Changes in Intermodal Transportation in Washington and Impacts on Road Infrastructure

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Planning, Research and Public Transportation Division

in cooperation with the
United States Department of Transportation
Federal Highway Administration

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16. Abstract

This study evaluated the changes occurring in intermodal (piggyback) transportation and the impacts of these changes on the infrastructure system. Past and present structures of the intermodal system were documented both nationally and in the state of Washington. An on-site review of the remaining "hub" centers was conducted. It was found the impact of these changes is mixed. Traffic is up in some areas and down in the others. Ninety-two percent of the traffic is in western Washington but most of the infrastructural damage is at eastern or central Washington locations. Continued monitoring will be useful.

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CHANGES IN INTERMODAL TRANSPORTATION IN WASHINGTON AND IMPACTS ON ROAD INFRASTRUCTURE

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The contents of this report reflect the view of the authors who are responsible for the facts and the accuracy of the data presented therein. The contents do not necessarily reflect the official views or policies of the Washington State Department of Transportation or the Federal Highway Administration. This report does not constitute a standard specification or regulation.

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Summary

The intermodal transport industry is in a time of rapid change while learning to adapt to the deregulated business environment. New technologies such as double stack trains are being incorporated into the competitive environment. Washington is experiencing the effects of this revolution since Washington state shippers are heavy users of piggyback, Trailer on Flat Car (TOFC) or Container on Flat Car (COFC), services.

In an effort to improve their competitive cost position, railroads are reducing the number of locations where trucks with trailers or containers interface with the rail system. Nationwide, the number of intermodal loading facilities has been reduced from 2,500 to 400. In Washington, the number of locations has decreased from 22 to 8. The reduction of the number of intermodal ramps has concentrated traffic at those locations and may now or in the future cause congestion and the deterioration of the infrastructure at these points.

To assist state, county and local highway planners, an assessment of the impacts of these changes and an identification of the market and regulatory forces driving these changes was undertaken. A history of piggyback development was combined with an examination of a new technology, double stack trains, to evaluate the structure of intermodal transportation. The report then reviews the Union Pacific and Burlington Northern railroads intermodal operations, noting marketing differences between the two. Present and potential impacts to the infrastructure by ramp consolidations and other intermodal industry changes were identified.

It was found that the impact of these activities on the local infrastructure is mixed. Traffic is up at Pasco, Spokane, Seattle

International Gateway and the Port of Tacoma, but down at two high volume yards, the UP's Argo yard in Seattle and the BN's Puget Sound facility. Roughly 92 percent of piggyback activity is in western Washington.

Generally, movements associated with ship-truck-rail are traveling less miles in Washington over public roads. But, in eastern and central Washington over-the-road miles have increased due to ramp closures in Yakima and Kettle Falls. The competitive environment created by double stack trains may mean the least cost shipment from central Washington would be to truck to Seattle for double stack movements to midwestern and eastern destinations, further increasing road mileage.

Impacts due to consolidation of the "Hub" centers were found to be minimal, except for Spokane. This happened either because traffic was down, terminal operations had been reorganized or because street/road planners had worked with terminal planners early, making appropriate investment decisions. The existing impacts on roads are small but the continuing changes in railroad and trucking intermodal relationships do deserve continual monitoring.

Introduction

The transportation system in the United States is restructuring as it responds to regulatory reform and a changing of economy. The transportation infrastructure in the State of Washington is being directly impacted by these changes. One of the most rapidly changing areas of the transportation system is the rail intermodal system. Rail intermodal service is commonly referred to as piggyback service and consists of the movement of truck trailers (TOFC) or containers (COFC) on flatcars. Washington state shippers are heavy users of piggyback services. Seattle and Tacoma have active international ports with modern containership facilities that service the entire nation. They are interchange points for high volumes of containers between ships and rail or ships and truck. Key to the state's economy is the production and sales of wood products and fresh fruits and vegetables for the U.S. and export markets. The movement of these products to domestic and export markets is increasingly dependent upon piggyback. The volume of freight originating in Washington going by piggyback has risen from 8 percent of all general cargo in 1975 to 33 percent in 1984 (Tippetts et al., 1985). In addition, Washington State receives many consumer products and industrial goods via the intermodal network.

In an effort to trim costs, improve efficiency and achieve competitiveness with other modes, the railroads are reducing the number of locations where trucks with trailers or containers interface with the rail system. Nationwide the number of intermodal loading facilities has been reduced from 2,500 to 400 (Traffic World, 4/29/85). It is predicted that the number will be further reduced to about 300 ramps nationwide. While an exact count is not available, one source suggests

that in Washington State there were once 22 locations where trailers or containers were loaded on railroad flatcars (Piggyback Map, etc.); there are now eight (Stiles, 1986; Glaze, 1986). The reduction of the number of intermodal loading facilities means that in some areas of the state, trucks with trailers or containers are now traveling longer distances over state and local roads to deliver or pick up their loads from the railroads. The reduction of the number of intermodal ramps has concentrated traffic at those locations and may, now or in the future, cause congestion and the deterioration of the infrastructure at these points.[1]

These cost cutting and efficiency improving actions by the private transportation industry may be accruing public costs that have not been previously identified and included in public planning. It is important for highway planners to understand the changes happening to the intermodal system and the potential impacts to the highway system so that those changes can be incorporated into the highway planning process.

To assist state, county, and local highway planners, an assessment of the impacts of these changes and an identification of the market and regulatory forces driving these changes has been undertaken. Data were

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[1]The term "ramp" is a carryover from when trailers were driven onto flatcars using a ramp. Today in the state of Washington almost all trailers and containers are placed on flatcars with some type of crane or front loader (see Appendix). The Wenatchee intermodal facility is the only remaining facility where ramps are the only means of loading and unloading trailers.

developed through reviews of applicable literature, interviews with rail, port and various highway personnel, and on site visits to the eight intermodal locations within the State of Washington.[2] That study is the subject of this report.

The report first provides a brief history of the piggyback industry. The important deregulation decisions and legislative initiatives are noted and their importance as forces molding today's intermodal decisions are discussed. A detailed evaluation of a new technology (double stack container trains) which has, in the three years since its commercial introduction, had a significant impact on the piggyback picture is presented. The report then reviews piggyback operations in the State of Washington with the Union Pacific Railroad's and Burlington Northern Railroad's intermodal operations being detailed and marketing differences between the two noted. Present and potential impacts to the infrastructure by ramp consolidations and other intermodal industry changes are covered. Even though the openings of the rail intermodal yards at the Port of Tacoma were not part of the ramp consolidations of the railroads, they were included in this study because they play an important role in the impacts at other intermodal terminals in the western Washington area. Findings and future implications for Washington infrastructure conclude the report.

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[2]There are two separate rail intermodal facilities on Port of Tacoma property which are operated by the Port Authority. The connection with the railroads is offered by a port terminal railroad. The same public road system serves each.

Intermodal Background

The United States domestic rail/truck intermodal transportation system is in the midst of one of the most rapidly changing times in its history. The reduction of the number of loading/unloading facilities is an indication the railroads are trying to reduce their cost structure. While certain regulatory and market changes having a direct effect on today's piggyback service started as early as the late 1970's, it has only been since the early part of 1983 that major changes in the industry became widespread. It is still early in the deregulation period and the actions of the transportation industry in response to deregulation are still unfolding. It is therefore useful to look in detail at the regulatory and market changes taking place in order to place them in perspective, and develop a framework for analyzing future changes and their potential impact on the state's highway system.

History

Piggyback has shown significant growth since it's adoption in the 1950's. Regulatory restrictions limited its use until 1953 when the Interstate Commerce Commission (ICC) determined connecting routes and joint rates between railroads and motor carriers were permissible (Mahoney, 1985). Also contributing to the slow development of piggyback was the reluctance of the trucking industry and the railroads to cooperate with each other. Over the last 50 years, trucks have continued to take intercity freight shares and revenues from the railroads. The railroads' share of U.S. intercity traffic dropped from 80 percent in 1925 to 36 percent by 1979 (Wilner, 1985). During this period, truck share had risen to nearly 24 percent. The truckers were

taking the lucrative traffic and had captured 79 percent of the freight traffic revenues with only 11 percent of freight revenues going to the railroads (Wood and Johnson, 1980). Since its adoption, piggyback has been one of the few growth areas for railroads. Piggyback tonnage grew over 40 percent from 1969 to 1977 while at the same time overall rail tonnage dropped by 6 percent.

Even though it had significantly grown, by 1977 piggyback represented less than 1 percent of all intercity traffic, a performance considerably less than had been forecasted (Mahoney, 1985). There were several reasons piggyback did not live up to its forecasted potential but the one most often cited was the regulatory environment surrounding the railroads. Regulation had not eliminated competition, as is seen by the loss of freight to trucks, but it had made it extremely difficult for the railroads to respond to the competition.

Deregulation and Competition

Under the prevailing regulatory framework, it was difficult for the railroads to make timely adjustments in rates, service, or cost cutting measures. Almost all actions had to be approved by the ICC. In one celebrated case it took four years for the ICC to formally approve reduced rail rates (Wolfe, 1984). Railroads were forced to maintain service on unprofitable lines because it was a lengthy and costly procedure to initiate and achieve rail line abandonment. In addition, work rules affecting employee numbers and work practices were imposed by law and regulation. Further, railroads were reluctant to undertake lower rates to compete with trucks because, once instituted, ICC regulations made rate increases very difficult. The net result was an

industry with high costs, comparatively low productivity and the inability/unwillingness to lower rates or reduce costs in response to competition.

The continuing loss of railroad market share to trucks and barges, along with the bankruptcy of several major U.S. railroads, spurred rail deregulation efforts in the 1970's. Major regulatory relief came with the passage of the Railroad Revitalization and Regulatory Reform Act (4-R Act) in 1976. Provisions of the Act were further strengthened and other areas of railroad operation deregulated by the Staggers Rail Act in 1980. Piggyback traffic was one of the first areas in which the railroads used their new pricing and service freedoms to respond to the competition.

The first impact of deregulation on piggyback traffic came in 1979 when the ICC, using the regulatory reform powers granted them by the 4-R Act, completely deregulated the rail movement of fresh fruits and vegetables (FFV). The rail share of FFV movements increased quickly from 10 to 14 percent with most of the new rail movements going by piggyback as railroads adjusted their rates to meet the competition. The Staggers Rail Act of 1980 allowed the railroads substantial new freedoms in the areas of pricing, operations and service and, in March of 1981, the ICC completely deregulated all piggyback traffic (Anderson, 1981). Following this action piggyback traffic grew rapidly, setting total carload records in 1982, 1983, and 1984, even in the face of declines of other rail traffic during the 1982-1983 recession.

The railroads have used the new operating freedoms to significantly reduce their cost structure. Railroad operating expenses per ton mile have declined 22.6 percent in the post Staggers era (Traffic World,

1/27/86). Rates now more closely resemble costs and, according to the American Association of Railroads (AAR), shippers are paying $1.40 in real or constant dollars per ton mile compared to $1.69 at time of the Staggers Act passage (Traffic World, 1/27/86). The railroads appear to respond quickly to the competition and new attitudes on marketing and service are evident throughout the railroad industry. As stated by Flint in a Forbes (June, 1986) article, ". . . they (the railroads) all seem to think there's a world full of trucks to conquer out there, and they want to go for it" (pp. 86-90).

The trucking industry has not remained stagnate while the railroads were gearing up to meet their competition. The Motor Carrier Act of 1980 provided significant regulatory reforms for the trucking industry, especially easing entry. The number of regulated carriers jumped from 17,000 in 1980 to more than 30,000 by April in 1984 (Traffic World, 4/23/84). There has been increased use of 45 foot or longer trailers (from 22 percent to 42 percent from 1977 to 1982), increased fuel efficiency, reduced use of union labor (from 27 percent to 15 percent of labor force), reduced use of team drivers, and the increased leasing of owner-operator trucks (Wolfe, 1984). By 1984 motor carrier cost reductions had been on the order of 10 percent with an estimated potential of reduction of another 30 percent in their costs (Wolfe, 1984).

This continuing cost reduction competition and changing market structure generates potential for increased piggyback freight movement with increased truck traffic at the existing piggyback ramps; for this to happen, the railroads will have to continue to be aggressive in their cost cutting, service improvements, and marketing of their service. The

trucking industry may not allow them to take the traffic without a competitive response.

There is now an intense arena of competition for all kinds of freight. Even though piggyback loadings have continued to increase since deregulation, the railroads have not been able to capture any sizeable amount of United States intercity freight from motor carriers. Piggyback car loadings increased from 10 to 20 percent per year since 1981 and now represent 15 percent of all railcar loadings and are approaching 5 percent of all intercity freight traffic. But from 1975 to 1984 the railroads non-coal traffic grew by only 4 percent while truck traffic grew by 33 percent (Traffic World, 3/17/86).

It is argued the increases in piggyback carloadings, 2,538,318 trailer/container loadings in 1976 to 5,011,037 in 1986 (Traffic World, 1/26/87) have for the most part come from other rail traffic and increases in imports moving in containers. Rail boxcar loadings dropped 14 to 21 percent per year from 1980 through 1982 and at lower rates following that year. Imports increased significantly in the 1980's, fueled by the strong U.S. dollar, with container unloadings at U.S. ports showing a concomitant increase. Deregulation has allowed the railroads to reduce their cost structure and to set rates to meet the competition, but it does appear the full impact of changes already taken, such as ramp reductions, is yet to be felt within the industry and on the infrastructure serving the industry.

New Technology

A very recent development in the piggyback area (potentially the development that will create the largest change in TOFC/COFC) has been

the development of the double stack railcar and the ensuing double stack dedicated trains. A normal piggyback flatcar is 85 to 89 feet long and can carry the equivalent of two 40 or 45 foot long trailers or containers placed end to end and stacked one high. Most piggyback cars weigh nearly 72,000 pounds (Mahoney, 1985), although newer versions can weigh as little as 48,000 pounds (Gardner, 1986). The double stack platform, as its name implies, allows containers to be stacked two high on each platform. There are a number of configurations such as two 20 foot containers on the bottom and a 40, 45 or 48 foot container stacked on the top, or a 40 foot container on the bottom and the same top combination. Car design allows the lower container to sit in a "well" (see Appendix) and keeps overall height of a loaded double stack car less than 18 feet 9 inches above the rails. A double stack rail car has five 53 foot long platforms linked together as one articulated car, thereby reducing the length of a train needed to carry the equivalent number of containers/trailers carried on a piggyback train. Each double stack platform weighs about 32,000 pounds (Mahoney, 1985), and in addition to weighing less, the double stack configuration reduces the wind resistance of the train. Each five platform car uses six wheel trucks between them (Marine Digest, 1986). Five normal flatcars, carrying the equivalent number of containers, would have 10 wheel trucks. Double stack trains normally carry 200 to 280 containers per train. Since each stack car is made of five articulated platforms which total 240 feet in length, there is much less slack in a double stack train, leading to far less cargo damage when braking or accelerating. The increased damage claims against traditional piggyback over trucks has long been an area where trucks held a service/cost advantage over

piggyback. Cargo in piggyback trailers or containers requires extra bracing and packaging (Gustin, 1986), a cost which the new technology can minimize.

Double stack transit costs are estimated to be reduced 35 to 40 percent over traditional piggyback (Marine Digest, 1986). Overall, ramp to ramp costs are reduced 20 to 25 percent.

The stack train revolution has not been without debate. With its adoption has come another player and competitor in the domestic piggyback arena. The adoption of the double stack technology has progressed rapidly since 1984 and has been led, not by the railroads, but by the steamship lines operating containerized ships. The railroads were reluctant to invest in the new double stack cars as they already had over $3 billion invested in serviceable single stack COFC/TOFC equipment (Traffic World, 10/28/85). Even as stack train equipment was being ordered and placed into service by the steamship lines, railroad analysts and railroad carriers were debating whether stack trains were feasible.

Since their adoption, double stack trains have been heavily utilized to move international containers, originating in the Pacific Rim, through western ports to midwestern and eastern destinations. The service has grown rapidly from 1,024 platforms in existence at the end of 1984 to a projected 7,000 platforms by the end of 1986 (Marine Digest, 1986). The United States Department of Agriculture's Office of Transportation reported 59 double stack trains in regularly scheduled service in April, 1987. As of mid-1986, 6 percent of flatcar capacity was double stack cars and they generated 15 percent of the industry's flatcar mileage and moved as much as 50 percent of the industry's COFC

traffic. Seven steamship lines operate stack trains on regularly scheduled service (they own or lease the cars and contract with the railroads to provide the power and trackage) as do 12 rail carriers (four are western carriers). The BN and UP originate stack trains from Seattle. Sea Land originates trains from Tacoma through contracts with BN and the Port of Tacoma, American President Lines (APL) operates trains from Seattle with the UP providing power and trackage, and Maersk operates stack train service from Tacoma through contracts with the UP and the Port of Tacoma.

As of mid-1986 almost all of the containers moving on stack trains originating at west coast ports were carrying international cargo. But for every five international container loads going east there is only one international container load originating in the midwest or east moving back west (Traffic World, 10/7/85). The marine containers must be repositioned back at the west coast ports. American President Lines has attacked this problem by purchasing three freight forwarding firms in the east to actively pursue loads in the domestic freight market so their containers would not move westbound empty. APL has estimated that in 1986 it would move 400,000 containers with domestic freight, 25 percent of which will move on their stack trains (Intermodal Reporter, 5/26/86).

One indication that the American President Lines is not just in the domestic market to secure loads for their marine containers is they have purchased and placed into service 48 foot by 102 inch containers which match the cubic volume of the latest trailers being utilized by the trucking industry. These containers were manufactured for rail and truck service only as they have neither the strength required for marine

service nor other attributes necessary for container ship usage. APL has announced that by mid-1988 they plan to be fully competitive with trucks not only in cost, but in service and time as well, and hope to capture a larger share of domestic intercity freight moving by truck. In 1986 APL controlled 13 percent of all domestic intermodal freight (Intermodal Reporter, 5/26/86). The amount of freight APL has already attracted is an indication of the impact that a fully operational stack train network might have. Increasing amounts of freight will be drawn to double stack terminals. If costs continue to drop and rates accompany them downward, it may be possible to service larger and larger areas from each double stack terminal. The net result could be a further reduction of intermodal loading facilities and attendant potential impact on infrastructure serving the remaining ramps.

It is estimated that about 60 percent of midwest domestic freight now moves to the Seattle/Tacoma/Portland area in steamship containers returning to the Orient. Most moves are discounted about $300 below rail trailer rates (Traffic World, 12/22/86). The containerization of domestic freight to any degree is such a recent happening that there is still considerable debate as to how widespread it will be. One truck manufacturer has predicted that by the year 2000 there will be three intermodal rail corridors east-west, three or four north-south with hub to hub service only by unit intermodal trains and all feeder traffic up to 600 miles being by truck (Intermodal Reporter, 11/10/86). Such a service network could result in rail costs on the long haul low enough that trucks would be unable to compete. As a result, the same truck manufacturer will be introducing a downsized heavy duty tractor named

the "Hub", to be used specifically for the 200 to 600 mile hauls seen in the future for trucks servicing intermodal terminals.

Whether or not the above forecast is met, it is evident that the double stack technology is having an impact. The impact on intermodal rates started in mid-July of 1985 when the western railroads were forced to lower their rates on all TOFC/COFC traffic moving from Chicago to the west coast by $200 per trailer or container because of steamship double stack trains (Traffic World, 7/29/85). This discounting, which has increased to at least the $300 mentioned earlier, will have an impact on the piggyback/motor carrier mix as trucks have traditionally been able to compete with piggyback rates in part because they have been able to garner a larger backhaul percentage. To the extent loads are solicited away from long haul truckers, traffic at the intermodal terminals will increase as will the associated impacts on the infrastructure at those locations. Whether truckers will be able to meet these new rate reductions over the long haul has not been determined. What has been determined at this time is the changes are coming rapidly, impacts are being felt, and these impacts will likely be lasting.

Piggyback Terminal Operations in Washington State and Associated Infrastructure Impacts

In the competitive environment between trucks and rail, cost competition seems to be critical. Railroads have used the new freedoms under deregulation to reduce their costs through labor force reductions, service area reductions by line abandonments, and, as focused on in this section of the study, through reducing the number of piggyback terminals. Washington State has been impacted by these cost cutting

moves. As of January 1987, there are only eight piggyback terminals left in Washington State, three of which are new facilities built near or on port locations since 1981 to service the international container market. Thirteen ramps have been closed in Washington State during the past 10 years (Glaze, 1986; Stiles, 1986) (see Table 1).

Table 1.

Ramp Closures by the UP and BN-Washington State

Location	Railroad
Centralia	UP
Tacoma	UP
Ft. Lewis	UP
Kelso-Longview	UP
Pasco	UP
Yakima	UP
Spokane	UP
Bellingham	BN
Everett	BN
Tacoma	BN
Aberdeen	BN
Yakima	BN
Kettle Falls	BN

Source: Glaze, 1986 and Stiles, 1986.

Visits were made to each of the eight remaining piggyback locations (see Figure 1). Piggyback terminals are operated by the UP, the BN and the Port of Tacoma. Terminal and railroad personnel were interviewed to develop an understanding of the marketing philosophy of the railroads, determine the present and future traffic levels at those facilities and to assess the impacts of these traffic levels on the local infrastructure. Specific infrastructure needs were discussed with county and city highway personnel.

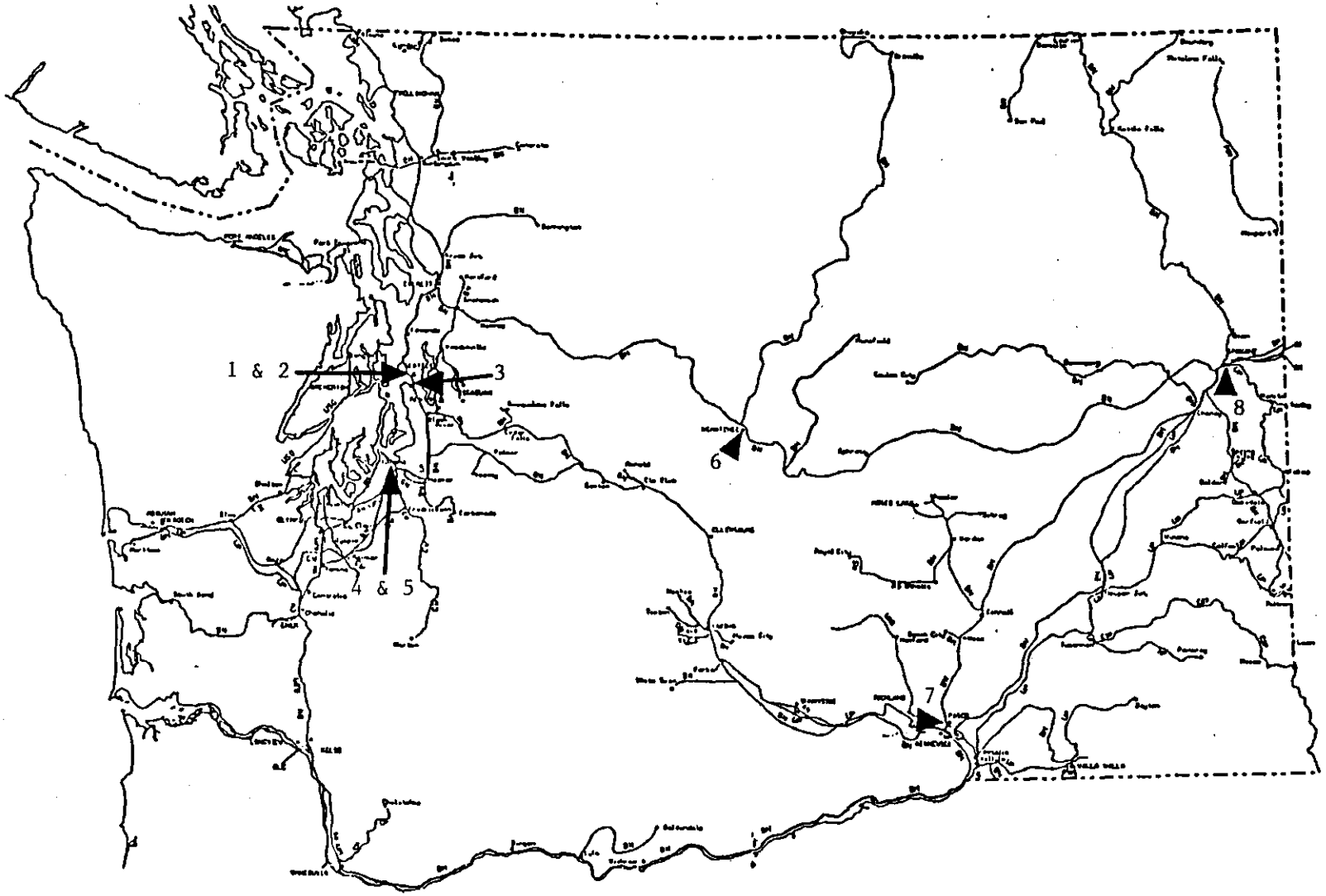

Figure 1. Rail Intermodal Yards - Washington State. 1 = Seattle International Gateway, BN; 2 = Argo Ramp Center, UP; 3 = Puget Sound Hub Center, BN; 4 & 5 = North and South Intermodal Yards, Port of Tacoma; 6 = Wenatchee Ramp, BN; 7 = Pasco Hub Center, BN; 8 = Spokane Hub Center, BN.

The Union Pacific Railroad (UP)

The UP has responded to competitive pressures by closing all of their piggyback loading facilities in the State of Washington except their Seattle "Argo Ramp Center."[3] The UP discovered that on their national rail system 20 ramps were doing more than 92 percent of their intermodal business. As a result, many of the UP ramps have been closed. In Washington State ramps were closed at Centralia, Tacoma, Ft. Lewis, Kelso-Longview, Pasco, Yakima and Spokane. In some cases, the UP picked up the excess drayage (short haul truck) costs to encourage shippers to continue to ship via the UP, and in other cases, lower rates were offered in an effort to offset drayage costs to and from the Seattle yard. In some cases, they simply let the business go. In terms of fresh fruit and vegetables (FFV) shipments out of central Washington, the UP is seeking ways (rate, volume discounts, etc.) to entice FFV and frozen food traffic back into boxcars, primarily out of their Hinkle, Oregon yard, rather than utilize piggyback, because of their large number of good refrigerated boxcars.

In the piggyback area they are concentrating on business between the western ports and Chicago, and from Chicago to Texas. The railroad is emphasizing door to door, personal contact, retail rather than wholesale piggyback service in the destination markets. Holding down operational costs has been identified as their key to a successful intermodal program.

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[3]The Union Pacific calls their piggyback facilities "Intermodal Ramp Centers." The Burlington Northern calls theirs "Intermodal Hub Centers."

The Union Pacific's Argo Ramp Center

The UP Argo intermodal ramp center is located in the Seattle Harbor area about two miles south of Harbor Island. It is the only UP ramp in Washington. Road access from Harbor Island and I-5 is entirely within Seattle city limits. The facility is a multipurpose rail yard handling domestic as well as international container freight, TOFC and boxcar traffic. A $4 million investment program is planned; boxcar tracks will be removed, piggyback tracks lengthened and truck processing facilities and trailer parking will be improved (see Appendix). These improvements will improve terminal efficiency which is a top priority for the Union Pacific in their intermodal operations. The fact the UP has chosen to concentrate their activity near the port is an indication of the importance they place on the international container traffic.

In 1984 there were 115,000 lifts (trailer or container loadings or unloadings) at the Argo yard. 1985 saw a reduction to 98,325 lifts. Most of this reduction was due to Sea Land moving its operations from Seattle to the Tacoma Port in May of that year. As part of that move, the UP lost the Sea Land contract to the BN who is now moving Sea Land double stack trains from Tacoma. 1986 lifts rebounded to 104,572, regaining 37 percent of the traffic lost when Sea Land moved to Tacoma. The UP operates two double stack trains outbound and inbound each week for the American President Lines as well as a double stack train for the Maersk Line from Tacoma. They operate one general commodity piggyback train a day outbound which splits in North Platte, Nebraska for service to Chicago and Kansas City. Two inbound TOFC/COFC trains a day with mixed domestic and international traffic are unloaded. On a recent APL

double stack train inbound at Seattle there were 245 containers, 42 or 18 percent of which carried domestic freight.

The Argo yard has room for parking 500 trailers but all terminal operators interviewed said efforts were being made to reduce the time a trailer spends at their yard. Most terminals will not accept a load without a billing. Yard operation is put out for bid and Union Pacific divisions as well as outside operators bid for the operation. The present operator is an outside firm. Loads are drayed in from as far away as Portland to the south with regular loads from the Kelso-Longview area. Paper and lumber products come from 200 plus miles away in Canada.

Infrastructure Impacts

The closing of Union Pacific ramps in Centralia, Kelso-Longview, Ft. Lewis, Yakima, Pasco and Spokane have reduced truck traffic at those ramp locations. The Centralia ramp was closed several years prior to the major consolidation of intermodal operations (Glaze, 1986) and the Spokane ramp was closed in December, 1984. The closure of the Kelso-Longview, Aberdeen, and Tacoma ramps has resulted in trailers/containers being drayed from those locations to the Seattle Argo yard. The number of loads from Kelso-Longview and Aberdeen was not available but yard personnel felt that 10 to 12 loads a day did come from Tacoma. The reduction of local impacts at the closed ramps has been somewhat offset by loads running over longer distances, albeit probably over roads with higher load design capacities.

Whether this has created increased impacts around the Argo facility is difficult to quantify. Traffic is down at the Argo yard due to Sea Land moving its operations to Tacoma. The magnitude of this loss is far

greater than the increases that have resulted from domestic traffic coming to the yard. This move has decreased rail intermodal related truck miles on public roads. Sea Land Seattle operations required that containers be trucked from dockside to the Argo yard over public roads a distance of about two miles. In Tacoma, the containers move several hundred yards on Port property and move only a very short distance on city streets. Streets in the vicinity of the Argo yard are designed to handle industrial level traffic and yard personnel had no congestion or road deterioration problems to report. Impacts to the road system from changes in UP intermodal operations are incremental in nature and not readily visible.

The Burlington Northern Railroad (BN)

The BN began reorganizing their intermodal operations in 1982. At that point they announced they were going to the hub center concept and would be closing a number of ramps systemwide. Within recent years, Washington State BN ramps have been closed in Bellingham, Everett, Tacoma, Aberdeen, Yakima, and Kettle Falls (Stiles, 1986). The BN has kept open four of their pre-1985 piggyback ramps, upgrading the facilities at South Seattle (Puget Sound Hub Center), Pasco (The Pasco Hub Center) and Spokane (The Spokane Hub Center) to mechanized "Hub

Centers."[4] The fourth ramp in Wenatchee is an older style non-mechanized ramp operated as an extension of the Spokane Hub Center. In 1985, the BN constructed an entirely new $10.5 million facility, the "Seattle International Gateway" (S.I.G.), within 300 yards of the Seattle Harbor containership facilities. This facility was built specifically to serve double stack trains.

The BN has a network of 22 Hub Centers across their national service area, each operated as an individual profit center. Eighteen of the 22 are managed by former trucking executives in line with the concept that the efficient operation of a hub center has more to do with efficient truck scheduling and processing than with train operations. The operation of the intermodal terminals is an area where the railroads believe they can make significant productivity gains and associated cost savings. The emphasis on marketing in the Burlington Northern system is on "wholesale" ramp to ramp service, although they do provide door to door service as well. They use third parties for the truck portion of the intermodal shipment and they concentrate on what they feel they do best, the long haul movement, thus, "wholesale" service.

They operate toward the goal of having at least 250 miles separating hub centers. Several of their Washington intermodal ramps

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[4]At mechanized ramps, which is all of the Washington ramps with the exception of the Burlington Northern ramp at Wenatchee, trailers or containers are positioned on the flatcars with a crane, a large front end loader called the backpacker, or other specialized equipment. At non-mechanized ramps, trailers are loaded and unloaded on flatcars by actually driving the trailers onto the flatcars via a ramp. The ramps can be either a portable "circus" ramp which is rolled to one end of the string of cars or a permanent ramp where a string of flatcars are backed to the ramp. Mechanized yards provide significantly greater speed in loading and unloading containers and trailers than non-mechanized yards.

violate that guideline. Pasco is approximately 230 miles from Seattle, but only 150 miles from Spokane. The Pasco center serves primarily perishables traffic originating within an 120 mile radius of the facility. Almost all of the Pasco outbound traffic is provided by one Plan 3 perishables shippers. Plan 3 shippers own or lease the trailers and are responsible for delivering them and picking them up from the intermodal terminals (Mahoney, 1985). The railroad furnishes the flatcar, performs ramping and deramping, and line haul transportation of trailers/containers. If Pasco was not available, shippers might use either long haul trucks, or the Hinkle, Oregon facility of the Union Pacific, rather than dray to the Spokane Burlington Northern Hub. The main shipper has significant volume, enough to warrant a strong negotiating position on Hub location. The Wenatchee ramp is 148 miles from Seattle (across the Cascade Mountains), 166 miles from Spokane, and 120 miles from Pasco. It remains open apparently because of negotiations with the high volume Plan 3 perishables shipper and because it is on the Burlington Northern mainline. Seattle and Spokane are 277 miles apart and meet the Burlington Northern criteria on distance. The two Seattle intermodal facilities, while only 12 miles apart, at present service two distinct markets with sufficient volume at each to support separate operations. Complete dedicated trains originate at each headed eastbound. The Burlington Northern also operates a daily priority train from the Port of Tacoma which is open to all shippers and serves primarily Port of Tacoma business.

Puget Sound Hub Center

The Puget Sound Hub Center is located adjacent to I-5 and just north of Tukwila in south Seattle. It was the primary intermodal

facility for the Burlington Northern in the Seattle area before the Seattle International Gateway was developed. It was designated as a "Hub Center" in April 1983 as the third of three trial hub centers in the Burlington Northern system. Prior to major changes in this hub's truck handling system in 1984, trucks would often be backed up on county roads for over a mile outside of the facility. In 1984, additional entrance and exit lanes were added, trailer parking was organized with incoming trailers in one area and outgoing in another, and billing and paper handling was reorganized. As a result, it was reported trucks are never backed up outside the entrance to the facility and there are seldom more than five trucks waiting to unload. These changes reduced labor charges by 35 percent. Waiting time has all but been eliminated. In addition, the reorganization of the terminal operation reduced the number of personnel needed to operate the facility. Loads are not accepted without billing to deter using the facility as a parking area for trailers.

Traffic has decreased at the facility with the opening of the new Seattle International Gateway facility which is 12 miles to the north and adjacent to the Seattle Port facilities. In 1984, there were 212,000 lifts and in 1985, 166,000. 1986 saw lifts continue to decline to 94,100. Projections call for lift growth of 3 to 4 percent per year. Only dedicated piggyback trains operate out of the facility. Eastbound traffic is 100 percent TOFC and westbound is 85 percent TOFC, 15 percent COFC. Almost all freight moving through the facility is domestic freight. Operation of the facility is by an outside contractor.

Seattle International Gateway

This $10.6 million 29 acre facility was opened July 1, 1985. The facility will handle double stack as well as conventional COFC traffic. It is located within 300 yards of the nearest Port of Seattle container facility and the most distant containership dock is 1-1/2 miles from the entrance to the Seattle International Gateway. All streets in the vicinity are maintained by the City of Seattle or are under City of Seattle jurisdiction. Seattle International Gateway dispatches six double stack trains a day to Chicago with an equal number westbound. Trains are running a 64 hour maximum schedule to Chicago. At present, 35 steamship lines call at the Port of Seattle and the BN is marketing space on their double stack trains to all of them. Thus far, very little outbound domestic freight comes through the terminal.

The terminal handled 5,030 lifts the first month in operation and had 138,116 lifts in 1986. The facility was designed as a high volume facility with containers being processed in the following manner. Identification numbers are read off the container with binoculars from the 'control tower' as the truck approaches the entrance inspection facility. The number is checked against computer records for destination and other shipping instructions. An inspector visually inspects the container and signals acceptance of the container. A dispatcher assigns the container to a train and instructions on where to drop the container are passed to the driver via speakers at cab height. A computer printout of the transaction is simultaneously generated at a computer terminal in a small building between the entrance lanes. The driver is handed the paperwork as the truck passes the building and the container is often delivered directly to the train where they are lifted

from the trailer chassis and placed directly on the double stack or conventional flatcar. Drivers never leave their trucks and often spend less than 10 minutes on Seattle International Gateway property delivering or picking up their loads. Terminal personnel estimated the terminal could handle 1,000 to 1,200 lifts per day. Gates are open from 8:00 A.M. to 5:30 P.M. daily. Operation of the terminal has been contracted out to a non-railroad private firm. In March of 1986, there were two Burlington Northern employees and 21 contract employees operating the ramp.

Pasco Hub Center

The Pasco ramp was designated as a "Hub Center" in the spring of 1985. It is located about 1.1 miles off of U.S. 395 on the northeast edge of Pasco. It is a mechanized facility, but since there is only one lift tractor called a "Packer" at the yard, a portable circus ramp is available in case the Packer breaks down. The Pasco facility is operated by an outside non-railroad private contractor. There are four Burlington Northern employees assigned to the Pasco terminal.

The Pasco ramp saw its traffic double when the Yakima ramp was closed in 1983. Lifts totalled 14,973 in 1985 and declined to 13,701 in 1986. Traffic peaks somewhat in the fall months but for the most part is spread fairly evenly throughout the year. Most freight is perishables handled by the previously mentioned Plan 3 shippers who were involved in negotiations to close the Yakima ramp.

The Burlington Northern pays for 75 percent of the drayage charges (a trucking subsidy) from Yakima to Pasco. Since there is a shortage of cars at the Pasco ramp, the BN now charges $150 to reposition a flatcar at Pasco. Daily service is provided as cars loaded at Pasco move to

Spokane on an intermodal train originating in Portland and are classified in Spokane to the appropriate dedicated piggyback trains for eastbound destinations.

Spokane Hub Center

The Spokane Hub Center was designated as a Hub Center on September 1, 1983. The Center is located east of the Spokane city limits in an area under Spokane County jurisdiction. The entrance to the center is off of North Dickey, a gravel road. In the latter part of 1985 and early 1986, about $1 million was invested in property, improvements, and lift equipment at the center.

Lifts at the facility have increased steadily since 1983.

Table 2

Lifts - Spokane Hub Center

Year	Total Lifts	Loaded Outbound
1983	19,166	13,000
1984	22,000	14,100
1985	23,000	20,000
1986	24,000	21,000

Source: Gustin, 1986.

Railroad personnel expect a 50 percent increase in lifts within five years. About 60 percent of outbound traffic is lumber products. Loads originate from as far as 400 miles away in Canada. The remaining traffic is less than truckload (LTL) with the primary shipper being United Parcel Service (UPS). UPS also accounts for about 75 percent of all inbound traffic. Targeted markets for growth include freight going

by long haul trucks and competitor railroads boxcar traffic as well as containerized agricultural products.

Spokane serves as a classification yard for intermodal trains. There are 16 dedicated intermodal trains a day passing through Spokane. Trains from Portland and Seattle are merged with cars from Pasco and Spokane for eastbound traffic, and westbound trains are split in Spokane for Portland-Pasco and Wenatchee-Seattle. No humping (practice of putting together trains where individual cars are pushed over a "hump" in the yard and the downward slope of the track is used as propulsion until the car connects up with the train) is used to classify intermodal trains anywhere in the BN system. This has reduced the jarring loads received and has reduced the damage claims for piggyback shipments. Seven of the 16 intermodal trains stop in Spokane. None of the double stack trains stop in Spokane. Loads for Spokane from Chicago or Minneapolis on the double stack trains continue to Seattle and are trucked back to Spokane. Several of the dedicated intermodal trains originate in Seattle with stops only in Spokane, Minneapolis, and Chicago. BN management of the Spokane Hub Center is responsible for oversight of the Wenatchee ramp and a ramp in Whitefish, Montana.

Wenatchee Ramp

The Wenatchee ramp is a non-mechanized ramp located just south of Wenatchee off of a paved county road on the west side of the Columbia River. The parking and work areas are unpaved. As stated above, the ramp is under the management of the Spokane Hub Center but is operated by an outside contractor. All loads are under contract to Plan 3 perishables shippers and are considered "time" sensitive because of their perishability. Loads originate primarily in the apple and pear

production areas from Wenatchee north to Oroville, a distance of 138 miles. Outbound loads fluctuate between 7,000 to 9,000 loads annually, depending upon fruit production and marketing. Traffic peaks in the early winter months at 32 to 34 loads outbound per day.

Loaded refrigerated trailers are dropped at the yard by over-the-road tractors, and are then backed onto flatcars with a special yard tractor called a hostler. The process is considerably slower than using a lift device such as the Packer (see Appendix). The Wenatchee yard has two permanent ramps and a portable circus ramp. A string of flatcars (up to five or six) are backed up to the permanent ramps and trailers are backed the full length of the string to begin the loading process. Plates attached at the end of the flatcars are lowered to allow movement between cars.

Infrastructure Impacts

There has been a reduction of local impacts at the closed Burlington Northern ramps in Bellingham, Everett, Tacoma, Aberdeen, Yakima, and Kettle Falls. These have been replaced by longer over the road trips to deliver trailers/containers to one of the five remaining Burlington Northern ramps. Pasco saw its volume of lifts double when the Yakima ramp was closed in 1983. Many of the 6,500-8,000 trailers in Pasco are now traveling an extra 90 road miles from Yakima, presumably on Interstate 82, 182, and U.S. 395. The associated road impacts are incremental and not highly visible. Impacts at the Pasco Hub Center are not presently significant. All trucks travel 1.1 miles of a rough, badly worn city road after leaving U.S. 395 to reach the ramp. The city road was built 40 years ago to standards far below those necessary to support heavy truck traffic. Major contributors to this road

deterioration include heavy gravel and asphalt trucks entering and leaving the intermodal facility. City highway personnel felt the increased traffic at the ramp had had minimal impact on the conditions of an already badly deteriorated road. Funds have been budgeted to reconstruct two miles of the road by 1987. Once this work is done, the highway personnel felt its load bearing capability would handle any increases in truck traffic at the ramp that might reasonably be expected (Wright, 1986).

The Spokane Center has experienced a steady increase in truck traffic since it was designated as a Hub Center in 1983. The closing of the Kettle Falls ramp has resulted in some increased traffic at Spokane. Much of the increase, though, has been the result of the BN aggressively marketing the services of the Hub Center. Trucks are traveling from as far away as 400 miles in Canada to deliver trailers. Increased business at the Spokane facility will most certainly be over highways feeding into Spokane. Highways most often travelled by trucks delivering loads to the center are U.S routes 2, 395, and 195.

Terminal personnel identified Baldwin Road and North Dickey Street as problems for the center. North Dickey is a gravel street with substantial potholes (see Appendix). Once the new entrance to the Hub is open, trucks will travel only a short block on North Dickey if they turn off Trent Road. It is a block on Baldwin to Fancher Way from the new Hub entrance. Work is needed on both Baldwin and North Dickey Streets, but the road condition problems existed in a similar magnitude before the area's designation as a Hub Center. If increased traffic projections are met, it was also felt that improvements at the

intersection of North Dickey and Trent Road would be required to relieve congestion there.

The opening of the new Seattle International Gateway has resulted in a decrease in miles travelled on public roads by international containers moving on the Burlington Northern. Previous to the opening, containers on chassis were trucked the 12 miles south from the Seattle Harbor to the Puget Sound Hub Center. Now they travel anywhere from 300 yards to 1-1/2 miles on city streets to Seattle International Gateway which is located next to the Harbor. The Seattle International Gateway has resulted in increased traffic on South Hanford Street where the entrance to the terminal is located. Traffic flows were studied and the entrance design was approved by the Seattle City Street Department before the terminal was allowed to open. If terminal operation is as efficient as planned, congestion problems at the facility should be minimal.

Lifts at the Puget Sound Hub Center are significantly lower since the opening of the Seattle International Gateway and introduction of daily intermodal service by the Burlington Northern Railroad from the Port of Tacoma. Containers previously trucked to the Puget Sound Hub Center from the Tacoma Port now move directly from that port by rail (see discussion below on the Port of Tacoma). Congestion at the terminal has been reduced significantly with the expansion of the entrance area and reorganization of entry and yard operation procedures. No longer do trucks back up outside of terminal grounds up to a mile waiting to drop off or pick up trailers as had once been part of accepted terminal operation. Terminal personnel felt that local roads would be able to handle projected traffic increases in the foreseeable

future. The opening of new intermodal rail terminals at the Seattle and Tacoma Ports have significantly reduced local impacts at this Center.

The Port of Tacoma

The Port of Tacoma has two intermodal rail yards on Port land. One was constructed and contracted for use by Sea Land. The other is a more general facility used by several ship lines. Road access is via I-5, with the Port of Tacoma Exit No. 136 providing the closest access, about one mile from the containership facilities. The two intermodal yards are served by a Port Terminal Railroad which connects to both the UP and BN railroads. The Port operates both yards. The initial yard, the North Intermodal Yard built in 1981, is unique among west coast facilities since it is an on-dock facility that allows containers to be taken from shipside by special straddle carriers and placed directly on railcars. At other port facilities, containers are first placed upon a trailer chassis, pulled by a tractor to the rail yard, and then lifted onto the railcars (hostler-chassis method).

The South Intermodal Yard, placed in service in 1985, primarily serves Sea Land which moved its container operations to the Tacoma Port from Seattle. Straddle carriers cannot be used because of vertical bridge clearances at the South Yard and Sea Land has union contracts requiring hostler-chassis operations. The Maersk Line also started container operations at Tacoma in 1985 and plans to move 50,000 to 60,000 containers through Tacoma in its first year of operation. The UP provides power and trackage for the Maersk double stack train and the BN

does the same for Sea Land as well as offering a daily priority piggyback train which is available to all shippers.

Container cargo handled at the Port (including Alaska shipments) has increased rapidly since 1984 (see Table 3).

Table 3

Port of Tacoma

Year	TEU (20' container equivalents)
1984	150,000
1985	505,000
1986	666,155

Source: Flood, 1986, 1987.

Future growth in 1987 and 1988 is estimated to be about 5 percent per year. In 1986, 139,000 containers (primarily 40 foot containers) moved through the rail intermodal yards. The remaining containers were either trucked to destinations, transloaded to domestic trailers for direct truck delivery and TOFC, or transloaded to ships for Alaska. Prior to 1984, most containers (including some transloading to domestic containers or trailers) were either moved to destination by truck, trucked to Seattle for rail movement, or transloaded to other ships for the Alaska trade. Some use of the on-dock rail facility was made by steamship lines and a few containers were drayed to the small Tacoma UP ramp which was closed in 1984. The BN Tacoma ramp was closed sometime in the mid-1970's.

The move of Sea Land from Seattle to Tacoma with its container operations has created shifts in traffic from Seattle to Tacoma. As has been identified earlier, this resulted in decreased traffic on public

roads for the rail-ship portion of Sea Land traffic. The increased volume of container traffic generally at the Tacoma Port has made it possible for the BN to offer a daily priority train from Tacoma. This has resulted in a reduction of containers being trucked to Seattle rail terminals from the Tacoma Port. City and county highway planners have worked closely with the Port of Tacoma in planning for these changes. By 1990 all north-south roads in the Port area will be brought up to load bearing capacity to handle the increased traffic levels (Price, 1987). The roads servicing the container operations have all been reconstructed to appropriate standards with the Port helping to finance several of the road projects. There were no reports of serious congestion from I-5 interchange 136 through to the container terminal. No attempt was made as part of this study to address the truck traffic increases generally that have resulted from the increased operations at the Port. The Puget Sound Council of Governments presently has a study in progress on truck traffic in the Port area.

Summary

The intermodal transport industry is in a time of rapid change. New technologies such as double stack trains, computerized terminals, and new lift devices are being placed into service. Steamship companies have entered the domestic transport market and are establishing transportation networks utilizing the double stack train technology that compete with both the trucking industry and the railroads. All transportation modes are still learning to adapt to the deregulated business environment of the 1980's. Firms are adjusting to competitive

forces that change almost daily. In short, the intermodal industry is changing more rapidly than at almost any other time in its history.

Washington is experiencing the effects of this revolution. Thirteen intermodal ramps have been closed, primarily in less urbanized areas. Three new intermodal rail yards have been built since 1981, and several million dollars have been invested in four others.

The impact of these activities on the local infrastructure is mixed. Traffic is up at Pasco, Spokane, Seattle International Gateway and the Port of Tacoma, but down at two high volume yards, the UP's Argo yard and the BN's Puget Sound facility (Table 4). As Table 5 shows, roughly 91 percent of piggyback activity is concentrated in western Washington.

Table 4

Piggyback Lifts - Washington State

Hub/Ramp	Location	Operator	1984	1985	1986	Percent 1986 Total
Pasco	Cent. Wa.	BN	14,500*	14,973	13,701	2.6
Wenatchee	Cent. Wa.	BN	9,000*	9,000*	9,000*	1.8
Spokane	East. Wa.	BN	22,000	23,000	24,000	4.6
Argo	West. Wa.	UP	115,000	98,325	104,572	20.0
Puget Sound	West. Wa.	BN	212,000	166,000	94,100	18.0
S.I.G.	West. Wa.	BN	0	42,000	138,116	26.4
Port of Tacoma (2 ramps)	West. Wa.	Port of Tacoma	N/A	N/A	139,000	26.6
Total					522,489	100.0

* = estimated lifts.
Source: Interviews with BN, UP and Port of Tacoma personnel.

Table 5

Piggyback Lifts by Region - Washington State

Region	1986 Lifts	Percent Total
Eastern Wash.	24,000	4.6
Central Wash.	22,701*	4.3
Western Wash.	475,788	91.1
All	522,489	100.0

* = estimated lifts.
Source: Interviews with BN, UP and Port of Tacoma personnel.

Because of the construction of the new intermodal rail yards and the domination of the intermodal traffic by the international container market, fewer piggyback trailers/containers are moving over public roads in Washington State today than were doing so in 1984. While an exact number is impossible to obtain, significantly fewer miles over public roads are being travelled by piggyback trailers/containers in 1986 than in 1984 in the Seattle-Tacoma area because of the opening of piggyback service at the Port of Tacoma and the opening of the Seattle International Gateway. This is not to suggest that other port related activities such as direct truck delivery of containers from the ports may be causing more highway mileage by truck, or that truck traffic in general may or may not be up, but only that those movements associated with ship-truck-rail intermodal are traveling less miles in Washington state over public roads because of the changes outlined above. This segment of the intermodal market is large enough in comparison to other traffic changes in piggyback transportation that it is not unreasonable to expect that overall trailer/container public road miles are down in western Washington. Improved service and closure of ramps in Aberdeen,

Kelso-Longview, Bellingham, Everett, Ft. Lewis and Tacoma is causing trailers/containers to be trucked longer distances from those locations. Yet, the number of loads is small by comparison and any increased wear on the road system is incremental and not readily visible nor segmentable.

In eastern and central Washington, over the road miles have increased due to ramp closures in Yakima and Kettle Falls. If as indicated, Pasco lifts doubled with the closing of the Yakima ramp, 6,850 of the 13,701 1986 lifts normally would have used the Yakima ramp. While some of those loads might originate at packing plants between Pasco and Yakima, the concentration of plants in the Yakima area makes it a reasonable assumption that many of those 6,850 trailers travel at least one way between Yakima and Pasco, a distance of approximately 92 miles. The two cities are connected by I-82 and I-182 and, given the very rural nature of the area, it is difficult to imagine that 6,000-8,000 additional trucks annually will congest or stress that system. Those additional trips will, though, incrementally shorten the life of that system although such impacts are not readily visible.

Given the uncertainty of the overall impact of the double stack phenomenon, it is possible to imagine a scenario in which the Pasco ramp might be closed altogether. There were reports in the popular press as this report was being written that the rates on westbound double stack trains had been lowered enough that westbound TOFC and long haul truck loads were being drawn to double stack trains. These loads have been an integral part of the eastbound perishables roundtrip traffic, perishables east and dry freight west. Eastbound TOFC rates were reported to have been increased as a result (The Packer, 1987). Today,

truck or piggyback fresh fruits and vegetables are almost entirely shipped by refrigerated trailer rather than by container. Freight must be containerized to move on double stack trains. The technology for moving refrigerated containers by double stack cars has not yet been perfected, but work is being done on this problem. The perishables industry is discussing the feasibility of using refrigerated containers. Thus, it is entirely plausible that the competitive environment created by the double stack trains, and their need for high volumes to be profitable, might change the economics of long haul shipments enough that the least cost shipment of perishables from central Washington would be to truck to Seattle for double stack train movements to midwestern and eastern destinations, e.g., go West in order to go East. No one in the industry has yet suggested that perishables will move regularly by double stack, but there is a great deal of uncertainty as to which way transport of perishables is headed.

Potential movements are further affected by the fact that the Union Pacific has expressed, as part of their marketing plans, efforts to draw perishables freight into their refrigerated boxcar fleet. If successful, truck mileages would be reduced as boxcars can be loaded at packing plants. With the truckers' backhaul freight being drawn to double stack, their rates are likely to increase on the perishables movements. Boxcar rates on a per pound basis have traditionally been lower than either truck or TOFC, but service attributes of TOFC and truck were enough better to warrant the higher costs of shipping in those modes. If the rate differences increase and service differences decrease, refrigerated boxcars might increase their segment of the market.

It is important to remember that the double stack train has really only been in operation three years. It has complicated the competitive mix and has made forecasting the next stable structure of the industry an extremely difficult task at this time. There is little consensus in the industry as to where things will finally settle out. It can be expected, though, that any major changes would more likely result in additional closings of the low volume ramps rather than there being significant increases in traffic at those ramps. The impacts of any future ramp closures would primarily fall on the interstate system as loads are trucked longer distances.

Impacts due to the consolidation of "Hub" or "Ramp" centers were found to be minimal either because traffic was down, terminal operations had been reorganized, or because street/road planners had worked with terminal planners and investment has been made or is planned in the road system at the facilities. The exception to this is the Spokane Hub where road repairs have been needed for some time. At the port areas, it is impossible to segregate impacts of the railroads consolidation of ramps from the increase in container traffic being experienced.

The international economy and trade will continue to strongly influence Washington's intermodal framework. If the double stack system continues to lower costs and rates, it can be expected a larger share of domestic intercity freight will move by piggyback even as truck operators push for larger legal loads, higher speed limits, and adopt other productivity increasing technology.

A clear outcome cannot be identified at this time. The forces influencing changes in the industry have been identified and in order for highway planners to adapt to those changes, it is important the

traffic levels at the existing piggyback ramps be monitored. Ramp managers will be the appropriate source of traffic information while Seattle and Tacoma Port personnel can provide additional information on the important international container traffic. Periodic calls can identify trends and physical infrastructure needs. The existing impacts on roads are small at this time but the continuing dynamic changes in railroad and trucking intermodal relationships do deserve continual monitoring.

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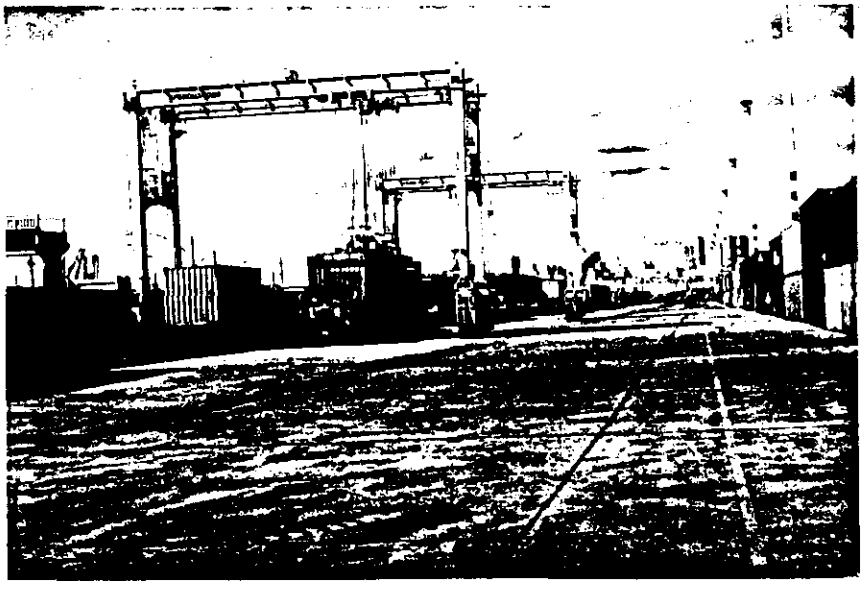
Appendix

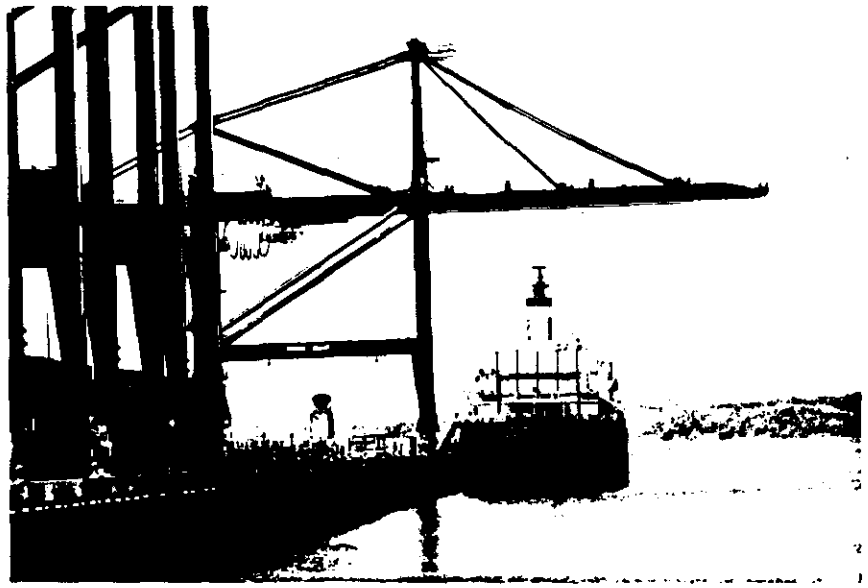
1. Entrance (on left) to Seattle International Gateway from South Hanford Street. (BN)

2. Entrance lanes with speaker/microphones at the Seattle International Gateway. (BN)

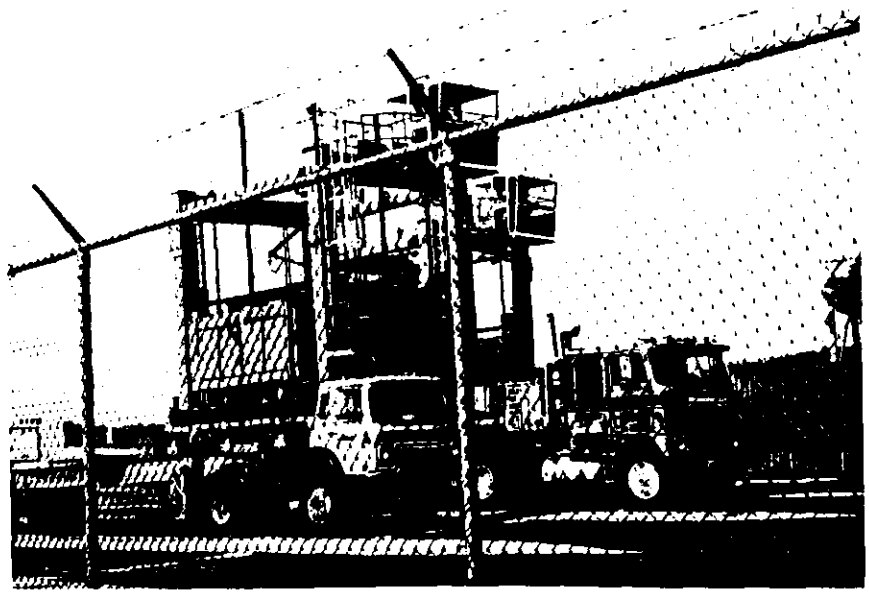
3. Control center with computer showing entering truck at speaker/microphones. [S.I.G. (BN)]



4. Large straddle crane lifting container from chassis to railcar. [S.I.G. (BN)]

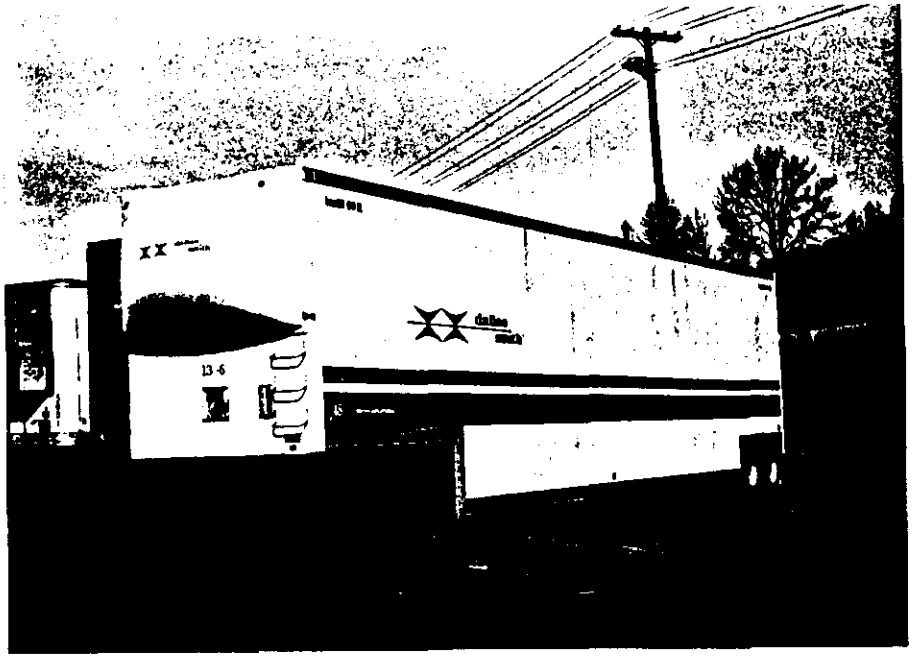


5. Sea Land container ship unloading at Port of Tacoma.

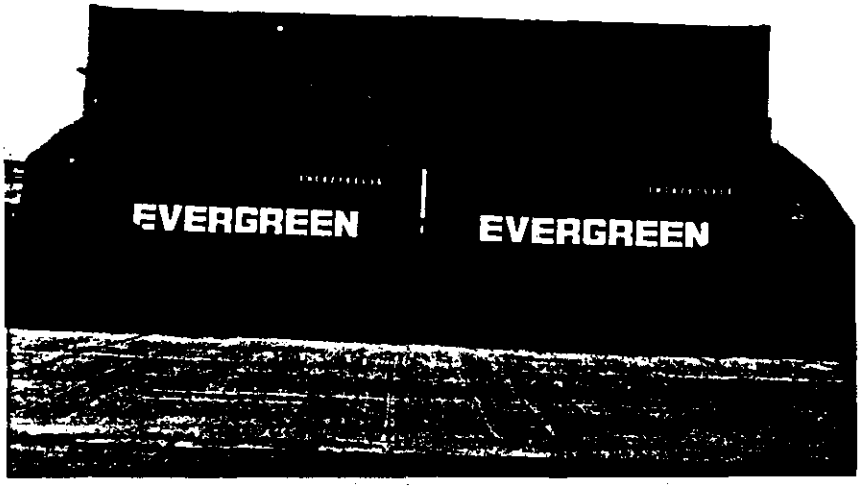


6. Straddle carrier at North Intermodal Yard. [Port of Tacoma]

7. Sea Land double stack train being loaded at Port of Tacoma South Intermodal Yard.



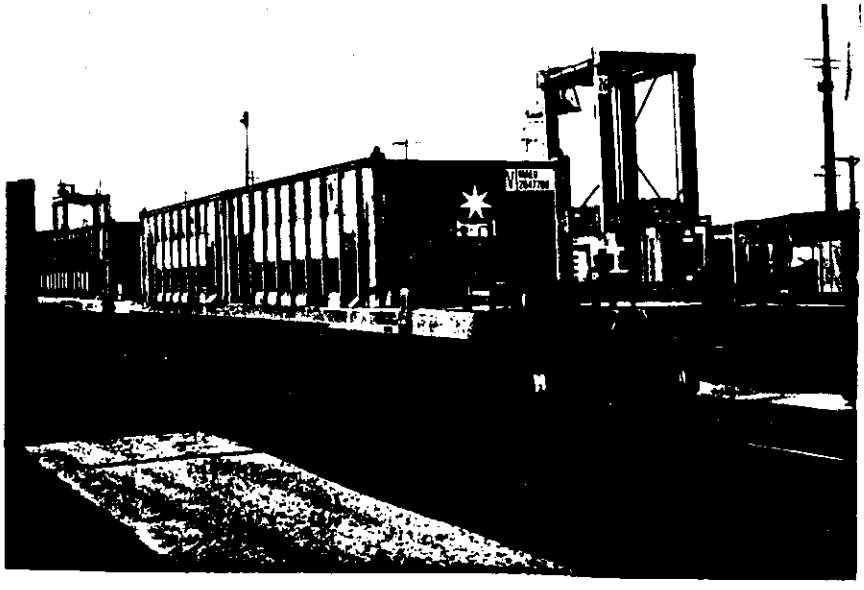
8. Dallas Smith car carrier. New van used to deliver new cars via TOFC. Part of new technology being employed in intermodal area. [Puget Sound Hub Center (BN)]



9. Gunderson double stack platform loaded with two 20 foot containers and one 40 foot container. Five articulated platforms make one double stack railcar. [S.I.G. (BN)]

10. "Well" of one platform of Gunderson double stack railcar. [S.I.G. (BN)]

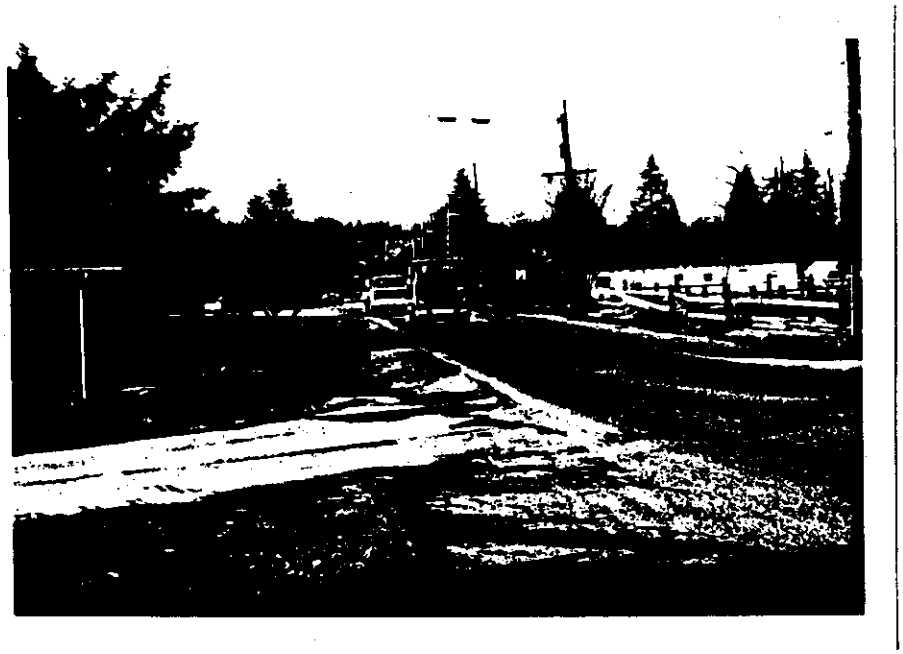
11. Double stack railcar at Burlington Northern Seattle International Gateway. (BN)



12. Articulated double stack platform, one of five in a double stack railcar, with two 20 foot containers in "well." [Port of Tacoma, North Yard]

13. Entrance to Puget Sound Hub Center. (BN)

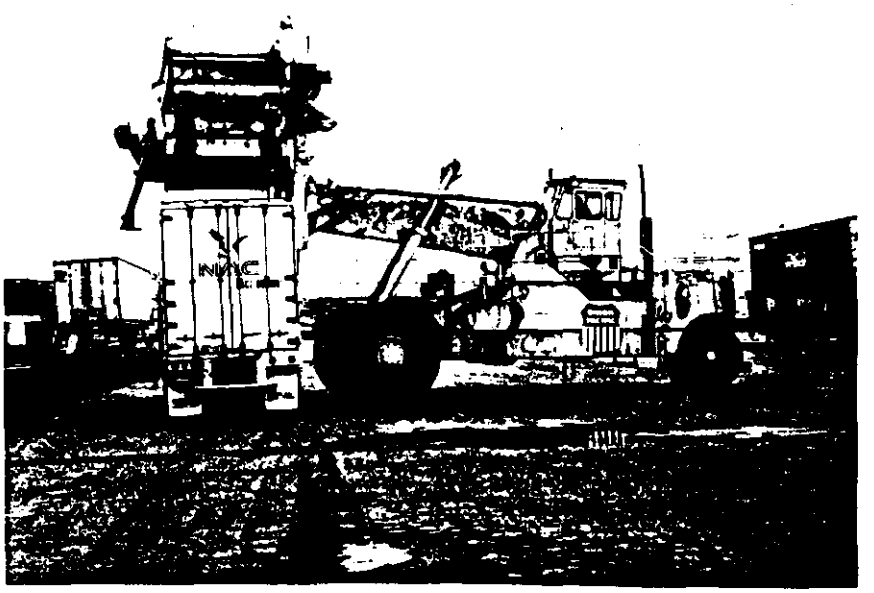
14. Entrance lanes and processing center, Puget Sound Hub Center. (BN)



15. Access road within one-quarter mile of entrance to Puget Sound Hub Center. (BN)

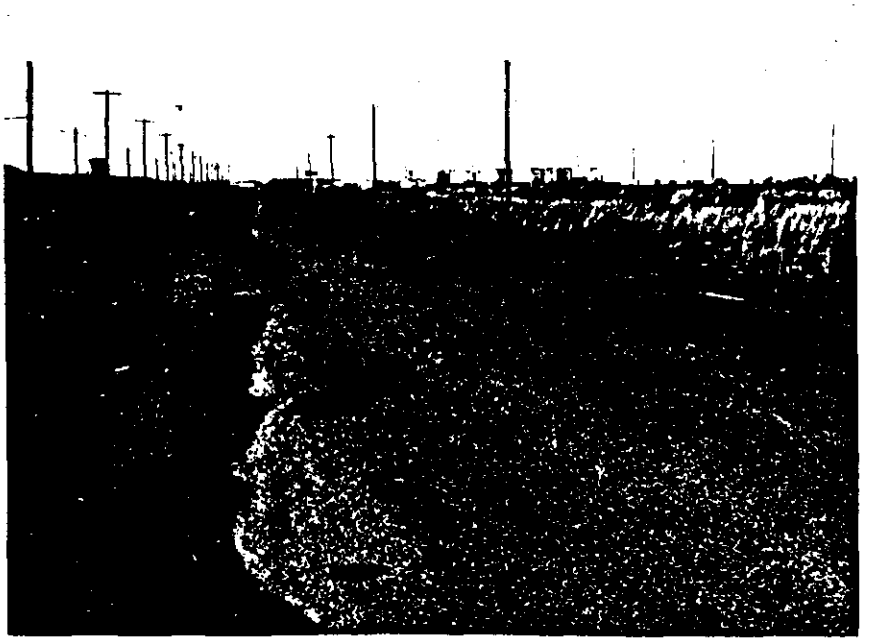
16. TOFC flatcar with "fifth wheel" in place. [Puget Sound Hub Center (BN)]

17. Entrance and processing center, Argo Ramp Center. (UP)



18. Front end "Packer" preparing to lift trailer onto flatcar. [Argo Ramp Center (UP)]

19. Packer placing trailer on flatcar. [Puget Sound Hub Center (BN)]

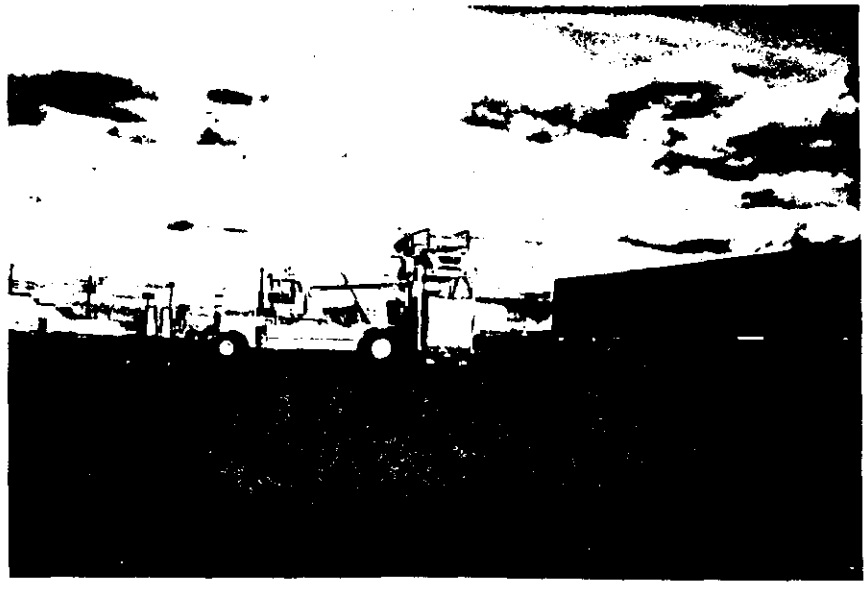


20. Access road to Pasco Hub Center. This road was reconstructed, Summer 1986.

21. Baldwin Road, between North Dickey Street and Fancher Way. [Spokane Hub Center (BN)]

22. North Dickey Street from old entrance of Spokane Hub Center, looking past new entrance. (BN)

23. Road condition at corner of Baldwin Road and North Dickey Street within 100 feet of new entrance to Spokane Hub Center. (BN)

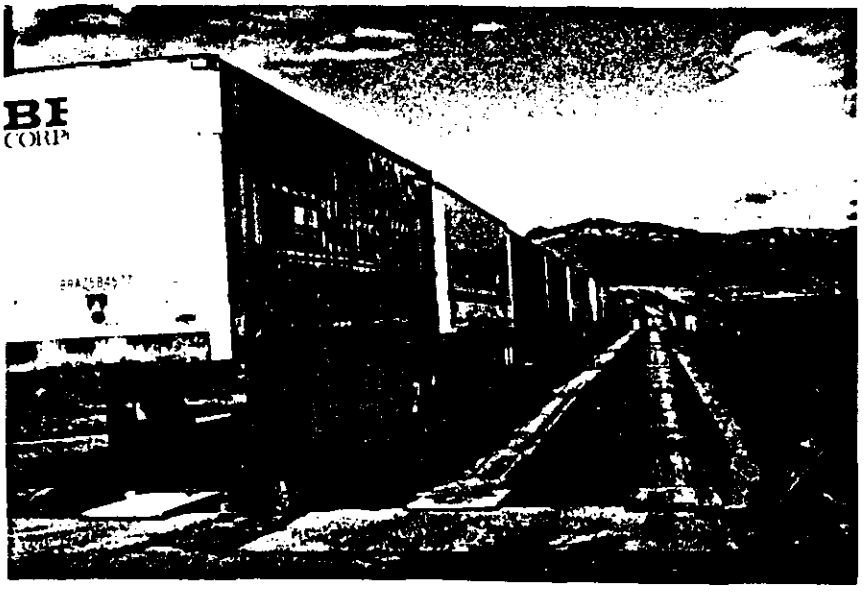


24. Packer preparing to lift trailer onto rail flatcar. [Spokane Hub Center (BN)]

25. Access road to Wenatchee ramp looking north past ramp entrance. (BN)

26. Entrance road to Wenatchee ramp. (BN)

27. Circus ramp with "hostler" and trailer being unloaded at the Wenatchee ramp. (BN)



28. Two strings of flatcars, one loaded with trailers and the other empty, at the permanent ramps of the Wenatchee Intermodal Yard. (BN)