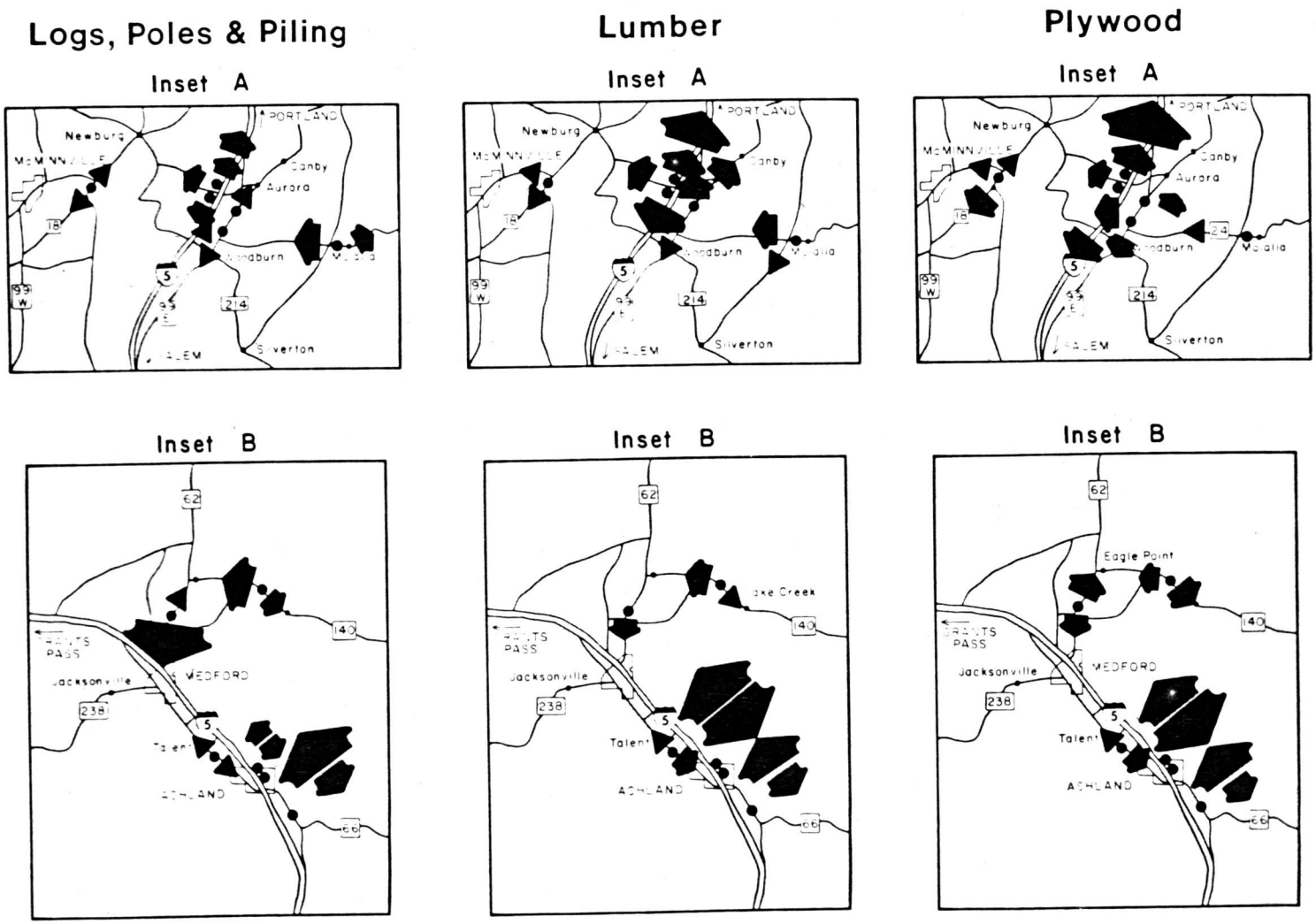


Figure 10. Inset Pairs A and B for Each Adjusted Commodity Flow Figure.

those in Western Oregon; the lumber and plywood in Eastern Oregon probably is conveyed for local market consumption or exported to interstate markets east of Oregon as the weigh stations near Ontario illustrate.

CONCLUSIONS

The use of motor carrier weigh station reports for commodity flow analysis of the forest products industry in Oregon is possible using the methods developed in this study. Data analysis is based on a relationship between the times the weigh stations are operating and the amount of time that is available for the hauling of forest products. The adjustment factors that are developed in this study are applied to the commodity weight data collected at each weigh station. A commodity flow pattern is produced that represents what passes through each weigh station if it is operating during the times available for hauling. The data are graphically displayed to assist in analysis by illustrating size and direction of commodity flow at each weigh station. The resulting commodity flows are supported by existing data on the forest products industry's harvest and consumption of timber and the production and marketing of lumber and plywood.

The accuracy of the methods used can be improved with the correction of certain data limitations encountered during this study. Improvements will exemplify how well the commodity flow

figures represent what is actually hauled. The time of day that the weigh stations are operating varies considerably during the year; but on an annual basis, the weigh stations individually operate about the same length of time. The weigh station program is set up to stop motor carriers for safety inspection and to check for haul-weight violations. If the weigh stations are operated in any type of systematic manner, the program will shortly be ineffective in accomplishing its designed mission. The program is not designed in a manner that best represents a statistical sampling procedure necessary to provide the proper data and allow for better analyses.

The times that the weigh stations operate during the year are not available except for a year-end total for each weigh station. Without these data, it is necessary to assume that the weigh stations are operating during the times that motor carriers are likely to be hauling forest products. With this assumption, it is possible that the adjusted commodity flows are an over- or underestimation of the true situation, but this is unknown.

A similar situation exists with the commodity weight data collected at each weigh station. The times when the commodity weights are recorded as going through the weigh stations are not readily available except for a year-end total. Without these data, it is necessary to determine when forest products are hauled by some other means. This is accomplished by using legal hauling

restrictions and assumptions as to whether or not night hauling is likely to occur. The lack of data is not as great a problem for the hauling of timber as it is for the hauling of lumber and plywood. The latter do not have legal hauling restrictions and are basically interstate haulers whereas timber haulers have legal restrictions and are basically intrastate. The motor carrier is the main transportation mode used in the hauling of timber, but in the hauling of lumber and plywood it makes up only a small percentage of it. Due to the lack of data and hauling restrictions, the complexity of the lumber and plywood marketing structure, and the mode of transportation used, it may be concluded that this method has great potential for further use in timber flow analysis than it does in lumber and plywood.

FOOTNOTES

1. Of the rate, entry, and physical economic regulations discussed in "Management of Transportation Carriers." by Davis, et al., (1975), the Oregon P.U.C. and D.O.T. are involved with the last two. Entry regulation deals with the number of motor carriers allowed to compete in a given area. The reasoning for this regulation is to protect the financial health of the carrier by taking into account the needs of the people being serviced. During an interview with Hardy Cave, Administrator of the Motor Carrier Enforcement Division of the P.U.C., on November 23, 1979, he stated that the P.U.C. regulates the number of independent haulers operating within defined areas of the state by requiring them to have hauling permits and P.U.C. license plates. The granting or denial of permit applications is the process that limits the number of operators in an area.

   The physical regulation of motor carriers is concerned with equipment condition, the quality of the operators, and operating procedures. The Oregon P.U.C. and D.O.T. inspect vehicles and drivers at the weigh stations located throughout the state. They also prescribe weight, height, width, and length regulations that motor carriers must follow. The reasoning for such

regulation is a concern for the safety of the highway co-users and the protection of the highway itself. The weight and mileage data collected at the weigh stations are used by the Collection Section of the P.U.C. to determine the road taxes that carriers are charged for the use of the road. Interstate taxes are also charged to long haulers that enter the state. The money generated from these taxes is distributed to city, county, and state road maintenance funds.

2. Private carriers are permitted to operate without completing application procedures unlike independent carriers. The companies obtain a carrier certificate from the P.U.C. for each of the vehicles they operate.

3. During an interview with Arthur Shelley from the Permits and Weighmasters Office of the P.U.C., on November 23, 1979, he explained that weigh stations vary in the capacity of motor carriers they can handle. Depending on this capacity, they are able to cover only one or both directions of traffic along a road.

4. Shelley, op. cit., footnote 3.

5. Another problem that surfaced when the calculations were made was that certain weigh stations were recorded as having a small amount of commodity hundred weight passing through them in a certain direction but did not have any record of their being a more thorough review.

6. James O. Howard and Bruce A. Hiserote, Oregon's Forest Products Industry 1976, USDA Forest Service Resource Bulletin PNW-79, PNW Forest and Range Experiment Station, Portland, Oregon, 1978, p. 16.

7. Eighteen of the less than 10 hour operating directions, out of 129 directions recorded made the adjusted commodity total for all the weigh stations too high. For example, weigh station #22-05 recorded in three directions having less than 10 hours operating time, north, south, and east for 4, 1 and 3 hours, respectively. Hundred weight recorded for each of these directions were 53,184; 11,833; and 44,344, respectively. When the adjustment factor was determined and applied to these recorded weights, the resulting figures of 55, 62, 49, 50, and 61.83 million hundred weight were respectively obtained.

8. D.P. Dykstra and J.J. Garland conducted a questionnaire survey of all Oregon log hauling operators in 1976 and presented their results in Paper No. 1192, Forest Research Laboratory, Oregon State University, 1977. The survey reveals that the loaded kilometers

traveled per trip is between 55.2 and 68.2, depending on the vehicle type. They also found that the number of trips made per day by the log haulers averaged between 2.5 and 3.2, with the haulers operating an average of 201.5 - 216.7 days that year. If there is not a weigh station on the stretch of road traveled by the log hauler, then his average of 3 trips per day over an average of 210 days per year will go unrecorded.

9. Robert O. McMahon, Associate Professor of Forest Products, Oregon State University, Corvallis, April 21, 1980, personal communication.

10. Western Wood Products Association, 1976 Statistical Yearbook, August 1977, p. 7.

11. Howard and Hiserote, op. cit., footnote 6, p. 16.

12. In June of 1979, the Weighmasters Office began to keep record of when the weigh stations were operating. The "Operation Graphics" show that the weigh stations are generally open in eight hour shifts, but these shifts can be single or back-to-back. The single shifts range from a few days of each month to consecutive days covering weeks or months. The single shifts also occur during the night, but not as often as they occur during the day. The back-to-back shifts are done occasionally and run for one or two day periods. The Weighmasters Office is responsible for selecting the times that the weigh stations will be open.

13. R.H.T. Smith, "Concepts and Methods in Commodity Flow Analyses," In Transportation Geography: Comments and Readings, Edited by Michael E. Elliot Hurst, New York: McGraw-Hill Book Co., 1974, p. 139.

14. Edward L. Ullman, American Commodity Flow - A Geographical Interpretation of Rail and Water Traffic Based on Principles of Spatial Interchange, Seattle: University of Washington Press, 1957, p. 20.

15. John C. Lowe and S. Moryadas, The Geography of Movement, Boston: Houghton Mifflin Co., 1975, p. 31.

20. J. Beuter, K.N. Johnson, and H.L. Scheurman, Timber for Oregon's Tomorrow: An Analysis of Reasonably Possible Occurrences, Research Bulletin 19, Forest Research Laboratory, Oregon State University, Corvallis, January 1976, p. 4.

21. Howard and Hiserote, op. cit., footnote 6, p. 9.

22. Howard and Hiserote, op. cit., footnote 6, p. 42.

23. J. Brodie, R. McMahon and W. Gavelis, Oregon's Forest Resources; Their Contribution in the State's Economy, Research Bulletin 23, Forest Research Laboratory, Oregon State University, Corvallis, September 1978, p. 75.

16. Lowe, op. cit., footnote 15, p. 32.

17. Lowe, op. cit., footnote 15, p. 133.

18. Lowe, op. cit., footnote 15, p. 133.

19. C. Schallau, W. Maki, and J. Beuter, Economic Impact Projections for Alternative Levels of Timber Production in the Douglas Fir Region, Annals of Regional Science, III(I): 96-106, June, 1969, and W. Maki and D. Schweitzer, Importance of Timber Based Employment to the Douglas Fir Region 1959-71, USDA Forest Service Research Note PNW-196, PNW Forest and Range Experiment Station, Portland, Oregon, 1973.

24. Plywood production figures are combined with those of Washington and given for the coast and inland regions of the combined state area.

25. McMahon, op. cit., footnote 9, April 21, 1980, personal communication.

26. Western Wood Products Association, op. cit., footnote 12, p. 7.

27. Brodie, op. cit., footnote 23, p. 75.

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Appendix I: Sample Weigh Station Computer Printout

(SCALERPT)

WEIGH STATION
15-06

NORTHBOUND

COMMODITY	VEHICLE & AXLE ARRANGEMENT	# OF TRUCKS	TOTALS COMBINED WEIGHT *	TOTALS COMMODITY WEIGHT *	AVERAGE COMBINED WEIGHT *	AVERAGE COMMODITY WEIGHT *	PERCENT OF TRUCKS
ALL COMMODITIES	ALL	385	246,360	135,670	640	352	100 %
AUTOMOBILES	ALL	1	481	181	481	181	0 %
CEMENT	ALL	3	2,016	1,176	672	392	1 %
FEED & FERTILIZER	ALL	1	375	145	375	145	0 %
FURNITURE	ALL	3	1,506	716	502	239	1 %
GRAIN OR SEEDS	ALL	1	437	207	437	207	0 %
GROCERIES	ALL	18	11,351	5,961	631	331	5 %
HOUSEHOLD GOODS	ALL	14	6,211	2,451	388	153	4 %
IRON,STEEL,TIN, ECT.	ALL	10	6,447	3,457	645	346	3 %
LIVE STOCK	ALL	2	1,532	932	766	466	1 %
LOGS, POLES & PILING	ALL	10	7,442	4,942	744	494	3 %
LUMBER	ALL	76	57,421	33,641	736	431	20 %
MANUF. LUMBER	ALL	3	1,665	755	555	252	1 %
MACHINERY	ALL	12	6,644	3,264	554	272	3 %
MEAT OR MEAT PROD.	ALL	1	217	137	217	137	0 %
PETROLEUM	ALL	4	1,356	796	339	199	1 %
PLYWOOD	ALL	13	9,692	5,652	746	435	3 %
PRODUCE	ALL	3	1,221	391	407	130	1 %
ROOFING	ALL	1	759	459	759	459	0 %
OTHER	ALL	205	129,587	70,407	632	343	53 %

EMPTY WEIGHTS *

1-1	080	3-4	140
1-5	230	4-7	320
2-7	250	5-9	290
3-0	220	6-2	180
3-2	190	6-3	200
3-3	200	6-4	240

OTHERS = UNDER 3-0 240 OVER 2-9 300

* ALL WEIGHTS IN HUNDRED-WEIGHT

(SCALE PT)

WEIGH STATION
15-06

SOUTHBOUND

COMMODITY	VEHICLE & AXLE ARRANGEMENT	# OF TRUCKS	TOTALS COMBINED WEIGHT *	TOTALS COMMODITY WEIGHT *	AVERAGE COMBINED WEIGHT *	AVERAGE COMMODITY WEIGHT *	PERCENT OF TRUCKS
ALL COMMODITIES	ALL	60,426	37,907,921	20,903,731	627	346	100 %
AUTOMOBILES	ALL	258	116,982	44,782	453	174	0 %
CEMENT	ALL	60	23,187	14,247	486	237	0 %
FEED & FERTILIZER	ALL	132	63,978	34,078	485	258	0 %
FIXED LOADS	ALL	176	43,180	19,140	245	109	0 %
FURNITURE	ALL	310	106,264	42,224	343	136	1 %
FUEL	ALL	34	15,583	8,573	459	252	0 %
GRAIN OR SEEDS	ALL	271	186,404	111,454	688	411	0 %
GROCERIES	ALL	2,272	1,371,369	747,649	604	329	4 %
HAY	ALL	48	26,447	13,237	551	276	0 %
HOUSEHOLD GOODS	ALL	2,191	878,305	380,365	401	174	4 %
HOUSE TRAILERS	ALL	96	30,441	9,541	311	97	0 %
IRON,STEEL,TIN, ECT.	ALL	1,746	1,109,581	602,971	635	345	3 %
JUNK METAL	ALL	87	60,130	34,640	691	398	0 %
LIVE STOCK	ALL	337	227,289	127,970	674	380	1 %
LOGS, POLES & PILING	ALL	1,464	1,068,915	695,735	731	475	2 %
LUMBER	ALL	10,036	7,422,107	4,375,997	740	436	17 %
MANUF. LUMBER	ALL	482	244,691	126,531	508	263	1 %
MACHINERY	ALL	1,469	843,283	436,303	574	297	2 %
MEAT OR MEAT PROD.	ALL	209	99,459	51,759	476	248	0 %
PETROLEUM	ALL	542	267,197	156,407	493	289	1 %
PLYWOOD	ALL	2,768	2,015,320	1,182,480	728	427	5 %
PRODUCE	ALL	399	250,916	145,106	629	364	1 %
ROOFING	ALL	440	304,554	177,274	692	403	1 %
OTHER	ALL	34,589	21,120,921	11,362,861	611	329	57 %
UNKNOWN	ALL	8	4,627	2,407	578	301	0 %

EMPTY WEIGHTS *

1-1	080	3-4	140
1-5	230	4-7	320
2-7	250	5-9	290
3-0	220	6-2	180
3-2	180	6-3	200
3-3	200	6-4	240

OTHERS = UNDER 3-0 240 OVER 2-9 300

* ALL WEIGHTS IN HUNDRED-WEIGHT

(SCALERPT)

WEIGH STATION
15-06

EASTBOUND

COMMODITY	VEHICLE & AXLE ARRANGEMENT	# OF TRUCKS	TOTALS COMBINED WEIGHT *	TOTALS COMMODITY WEIGHT *	AVERAGE COMBINED WEIGHT *	AVERAGE COMMODITY WEIGHT *	PERCENT OF TRUCKS
ALL COMMODITIES	ALL	59	39,935	22,545	677	382	100%
GROCERIES	ALL	2	1,255	655	628	328	3%
HOUSEHOLD GOODS	ALL	5	2,024	824	405	165	8%
IRON, STEEL, TIN, ECT.	ALL	1	437	137	437	137	2%
LUMBER	ALL	11	8,205	4,795	746	436	19%
PLYWOOD	ALL	1	771	451	771	451	2%
OTHER	ALL	39	27,243	15,693	699	402	66%

EMPTY WEIGHTS *

1-1	080	3-4	140
1-5	230	4-7	320
2-7	250	5-9	290
3-0	220	6-2	180
3-2	160	6-3	200
3-3	200	6-4	240

OTHERS = UNDER 3-0 240 OVER 2-9 300

* ALL WEIGHTS IN HUNDRED-WEIGHT

(SCALE RPT)

WEIGH STATION
15-06

WESTBOUND

COMMODITY	VEHICLE & AXLE ARRANGEMENT	# OF TRUCKS	TOTALS COMBINED WEIGHT *	TOTALS COMMODITY WEIGHT *	AVERAGE COMBINED WEIGHT *	AVERAGE COMMODITY WEIGHT *	PERCENT OF TRUCKS
ALL COMMODITIES	ALL	65	44,185	24,915	680	383	100 %
GRAIN OR SEEDS	ALL	1	400	170	400	170	2 %
GROCERIES	ALL	2	1,449	849	725	425	3 %
HOUSEHOLD GOODS	ALL	1	413	213	413	213	2 %
IRON,STEEL,TIN, ECT.	ALL	2	1,532	932	766	466	3 %
LUMBER	ALL	19	14,246	8,346	750	439	29 %
PLYWOOD	ALL	4	3,065	1,865	766	466	6 %
PRODUCE	ALL	1	774	474	774	474	2 %
OTHER	ALL	33	20,861	11,221	632	340	51 %
UNKNOWN	ALL	2	1,445	845	723	423	3 %

EMPTY WEIGHTS *

1-1	080	3-4	140
1-5	230	4-7	320
2-7	250	5-9	290
3-0	220	6-2	180
3-2	180	6-3	200
3-3	200	6-4	240

OTHERS = UNDER 3-0 240 OVER 2-9 300

* ALL WEIGHTS IN HUNDRED-WEIGHT

Appendix II: 1976 Weighmaster Scale Locations

Scale No.	Location	Hwy.	Route	Highway	Mile Point
01-01	South Baker (1 mile south)	13	7	Baker-Unity	43.44
01-03	East Baker (3 miles east)	6	I-80-N	Old Oregon Trail	306.59
02-01	Philomath (1 mile east)	33	20	Corvallis-Newport	51.64
03-03	Molalla (1 mile west)	161	211	Woodburn-Estacada	11.39
03-04	Clackamas (7 miles east)	171	212	Clackamas	7.94
03-07	West Brightwood (12 mi. east of Sandy)	26	26	Mt. Hood	36.31
03-08	East Brightwood (12 mi. east of Sandy)	26	26	Mt. Hood	36.51
03-10	Memaloose (10 mi. east of Estacada)	171	212(224)	Clackamas	33.50
04-03	Seaside (7 miles north)	9	101	Oregon Coast	14.33
05-01	Scappoose (2 miles east)	2W	30	Columbia River	19.45
06-02	Bandon (2 miles south)	9	101	Oregon Coast	276.11
06-03	Myrtle Point (east city limits)	35	42	Coos Bay-Roseburg	21.87
06-05	Coaledo (5 miles north of Coquille)	35	42	Coos Bay-Roseburg	21.87
06-06	Hauser (6 mi. north of Coos Bay Bridge)	9	101	Oregon Coast	227.69
07-01	Prineville (1 mile east)	41	26	Ochoco	21.18
08-02	Brookings (south city limits)	9	101	Oregon Coast	357.73
09-02	Sisters (junction 20 & 126)	15	20	McKenzie	93.07
09-03	Bend (6 miles south)	4	97	The Dalles-California	143.96
10-06	Wilbur (5 miles north of Roseburg)	1	I-5	Pacific	130.03
10-08	Booth Ranch (3 mi. north of Myrtle Cr.)	1	I-5	Pacific	111.07
10-09	Brockway (2 miles west of Winston)	35	42	Coos Bay-Roseburg	71.20
10-10	Days Creek (2 miles east)	230	227	Tiller-Trail	12.54
12-01	John Day (1 mile west)	5	26	John Day	160.97
13-01	Burns (1 mile east)	7	20	Central Oregon	133.53
14-02	East Wyeth (westbound, 10 mi. east of Cascade Locks)	2	I-80-N	Columbia River	52.43
14-03	West Wyeth (eastbound, 5 mi. east of Cascade Locks)	2	I-80-N	Columbia River	47.58

Appendix II (cont.)

Scale No.	Location	Hwy.	Route	Highway	Mile Point
15-02	North Medford (5 miles north)	22	62	Crater Lake	7.69
15-04	East Ashland (northbound, 2 mi. north of Ashland)	66	99	Rogue Valley	16.96
15-06	West Valley View (southbound, 2 miles north of Ashland)	1	I-5	Pacific	13.24
15-07	Ashland Port of Entry (northbound, 2 miles north of Ashland)	1	I-5	Pacific	13.03
15-08	Siskiyou Junction (5 miles east of Ashland)	21	66	Green Springs	3.43
15-09	Lakecreek (20 mi. east of Medford)	270	140	Lake of the Woods	13.35
16-01	Madras (north city limits)	4	97	The Dalles-Calif.	91.89
17-01	Grants Pass (west city limits)	25	199	Redwood	0.67
17-02	O'Brien (5 miles south)	25	199	Redwood	41.05
18-05	North Klamath Falls (1 mile north)	4	97	The Dalles-Calif.	271.41
18-06	Modoc Point (13 miles north of Klamath falls)	4	97	The Dalles-Calif.	259.73
19-01	West Lakeview (west city limits)	20	140	Klamath Falls-Lakeview	99.55
19-02	North Lakeview (north city limits)	19	395	Fremont	142.15
20-02	Walterville (10 mi. east of Springfield)	15	126	McKenzie	13.04
20-03	Goldson (1 mile west of Cheshire)	229	36	Mapleton-Junction City	46.15
20-05	Lowell (4 mi. east of Lowell Junction)	18	58	Willamette	17.17
21-02	Toledo (1 mile west)	33	20	Corvallis-Newport	3.72
22-02	Albany (1 mile east)	16	20	South Santiam	1.47
22-05	Foster (5 miles east)	16	20	South Santiam	32.29
23-03	Jordon Valley (north city limits)	455	95	I.O.N.	20.10
23-04	Vale (1½ miles east)	7	20-26	Central Oregon	248.08
23-05	Olds Ferry (21 mi. northwest of Ontario)	6	I-80-N	Old Oregon Trail	352.89
24-02	West Hubbard (southbound, 1 mi. north)	1E	99E	Pacific East	23.18
24-03	Gates (1 mile west)	162	22	North Santiam	32.06
24-07	East Hubbard (northbound, 1 mile north)	1E	99E	Pacific East	27.35
24-08	East Woodburn (northbound, 2 mi. north)	1	I-5	Pacific	273.95

Appendix II (cont.)

Scale No.	Location	Hwy.	Route	Highway	Mile Point
24-09	West Woodburn (southbound, 2½ mi. north)	1	I-5	Pacific East	274.37
27-01	Sola (4 miles west of Salem)	30	22	Willamina-Salem	21.53
27-04	Fort Hill (East of Valley Junction)	39	18	Salmon River	24.07
29-03	Tillamook (2 miles east)	37	6	Wilson River	2.40
30-02	Pilot Rock (west city limits)	28	395	Pendleton-John Day	16.18
30-04	Cold Springs (Junction 730 & 395)	2	730	Columbia River	192.12
30-05	Emigrant Hill (18 mi. east of Pendleton)	6	I-80-N	Old Oregon Trail	226.96
31-03	West La Grande (2 miles west)	6	I-80-N	Old Oregon Trail	257.66
32-02	Joseph (north city limits)	10	82	Wallowa Lake	71.33
34-02	North Plains (2 miles west)	47	26	Sunset	54.09
36-02	Dayton (north of Dayton Junction)	18	99W	Pacific West	29.13

Appendix III: Adjustment of Logs, Poles and Piling Commodity Weights

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Hd. Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x (4183/Col. B) or x 1 if Col. B > 4183 (Million Hd. Wt.)	Million Board Ft.
01-01	1796	94	N	912,184	913	4.14	104.50
	9	6	S	4,132	157	0.11	2.75
01-03	73	1	W	35,678	2070	0.07	1.80
02-01	6	75	N	3,084	11	1.17	29.25
	3321	44	E	1,576,525	1660	3.97	99.50
	93	33	W	45,421	36	5.26	132.00
03-03	8	42	E	3,989	25	0.66	16.56
	357	32	W	175,399	326	2.25	56.25
03-04	3	10	E	1,463	13	0.47	11.77
	2112	21	W	1,018,720	1383	3.08	77.00
03-07	39	54	N	18,215	4	*19.09	*476.26
	6165	56	W	3,039,988	1859	6.84	171.01
03-08	1	2	W	508	9	*0.24	*5.99
03-10	52	100	S	26,153	14	7.81	195.25
	3930	96	W	1,975,702	861	9.60	240.00
04-03	2511	50	N	1,228,138	1074	4.78	119.50
	101	44	S	49,331	45	4.59	114.80
	218	51	W	106,410	103	3.82	90.50
05-01	5	9	N	2,083	1	*8.63	*215.75
	1	13	S	509	Not listed as open		
	10	11	E	4,731	32	0.63	15.63
	2615	13	W	1,302,435	2526	1.93	48.25
06-02	2267	30	N	1,113,388	1032	2.47	61.75
	26	44	S	13,717	4	*14.34	*358.50
06-03	241	53	N	117,524	49	10.03	250.75
	14	74	S	6,742	Not listed as open		
	3256	49	W	4,045,362	1538	11.00	275.00
06-05	7497	33	N	3,596,804	1979	7.60	190.00
	6	21	E	2,703	Not listed as open		
	19	61	W	9,535	1	*39.88	*997.00
06-06	5	5	N	3,569	4	4.05	*101.25
	2341	14	S	1,417,463	2403	2.47	61.75
07-01	5	83	N	2,528	1	*10.57	*264.25
	2	67	S	1,009	Not listed as open		
	1	>1	E	502	392	0.005	0.13
	4064	88	W	2,051,384	1217	7.05	176.25
08-02	2640	43	N	1,347,040	1366	4.12	103.00
	12	13	S	4,639	106	0.18	4.50
	2	22	W	1,006	Not listed as open		
09-02	2	50	N	866	Not listed as open		
	2088	53	S	1,059,547	1296	3.42	85.50
	1043	72	E	519,366	863	2.48	61.99
	2	5	W	1,045	7	*0.62	*15.51
09-03	3354	39	N	1,693,290	2276	3.11	77.75
	69	1	S	31,032	1608	0.07	1.74
10-06	43	16	N	21,368	45	1.99	49.75
	4526	12	S	3,171,342	3544	3.74	93.50
	12	15	E	6,072	7	*3.03	*75.75
	4	9	W	1,956	Not listed as open		

Appendix III (cont.)

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Hd. Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x (4183/Col. B) or x1 if Col. B >4183 (Million Bd. Ft. Wt.)	Million Board Ft.
10-08	13648	23	N	6,504,058	3214	8.60	215.00
	16	23	S	6,989	11	3.40	85.00
	2	15	W	855	Not listed as open		
10-09	8138	77	E	3,981,028	2020	8.24	236.00
	2	15	W	983	11	0.38	9.60
10-10	3	100	N	1,533	Not listed as open		
	20	74	E	9,473	12	3.30	82.50
	312	93	W	153,989	176	3.66	91.50
12-01	1235	43	E	602,544	1603	1.57	39.25
	2966	67	W	1,471,648	1570	3.93	98.25
13-01	17	2	E	7,879	990	0.03	0.84
14-02	6	4	E	3,715	16	0.97	24.25
	311	2	W	142,642	1434	0.40	9.98
14-03	126	1	E	54,705	1656	0.14	3.49
15-02	2	22	N	985	15	0.23	5.72
	6111	57	S	2,983,571	1159	10.77	269.25
	14	54	W	7,054	Not listed as open		
15-04	293	15	N	146,614	1593	0.35	8.72
	10	10	S	5,166	112	0.19	4.72
15-06	10	3	N	4,942	43	0.48	12.02
	1464	2	S	695,739	4384	0.70	17.39
15-07	32017	16	N	15,481,395	8293	15.48	387.00
	26	13	S	12,427	15	3.47	86.75
	1	13	E	741	Not listed as open		
15-08	1	100	W	526	Not listed as open		
15-09	11	100	N	5,648	5	•4.72	•118.00
	4	57	S	1,933	Not listed as open		
	94	15	E	45,895	475	1.40	35.10
	4298	63	W	2,110,255	1855	4.80	120.00
16-01	1	>1	N	463	486	0.004	0.11
	6	1	S	2,543	473	0.02	0.56
17-01	4	3	N	1,991	1	•1.33	•266.85
	1949	12	E	926,148	2891	1.72	43.00
	3	6	W	1,730	Not listed as open		
17-02	6	5	N	3,010	66	.14	4.72
18-05	5451	22	S	2,677,499	2861	3.91	97.75
	3	13	E	1,431	2	•2.39	•74.75
	4	40	W	1,988	Not listed as open		
18-06	364	4	N	177,784	1482	0.50	12.54
	1	5	S	499	15	0.14	3.48
	2	40	E	974	Not listed as open		
19-01	3	100	N	1,457	Not listed as open		
	553	73	S	274,284	315	3.92	98.00
	3	1	W	1,256	144	0.09	0.56
19-02	68	50	S	36,651	139	1.03	25.75
20-02	15	68	N	7,009	11	2.67	66.75
	20	87	S	10,018	Not listed as open		
	3	23	E	1,506	13	0.48	12.11
	13597	84	W	6,507,462	2165	12.57	314.25
20-03	900	60	E	424,146	612	2.90	72.50
	27	5	W	12,411	500	0.10	2.60

Appendix III (cont.)

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x (4183/Col. B) or x1 if Col. B> 4183 (Million Wt.)	Million Board Ft.
20-05	9	25	N	4,183	3	•5.83	•145.75
	6	62	S	3,942	Not listed as open		
	22	14	E	9,681	30	1.35	33.75
	22366	50	W	10,633,179	4057	10.96	274.00
21-02	3	33	N	1,557	Not listed as open		
	4	20	S	2,021	11	0.77	18.21
	1081	26	E	523,958	736	2.98	74.50
	16	24	W	7,676	46	0.70	17.45
22-02	13	8	E	6,558	88	0.31	7.79
	167	14	W	79,586	445	0.75	18.70
22-05	107	88	N	53,184	4	•59.62	•1340.50
	24	96	S	11,833	1	•49.50	•1237.50
	90	83	E	44,344	3	•61.83	•1545.75
	19981	90	W	9,842,185	2127	19.36	484.00
23-03	3	<1	S	1,192	376	0.01	0.33
23-04	28	67	N	13,939	15	3.89	97.25
	27	64	S	13,659	15	3.81	95.25
	2	<1	E	832	1398	0.002	0.06
	4	<1	W	1,250	1394	0.004	0.10
23-05	50	<1	E	19,313	2251	0.04	0.90
24-02	109	4	S	52,701	853	0.29	8.24
	2	4	W	877	17	0.22	5.39
24-03	6	27	N	2,944	8	•6.16	•154.00
	5	42	S	2,527	Not listed as open		
	21	20	E	10,352	27	1.60	40.00
	6212	45	W	3,008,596	2203	5.70	142.50
24-07	56	2	N	27,126	1012	0.11	2.80
24-08	1868	5	N	928,524	2259	1.72	43.00
	2	11	W	993	Not listed as open		
24-09	8	2	N	3,576	28	0.53	13.36
	756	2	S	333,240	2296	0.61	15.19
	7	6	W	3,011	19	0.66	16.57
27-01	269	9	E	126,774	664	0.80	19.97
	10	8	W	4,989	20	0.001	0.03
27-04	17	89	N	8,592	Not listed as open		
	20	63	S	9,879	1	•40.49	•1012.25
	10346	81	E	5,127,891	2411	8.90	222.50
	133	52	W	66,202	72	3.96	99.00
29-03	272	33	E	131,546	537	1.02	25.50
	97	9	W	46,649	566	0.34	8.52
30-02	2699	75	N	1,304,195	1354	4.63	100.75
	371	56	S	186,810	642	1.23	30.75
	1	33	W	516	Not listed as open		
30-04	1	<1	E	466	1113	0.002	0.04
	2	<1	W	755	1097	0.003	0.07
30-09	443	2	W	213,619	2027	0.44	11.02
31-03	1	7	N	518	Not listed as open		
	2056	10	E	1,106,820	2602	1.78	44.58
38-02	294	77	E	150,329	273	2.30	57.40
	153	55	W	77,358	220	1.47	36.75

Appendix III (cont.)

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Hd. Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x (4183/Col. B) or x1 if Col. B > 4183 (Million Hd. Wt.)	Million Board Ft.
34-02	1	8	N	443	Not listed as open		
	1	100	S	463	Not listed as open		
	475	20	E	231,252	659	1.48	37.00
	68	27	W	32,920	95	1.45	36.25
36-02	1	1	N	524	36	0.06	1.54
	45	2	S	20,612	608	0.14	3.55

* The figures for the less than 10 hour operating directions are not included in the commodity flow graphics. Their inclusion is not justifiable based on the short time span that the weigh stations were operated.

Appendix IV: Adjustment of Lumber Commodity Weights

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Hd. Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x(8760/Col B) or x1 if Col. B>8760 (Million Hd. Wt.)	Million Board Ft.
01-01	21	15	S	8,702	157	0.49	12.25
01-03	66	1	W	23,600	2070	0.10	2.50
02-01	2	25	N	1,016	11	0.81	20.25
	1250	17	E	495,724	1660	2.62	65.50
	45	16	W	16,526	36	4.09	102.25
03-03	1	50	N	465	Not listed as open		
	2	11	E	759	25	0.27	6.75
	165	15	W	59,846	326	1.61	40.25
03-04	1	3	E	436	13	0.29	7.25
	732	7	W	253,946	1383	1.61	40.25
03-07	1	1	N	423	4	•	•
	222	2	W	84,911	1859	0.40	10.00
03-08	57	4	E	14,006	460	0.27	6.75
	1	2	W	145	9	•	•
03-10	7	<1	W	584	861	0.01	0.75
04-03	106	2	N	24,635	1074	0.20	5.00
	6	3	S	1,549	45	0.30	7.50
	9	2	W	1,353	123	0.10	2.50
05-01	3	6	N	639	1	•	•
	4	4	E	1,230	32	0.35	8.75
	812	4	W	259,331	2826	0.80	20.00
06-02	943	12	N	388,656	1692	1.80	45.00
	9	14	S	3,465	4	•	•
06-03	14	3	N	5,777	49	1.03	25.75
	511	3	W	205,931	1538	1.17	29.25
06-05	742	3	N	293,442	1479	1.30	32.50
	1	4	E	166	Not listed as open		
06-06	14	14	N	5,383	4	•	•
	2533	12	S	1,028,413	2403	3.75	93.75
07-01	17	6	E	5,129	392	0.12	3.00
	405	9	W	131,260	1217	1.38	34.50
08-02	306	5	N	116,621	1366	0.75	18.75
09-02	575	15	S	240,634	1296	1.63	40.75
	122	8	E	48,356	883	0.48	12.00
	3	8	W	775	7	•	•
09-03	435	5	N	171,730	2276	0.66	16.50
	478	8	S	194,449	1808	0.94	23.50
	2	29	E	809	31	0.23	5.75
	1	33	W	528	Not listed as open		
10-06	27	10	N	11,636	45	2.26	56.50
	5613	10	S	2,349,359	3544	5.81	145.25
	9	11	E	3,941	7	•	•
	7	15	W	3,174	Not listed as open		
10-08	2330	4	N	860,680	3214	2.35	58.75
	1	1	S	360	11	0.29	7.25
10-09	587	6	E	241,577	2020	1.05	26.25
10-10	3	1	W	955	176	0.05	1.25
12-01	258	10	E	155,348	1606	0.85	21.25
	378	9	W	178,478	1570	1.00	25.00
13-01	136	15	E	63,780	940	0.74	18.50

Appendix IV (cont.)

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Hr. Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x (3760/Col. B) or x1 if Col. B >3760 (Million Hr. Wt.)	Million Board Ft.
14-02	1	4	N	356	Not listed as open		
	1	100	S	880	Not listed as open		76.75
	14	6	E	5,614	16	3.07	86.75
	605	3	W	243,031	1934	1.07	71.50
14-03	1364	7	E	541,231	1655	2.36	•
	3	6	W	1,333	1	•	18.25
15-02	239	2	S	101,346	1159	0.77	3.00
15-04	86	4	N	21,814	1593	0.12	11.50
	16	16	S	5,682	112	0.46	171.25
15-06	78	20	N	33,641	43	5.85	192.25
	10036	17	S	4,379,997	4984	7.61	
	11	19	E	4,795	Not listed as open		
	19	29	W	8,346	Not listed as open		126.00
15-07	11565	.6	N	4,771,434	8893	5.04	94.00
	14	7	S	6,433	15	3.76	
15-09	1	14	S	483	Not listed as open		•
	54	8	E	19,883	475	0.37	9.25
	618	9	W	247,729	1838	1.18	29.50
16-01	20	3	N	7,792	436	0.16	4.00
	50	5	S	21,239	473	0.39	9.75
17-01	8	17	N	3,035	1	•	•
	3550	22	E	1,511,307	2251	5.38	147.00
	12	26	W	5,074	Not listed as open.		
17-02	55	47	N	24,766	66	3.29	82.25
18-05	2	5	N	957	18	0.47	11.75
	2595	16	S	1,095,451	2661	3.35	83.75
	3	13	E	1,083	2	•	•
18-06	253	7	N	96,712	1432	0.57	14.25
	1	9	W	431	Not listed as open		
19-01	24	3	E	9,957	300	0.29	7.25
	8	4	W	2,676	179	0.12	3.00
19-02	3	4	N	1,181	91		2.75
	15	13	S	9,187	133	0.80	15.00
20-02	1	8	E	533	13	0.30	7.50
	188	1	W	66,611	2165	0.27	6.75
20-03	71	6	E	30,745	612	0.44	11.00
	20	4	W	4,525	500	0.03	2.00
20-05	13	6	E	5,593	30	1.83	46.75
	1040	2	W	431,685	4057	0.93	23.25
21-02	1	5	S	394	11	0.28	7.00
	133	3	E	48,186	739	0.27	14.25
	15	15	W	3,876	46	0.74	18.50
22-02	22	14	E	8,626	44	0.86	21.50
	138	11	W	51,674	447	1.08	27.00
22-05	6	5	N	2,545	4	•	•
	5	5	E	2,262	3	•	•
	959	4	W	407,035	2187	1.69	42.00
23-03	8	1	N	3,304	382	0.07	1.75
	33	5	S	13,344	378	0.31	7.75
	1	17	E	326	Not listed as oper.		
23-04	3	5	N	830	15	0.48	12.00
	227	9	E	96,258	1398	0.68	17.00
	34	1	W	11,631	1304	0.08	2.00

Appendix IV (cont.)

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Hd. Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x (8760/Col. B) or x1 if Col. B >8760 (Million Hd. Wt.)	Million Board Ft.
23-05	1701	6	E	451,347	2251	1.76	44.00
	1	5	W	438	1	•	•
24-02	75	3	S	21,240	883	0.21	5.25
	1	2	W	340	17	0.18	4.40
24-03	10	45	N	4,448	2	•	•
	4	33	S	1,825	Not listed as open		
	19	18	E	7,834	27	2.54	63.50
	3612	26	W	1,581,617	2203	6.29	157.25
24-07	467	13	N	169,745	1012	1.47	36.75
	6	14	W	2,445	16	1.34	33.50
24-08	3118	8	N	1,226,965	2259	4.76	119.00
	1	2	S	350	1	•	•
	3	8	E	624	Not listed as open		
	3	16	W	771	Not listed as open		
24-09	17	5	N	7,024	28	2.20	55.00
	2294	6	S	856,078	2296	3.27	81.75
	1	3	E	458	Not listed as open		
	5	6	W	1,689	19	0.78	19.50
27-01	338	11	E	97,395	644	1.32	33.00
	6	5	W	1,729	20	0.76	19.00
27-04	1	5	N	358	Not listed as open		
	3	9	S	1,237	1	•	•
	611	5	E	230,263	2411	0.84	21.00
	12	5	W	4,391	72	0.50	12.50
29-03	167	20	E	60,469	537	1.12	28.00
	126	12	W	49,057	566	0.76	19.00
30-02	74	2	N	35,512	1354	0.33	8.25
	7	1	S	1,728	642	0.02	0.50
30-04	107	2	E	41,603	1113	0.33	8.25
	52	2	W	20,614	1097	0.16	4.00
30-05	196	1	W	213,619	2027	0.92	23.00
31-03	983	5	E	410,085	2602	1.38	34.50
34-02	298	12	E	113,781	655	1.52	38.00
	32	13	W	11,463	95	1.06	26.50
36-02	6	7	N	2,594	66	0.33	8.25
	90	4	S	24,478	603	0.35	8.75
	5	3	W	1,131	47	0.21	5.25

• Calculations using the data from the weigh stations operating less than 10 hours are not done because of the short time span that the weigh stations were operated.

Appendix V: Adjustment of Plywood Commodity Weights

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Hd. Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x (8760/Col. B) or x1 if Col. B >8760 (Mill. Sq.Ft.,3/8"basis)	Million Sq. Ft. 3/8" basis
01-01	2	1	S	699	157	0.04	5.20
01-03	46	<1	W	18,430	2070	0.08	10.40
02-01	131	2	E	53,512	1660	0.28	37.60
	2	1	W	746	36	0.18	24.27
03-03	2	<1	W	302	366	0.01	1.07
03-04	11	<1	W	1,016	1383	0.01	0.80
03-07	56	1	W	22,016	1659	0.10	13.87
03-08	4	<1	E	1,362	460	0.03	3.47
	1	2	W	420	9	•	•
04-03	11	<1	N	1,468	1094	0.01	1.30
	1	<1	S	270	45	0.05	7.07
	1	<1	W	12	123	0.001	0.13
05-01	2	2	E	927	32	0.25	33.37
	142	1	W	38,254	2586	0.12	15.87
06-02	456	6	N	194,593	1648	0.90	120.13
06-03	4	1	N	1,705	43	0.31	40.67
	1	5	S	404	Not listed as open		
	143	1	W	58,656	1533	0.34	45.33
06-05	235	1	N	99,223	1479	0.44	58.53
	1	4	E	406	Not listed as open		
06-06	1	1	N	407	4	•	•
	441	2	S	176,672	2483	0.69	86.30
07-01	2	1	E	945	382	0.02	2.30
	1	<1	W	503	1217	0.004	0.53
08-02	25	<1	N	9,975	1386	0.06	8.27
09-02	133	3	S	58,657	1496	0.40	52.80
	13	1	E	5,563	663	0.06	7.93
	1	3	W	79	7	•	•
09-03	223	3	N	103,146	1279	0.40	52.93
	62	1	S	21,442	1606	0.11	14.13
	1	14	E	445	31	0.13	16.90
10-06	8	3	N	3,319	43	0.69	90.43
	831	4	S	327,954	3944	0.811	105.13
	4	5	E	1,731	7	•	•
10-08	1124	2	N	466,163	3814	1.27	169.47
	2	3	S	874	11	0.70	92.80
	2	18	W	868	Not listed as open		
10-09	60	1	E	26,264	2020	0.11	15.00
12-01	9	<1	E	3,636	1608	0.02	2.80
	5	<1	W	1,436	1570	0.01	1.07
13-01	215	20	E	97,751	990	0.87	115.53
14-02	2	1	E	823	18	0.45	59.10
	184	1	W	73,273	1994	0.32	42.43
14-03	660	3	E	273,240	1659	1.44	190.93
	3	6	W	583	1	•	•
15-02	1	11	N	393	11	0.19	25.47
	38	<1	S	14,987	1159	0.11	15.07
15-04	20	1	N	5,394	1993	0.03	4.17
	5	5	S	1,472	112	0.12	15.97
15-06	13	3	N	5,652	43	1.15	152.47
	2768	5	S	1,136,430	4754	2.03	267.17
	1	2	E	451	Not listed as open		
	4	6	W	1,865	Not listed as open		

Appendix V (cont.)

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Total Hrs. Open Mo. At. (A)	Total Hrs. Open Col. A x (8760/Col. B) by Direction (B)	(Mill.Sq.Ft./5"Basis)	Million Sq. Ft. 5"/5" basis
15-07	3062	1	N	1,355,920	8239	1.43	[illegible]
	2	1	S	471	15	0.28	[illegible]
15-09	34	5	E	14,233	475	0.26	43.33
	51	1	W	18,805	1838	0.09	[illegible]
16-01	31	4	N	14,005	436	0.29	36.40
	6	1	S	2,345	473	0.04	[illegible]
17-01	270	2	E	105,614	2291	0.41	[illegible]
	1	2	W	424	Not listed as open		
17-02	6	5	N	2,676	66	0.36	[illegible]
18-05	270	1	S	114,044	2861	0.35	[illegible]
	2	8	E	869	2	•	•
18-06	569	6	N	253,715	1462	1.50	[illegible]
	1	9	W	457	Not listed as open		
19-01	6	1	E	2,776	300	0.08	[illegible]
19-02	2	3	N	973	91	0.09	12.53
20-02	1	5	N	467	11	0.37	48.60
	24	<1	W	9,260	2165	0.04	4.33
20-03	5	<1	E	2,228	612	0.03	4.37
	7	1	W	3,010	500	0.05	7.37
20.05	6	4	E	2,564	30	0.75	[illegible]
	1035	2	W	456,341	4057	0.99	131.33
21-02	6	<1	E	846	736	0.01	1.33
22-02	9	6	E	3,865	88	0.39	51.33
	65	5	W	25,998	445	0.51	[illegible]
22-05	3	<1	W	1,175	2127	0.005	0.67
23-03	20	3	W	7,984	392	0.18	23.73
	5	1	S	2,293	378	0.05	[illegible]
23-04	169	7	E	70,401	1398	0.44	58.80
	22	1	W	7,059	1304	0.05	[illegible]
23-05	462	3	E	206,996	2251	0.81	107.47
	2	9	W	896	1	•	•
24-02	46	2	S	11,264	833	0.11	[illegible]
	2	4	W	605	17	0.31	[illegible]
24-03	1	1	E	403	27	0.13	[illegible]
	170	1	W	74,359	2203	0.30	39.47
24-07	42	1	N	10,342	1012	0.09	[illegible]
24-08	2217	6	N	917,526	2259	3.56	[illegible]
	1	2	S	474	1	•	•
	1	3	E	443	Not listed as open		
	1	5	W	480	Not listed as open		
24-09	3	1	N	1,347	25	0.42	[illegible]
	463	1	S	143,965	2836	0.58	[illegible]
	1	1	E	284	19	0.12	[illegible]
27-01	112	4	E	40,342	644	0.56	[illegible]
	3	3	W	971	[illegible]	[illegible]	[illegible]
27-04	34	1	E	14,607	2411	[illegible]	[illegible]
29-03	36	4	E	13,844	537	0.22	[illegible]
	5	1	W	2,570	[illegible]	[illegible]	[illegible]

Appendix V (cont.)

Scale No.	No. of Trucks	% of All Trucks	Direction Traveling N S E W	Recorded Hd. Wt. (A)	Total Hrs. Open by Direction (B)	Col. A x (8760/Col. B) (Mill.Sq.Ft. 3/4"basis)	Million Sq. Ft. 3/4" basis
30-02	4	<1	N	1,901	1354	0.01	1.60
	4	1	E	1,746	642	0.02	3.20
30-04	99	2	E	42,621	1113	0.34	44.67
	26	1	W	8,439	1097	0.07	9.93
30-05	1	13	N	424	Not listed as open		
	212	1	W	84,096	2027	0.36	48.40
31-03	230	1	E	103,204	2602	0.35	46.27
32-02	1	1	W	43	220	0.002	0.27
34-02	41	2	E	15,475	655	0.21	27.60
36-02	2	2	N	77	36	0.02	2.53
	77	3	S	20,307	608	0.29	39.07
	1	1	W	339	47	0.07	9.20

* Calculations using the data from the weigh stations operating less than 10 hours are not done because of the short time span that the weigh stations were operated.

Appendix VI: Oregon Department of Transportation Records for the Number of Days Each Weigh Station was Operated each Month - April 1976 to March 1977.

Scale No.	1976 A	M	J	J	A	S	O	N	D	1977 J	F	M
01-01	2	3	7	10	7	10	7	7	10	11	1	1
01-03	20	20	11	13	13	10	10	11	13	13	14	22
02-01	14	12	13	10	7	12	14	14	11	9	5	11
03-03	1	2	3	2	0	4	1	3	3	2	1	4
03-04	14	7	7	5	11	8	9	12	12	11	14	18
03-07	4	8	14	16	14	20	16	20	12	7	5	10
03-08	5	2	5	3	7	10	4	6	4	5	7	1
03-10	6	5	16	15	9	3	6	5	5	3	3	4
04-03	11	10	15	9	13	9	7	9	7	9	7	11
05-01	22	18	13	15	17	20	16	13	13	26	20	25
06-02	11	13	12	9	8	9	12	13	10	15	10	8
06-03	11	8	9	8	9	7	7	7	6	10	7	14
06-05	16	9	11	9	12	12	13	13	15	13	12	15
06-06	14	15	16	11	16	17	13	19	17	20	12	18
07-01	7	9	13	10	9	10	10	10	10	15	8	8
08-02	7	11	8	8	10	10	4	10	8	10	15	11
09-02	8	11	10	11	11	10	9	7	10	11	8	14
09-03	14	12	10	13	14	11	18	11	13	13	13	17
10-06	21	20	16	18	22	20	19	21	17	15	21	19
10-08	16	20	19	16	18	12	14	20	17	15	17	15
10-09	11	10	13	14	16	12	13	10	7	10	11	9
10-10	1	0	0	0	5	2	1	0	2	2	1	0
12-01	10	15	12	7	11	12	8	11	12	12	8	10
13-01	9	3	9	9	9	7	6	4	8	8	6	11
14-02	16	17	15	11	11	12	19	11	17	13	11	13
14-03	16	10	12	10	8	11	16	15	11	8	10	15
15-02	15	16	3	0	1	14	4	11	17	14	14	16
15-04	14	12	12	11	16	10	10	12	5	7	11	16
15-06	30	28	28	25	27	26	19	29	25	25	26	31
15-07	30	30	30	30	31	30	31	29	30	30	23	31
15-08	0	0	0	0	0	0	0	0	0	0	1	0
15-09	13	15	16	11	17	10	11	12	15	14	14	17
16-01	5	4	5	6	6	5	5	5	4	5	2	6

Appendix VI (cont.)

Scale No.	1976 A	M	J	J	A	S	O	N	D	1977 J	F	M
17-01	22	15	15	16	14	16	13	20	15	21	13	20
17-02	0	0	3	0	0	2	0	0	1	0	0	3
18-05	18	16	12	18	20	13	19	15	14	16	19	16
18-06	10	14	15	9	6	8	8	7	7	11	5	14
19-01	2	1	3	2	3	5	5	5	1	1	2	1
19-02	0	1	1	2	3	2	0	1	1	1	1	1
20-02	10	8	12	13	17	15	12	13	14	18	12	14
20-03	1	4	3	2	5	4	6	1	5	9	3	7
20-05	24	23	21	20	21	20	21	20	20	17	19	24
21-02	4	6	5	9	9	7	4	7	6	7	4	10
22-02	3	2	1	5	5	6	7	8	7	3	1	5
22-05	19	14	17	16	14	12	15	12	9	10	13	12
23-03	5	3	2	4	2	4	4	2	5	3	4	2
23-04	5	6	8	7	10	8	9	13	9	15	9	13
23-05	21	16	17	14	16	9	10	13	17	18	13	19
24-02	6	8	9	7	7	7	5	8	8	7	4	6
24-03	22	19	22	17	19	18	23	19	20	21	16	20
24-07	9	9	10	9	14	10	7	8	10	7	5	8
24-08	22	19	18	19	19	13	13	9	19	18	12	21
24-09	24	19	18	19	20	13	12	11	18	18	15	20
27-01	6	5	7	13	7	6	11	8	5	6	6	5
27-04	16	19	13	14	18	17	16	15	19	8	8	14
29-03	1	6	6	2	2	2	3	4	5	4	4	7
30-02	6	11	9	9	11	8	9	11	12	12	4	6
30-04	9	7	7	7	7	7	5	10	7	4	7	14
30-05	13	13	18	15	14	12	15	8	14	9	10	10
31-03	17	15	16	12	15	17	14	16	17	23	15	22
32-02	0	0	4	6	6	3	5	4	2	0	0	0
34-02	5	5	6	7	6	7	2	4	9	8	6	6
36-02	5	6	8	13	7	3	9	7	5	4	4	3