# 3.0 National Economic Development Analysis

## 3.1 Power System Impacts

## 3.2 Recreation

## 3.3 Transportation

The four alternatives being evaluated in this Feasibility Study/EIS are the existing conditions, existing conditions with maximum transport, major system improvements, and dam breaching or drawdown. There would be no change to existing navigation facilities on the lower Snake River under the first three alternatives. Commercial navigation on the lower Snake River would, however, no longer be possible under the drawdown alternative. The following sections present a summary of the effects of drawdown on the transport of commodities that are now shipped from ports on the Snake River. The base case condition for the analysis that is summarized in this section of the report is the continued operation of the Snake River portion of the CSRS. Due to the limited amount of space available to present the summary, the focus of the summary is on methodology, transportation system costs with and without drawdown, including infrastructure requirements, and uncertainties surrounding the analysis. Details of the analysis are contained in the full-length report developed as part of this feasibility study (DREW Transportation System Impacts Analysis Report, 1999).

### 3.3.1 Methodology

The methodological approach and analysis of commodity transportation costs is based in part upon analytical techniques that were employed in System Operation Review studies (SOR) performed during 1992-93. That interagency study evaluated a variety of alternative system operating scenarios for the Columbia-Snake River system (CSRS) and quantified the economic effects of each scenario applying national economic development (NED) criteria. The evaluation of drawdown of the lower Snake River reservoirs and the resulting economic effects on the existing transportation system contained herein utilizes the same general approach as the SOR and builds upon the methodology and data developed for that study. In addition to the analysis of transportation system costs, a cursory assessment of potential impacts on the cruise-ship industry was also conducted. This assessment was limited to a review of current levels of activity and potential impacts of drawdown on future activity.

Direct economic costs resulting from breaching the four lower Snake River federal dams are measured and expressed as changes in the national economic development account (NED). NED costs represent the opportunity costs of resource use, measured from a national rather than a regional perspective. In the case of drawdown, the change in the cost of transporting products and commodities now shipped from ports on the Snake River are an NED cost, but the loss of revenue and profit by barge companies is not. Thus, in the NED analysis only the costs of resources actually used are included. Although market prices often reflect total opportunity cost of resources, this is not always the case and surrogate costs must sometimes be used to adjust or replace market prices (or published or contract rates). In this study, for example, it was necessary to use modal costs computed through analysis of the actual fixed and variable costs of each transportation mode—barge, rail and truck.

Transportation system impacts with drawdown were estimated using a transportation system model that was designed specifically to track and estimate the cost of transporting commodities that now move on the Snake River. Modeling information requirements and assumptions are summarized in the following section.

#### 3.3.1.1 Modeling Requirements

Measurement of direct economic effects required the assessment of permanent drawdown on commercial navigation activity, including the consideration of alternative shipping modes and costs, and determination of the most probable combination of storage, handling, and transport modes that would emerge in response to curtailment of waterborne transport. Specific information requirements of the analysis included the following: (1) establishment of base and projected future commodity shipments; (2) identification of commodity origins and destinations with and without drawdown; (3) estimation of modal costs and storage and handling costs at throughput facilities; (4) assessment of regional rail and truck capacity; and, (5) assessment of a variety of other elements that characterize the regional transportation system. A synopsis of how these data were derived and a description of the procedures and assumptions applied in the evaluation process are presented in the following paragraphs.

### *Base and Projected Future Commodity Shipments*

Projections of future commodity shipments were developed through analysis of waterborne commerce data for the Columbia-Snake River System for the decades of the 1980s and 1990s. The analysis included assessments of exports, the volume of shipments on the Snake River, and the types of commodities shipped. Forecasts of future shipments were developed for each of eight commodity groups and later combined into five groups for the analysis of transportation system costs.

### *Commodity Origins and Destinations*

The study area considered in the study encompasses grain producing areas as well as origins and destinations for non-grain commodity groups that utilize the CSRS. Origins of grain transported by barge on the lower Snake River were derived from previous studies conducted in 1992 for the SOR. The origins include areas within northeastern Oregon, eastern Washington, Idaho, Montana and North Dakota. Origins or destinations for non-grain commodity groups in the lower Snake River region (such as petroleum or fertilizers) also generally fall within the sizeable area that comprises the hinterland for barged grain. The origins of all non-grain shipments were taken directly from the data developed for the SOR. Origins of grain were updated for this study. However, due to the relative insignificance of the non-grain commodity groups to the overall volume of Snake River shipments, origins of these commodities were not updated.

### *Commodity Growth Forecasts*

The basis for commodity growth forecasts is the volume of grain and non-grain shipments that originate from the Snake River above Ice Harbor Dam. Thus the forecasts developed for the analysis are limited to the volume of shipments on just the Snake River, rather than the combined CSRS. The actual forecasts, however, were derived from forecasts developed by the Portland District for the Columbia River Channel Deepening Feasibility Study, in conjunction with analysis of historical data and anticipated trends in the volume of relevant commodities now moving on the Snake River. Using data developed for that study, waterborne traffic forecasts were developed for the 1997 to 2017 period for the Snake River segment of the CSRS. Projections for this 20-year period were made at five-year intervals for the various commodity groups. Due to the degree of uncertainty inherent in long range forecasting, projected volumes were assumed to remain level beyond 2017.

### *Transportation System Cost Estimating Procedures*

A Microsoft ACCESS database was developed to estimate transportation-related costs associated with the base condition and the drawdown scenario. The database was used to quantify the costs (transportation, storage and handling) of shipping commodities under existing conditions and in the absence of commercial navigation on the lower Snake segment (drawdown). The results of these two analyses were then compared to determine the effect that river closure would have on transportation system costs. This comparison is simply the difference between transportation costs with drawdown versus transportation costs without drawdown.

The model is not an optimization model. It is simply a database of existing routings (base case) and alternative routings (with drawdown case) of grain and non-grain commodity movements from origins to destinations. In the base case existing routings are used and in the with drawdown case, most likely alternative routings are used. With drawdown, at least two routings for commodities from each origin are included in the database and the model is designed to select the least cost routing. Storage and handling costs are associated with routing alternatives, with these costs being added to the transportation cost to determine the total cost associated with each routing. The model accumulates transportation, storage, handling and total costs for the least-cost routings and compiles summary reports on movements and costs by state, county or region and mode of transportation. In addition, miles (bushel-miles for grain) and ton-miles for non-grain) are similarly compiled and reported.

***Modal Cost Estimating Procedures***

Modal costs for barge, rail and truck were developed using transportation analysis models (TAMs) for each mode. The models used were developed and copyrighted by Reebie Associates, Transportation Management Consultants. The specific models used are briefly described as follows:

- **Barge Cost Analysis Model (BCAM).** The BCAM is designed to facilitate the analysis of barge-load shipments on the nation's inland waterways. The design concept involves bringing data about the river systems, locks and dams, barges, towboats, and commodities to the processing capabilities of the personal microcomputer. All of the inland waterways on which commercial barge-load shipments are made are built into the model. This includes the Mississippi River System, in the central part of the country and the Columbia/Snake River System in the Pacific Northwest. In running the model, the user specifies shipment characteristics; cost factors; operating factors; and, routing.
- **Rail Cost Analysis Model (RCAM).** The RCAM is an enhanced personal computer application of the Interstate Commerce Commission's Uniform Rail Costing System (URCS) methodology. URCS was adopted by the ICC as a General Purpose Costing System for all regulatory costing purposes in Ex Parte 431, 1989. The URCS itself is a complex set of procedures that transforms annually reported railroad expense and activity data into estimates of the costs of providing specific services. It is based an analysis of cause and effect relationships between the production of railroad output ("service units" such as car miles or gross ton miles) and the incurrence of expenses as defined within the accounting system. These relationships define a series of "unit costs" (e.g. crew costs per train mile) that are applied to the service units generated by a shipment to produce the estimated cost of providing the service.
- **Truck Cost Analysis Model (TCAM).** The TCAM provides the ability to determine the underlying cost and revenue requirements for truck shipments. The TCAM data input process is divided into three sections: primary shipment specifications (11 variables); driver and utilization factors (10 variables); and, detailed costing factors (25 variables). Default values are built into the model for all input variables.

### 3.3.1.2 Modeling Assumptions

***Grain Storage and Handling Costs and Assumptions***

Storage costs are a function of two factors, the duration of storage and the monthly cost of storage. The duration of storage is a function of the relationship between harvest and demand. Thus, the duration of storage in the model is the same with and without drawdown. Differences in costs between the two cases are due to the difference in the cost of storage at the various types of elevators. Elevator storage costs at country and river elevators were reviewed for this study. The review revealed that monthly storage costs at country elevators are about $0.006 per bushel higher than storage costs at river elevators. Thus, the difference in storage cost is due to use of country elevator storage with drawdown, rather than the cheaper river elevator storage. Storage costs are incurred at each elevator type, except export terminals. A cost for on-farm storage is not estimated on the basis that it would remain the same with and without drawdown.

Handling costs are a function of the number of times grain is required to transfer to a different mode of transportation or to go into or out of storage. The types of movements included in the model are as follows:

- **Base Case:**
  - Farm-to-River-to-Export Terminal
  - Farm-to-Country Elevator-to-River-to-Export Terminal

  Note: The model does not include any farm-to-rail-to-river movements, even though these types of movements have been reported for ports in the Lewiston area and the Port of Wallula.
- **With Drawdown:**
- Farm-to-Alt River-to-Export Terminal
- Farm-to-Country Elevator-to-Alt River-to-Export Terminal
- Farm-to-Railhead-to-Export Terminal
- Farm-to-Country Elevator-to-Railhead-to-Export Terminal

Storage and handling costs are assumed to be the same for all country elevators, including those with unit-train loading facilties. Handling costs at the export terminals are not computed because of an assumption that these costs are the same for both rail and barge grain deliveries.

### *Capacity Assumptions*

Two general assumptions about capacity are fundamental to the analysis and the construction of the transportation system model. The first assumption is that the current system is in equilibrium in terms of storage, handling and transport mode capacity. On the basis of this assumption, it was unnecessary to model capacity in the base case. The second assumption is that with drawdown, modal, handling and storage capacity can be expanded on a regional basis to meet geographic shifts in demand without significant increases in long-run marginal and average costs. The Economic Procedures and Guidelines used by the U.S. Army Corps of Engineers to determine project benefits and costs reason that if inland navigation capacity is reduced, competing surface transport modes either possess or would add the capacity necessary to accommodate additional traffic. Similarly, it is assumed that elevator throughput capacity could be increased with little impact upon long-run marginal and average costs. As a consequence, it is judged possible that additional transportation capacity could be made available with no significant increase in its unit cost. For non-grain commodities, storage and handling costs were assumed to be generally equivalent under either scenario. On the basis of this second assumption, modeling of capacity in the with-drawdown case was also unnecessary. However, specific assessments of capacity infrastructure improvements that would be needed with drawdown were made.

### *Seasonality of Shipments*

Shipment of both grain and non-grain commodities experience some month-to-month or season-to-season fluctuation in volume. On a year-to-year basis much of this fluctuation is due to fluctuations in market conditions rather than the underpinning demand factors. Thus, grain exports from the lower Columbia

River may vary significantly from one month to the next because of market conditions while the demand for grain remains relatively constant. Despite the fact that volume of shipments, especially of grain, has historically varied from month-to-month, such variations were not built into the model. Instead, the model was constructed and operates on the premise of an implicit assumption that the volume of shipments of both grain and non-grain commodities are uniform from month to month.

### *Operation of the Model Without and With Drawdown*

In the base case, the model is constructed to attempt to replicate a non-optimized base condition that takes into account commodity movements on the river under present conditions, but using the projected future volume of shipments. In the with drawdown case, the model is constructed to evaluate transportation, storage and handling costs resulting from the shift of projected future volumes of commodities to alternative modes of transportation and routings. In all cases, the model includes at least two alternative routings for commodities from each origin in the drawdown case. In general, alternative routings developed for the SOR were used. These alternative routings were, however, reviewed and updated to take into account changes in unit-train rail loading facilities at country elevators. Alternative rail origins for grain were limited to those having a car loading capacity of at least 25 cars. This requirement was imposed because for rail transport to be feasible a minimum unit-train loading capability of 25 to 26 cars is needed. Imposition of this requirement reduced the number of country elevators identified in the base case as having rail access from over 100 to 14. Those facilities that were eliminated are those with a loading capacity of fewer than 25 cars. In addition, facilities within 15 miles of a facility included in the model were excluded on the basis that costs associated with these facilities would be the same as for those already in the model.

Construction of the model further assumes that as grain or other commodity transport is impaired by drawdown, shipments would be rerouted by motor carriers to river elevators located on the McNary pool and transshipped by barge, or would be shipped by rail directly to lower Columbia export elevators. The model includes unit costs for transportation, storage and handling associated with each of the alternative routings for each origin-destination pair affected by waterway closure. Distances between origins and destinations were identified and are included in the model. The overall method employs the assumption that current and projected levels of exports from the region would continue to be maintained.

### *Adjustment of Model Results*

A fundamental assumption made by modelers was that the existing transportation of grain represents the least-cost condition. Therefore, modelers assumed that the cost of all movements of grain with drawdown should be at least as costly as without drawdown. Actual operation of the model, however, showed that this was not the case. The model results showed that a number of grain movements were found to be less costly with drawdown than with the existing transportation system. Since this violated the assumption that the existing system is the least-cost system, the model includes a check to determine if the cost of a movement is less with drawdown than without drawdown. If the cost with drawdown is less, the difference is calculated and added to the transportation costs with drawdown. The adjustments computed, however, are not tracked in the model by movement, etc., but are simply summed and added to total transportation costs with drawdown. The use of this type of adjustment is somewhat unconventional and is opposed by the IEAB. The use of the adjustment is an unresolved issue.

### *Taxes, Subsidies and Price Level Changes*

The analysis does not take into consideration the effects of taxes or subsidies, which represent transfer payments within the national economy. Also, effects of potential changes in relative prices are not considered.

### *Effects on Quantity of Land in Grain Production*

In the short-term, it is possible that some marginal land now used for production of grain could become unprofitable and some grain farmers could be forced out of business. The actual impact on individual operators will depend on a number of factors, including the productivity of the land; the fixed cost of land, in the form of capital and interest payments and taxes; and, the actual increase in transportation costs. However, for most farms the increase in transportation costs would simply mean that the return to fixed capital (such as land) would be reduced. Although some land may go out of production in the short-term, assuming that grain production is the highest and best use of the land currently used for this purpose, in the long-run the reduced economic return to land because of higher transportation costs would be reflected in a reduced value of land and the land would continue to be used for grain production. Therefore, this analysis is based on the assumption that implementation of drawdown would have no effect on the amount land used for grain production in both the short- and long-terms.

### *Period of Analysis, Price Level and Interest (Discount) Rates*

The initial year of drawdown implementation is assumed to be 2007, and NED effects are measured over the 100-year period, 2007 to 2106. For purposes of comparison with other fish restoration measures being evaluated in the feasibility study, annual economic costs were adjusted to a base year, 2005.

### *Uncertainty*

A considerable amount of uncertainty exists about modal rate behavior, infrastructure and capacity requirements, the potential for lost grain sales to export markets, and overall financial impacts with drawdown. These issues and the sensitivity of the analysis to alternative assumptions are addressed later in this section of this summary report.

## 3.3.2 Navigation Facilities

The Columbia-Snake Inland Waterway is a 465-mile-long water highway formed by the eight mainstem dams and lock facilities on the lower Columbia and Snake rivers. The waterway provides inland waterborne navigation up and down the river from Lewiston, Idaho to the Pacific Ocean. This system is used for commodity shipments from inland areas of the Northwest and as far to the east as North Dakota. The navigation system consists of two segments: the downstream portion, which provides a deep-draft shipping channel, and the upstream portion, which is a shallow-draft channel with a series of navigation locks.

The deep-draft portion of the navigation system consists of a 40-foot-deep by 600-foot-wide channel that extends up the Columbia River from the Columbia Bar (River Mile [RM] 3.0) to Vancouver, Washington (RM 105.6). Major import-export terminals are located adjacent to the channel at the Columbia River ports of Vancouver, Longview, and Kalama in Washington and Portland and Astoria in Oregon.

The shallow draft portion of the waterway is a Federally maintained channel and system of locks that extends from Vancouver, Washington to Lewiston, Idaho. The channel extends up the Columbia River from Vancouver, Washington (RM 106) to Richland, Washington (RM 345) and from the mouth of the Snake River (Columbia River RM 325) to Lewiston, Idaho (Snake River RM 141). This channel has a minimum authorized depth of 14 feet at the minimum operating pool (MOP) elevations of each of the upstream dams.

The presence of the Columbia-Snake River Inland Waterway has led to the development of a sizable river-based transportation industry in the region. Riverside facilities managed by port districts and various other public and private entities are located on the pools created by the system of dams and locks. Fifty-four port and other shipping operations provide transportation facilities for agricultural, timber, and other products. There are 22 port facilities located along the shallow draft portion of the waterway including 9 on the lower Snake River. All of the ports on the lower Snake River have grain-handling capability

## 3.3.3 Waterborne Commerce

### 3.3.3.1 Columbia River Deep-Draft Channel

The Columbia River serves an extensive region that covers much of the western United States. Within the region, a variety of commodities, foodstuffs, and other products are produced. Of those industries within the region that generate waterborne commerce, agriculture predominates, particularly with respect to the production of grains such as wheat and barley. In addition, corn, which is produced outside of the region, represents a significant volume of shipments from export terminals on the lower Columbia River. Other regional industries that utilize water to transport products include aluminum, pulp and paper, petroleum products, and logs and wood products. In terms of volume, wheat and corn represent the major share of total commodities shipped on the deep draft segment of the Columbia River channel. Other products include autos, containerized products, logs, petroleum, chemicals and other miscellaneous products. Countries involved in the region's export trade are Japan, Korea, and Taiwan, as well as other Pacific Rim countries.

### 3.3.3.2 Columbia-Snake Inland Waterway

Products shipped on the shallow draft segment of the river system consist principally of grain, wood products, logs, petroleum, chemicals, and other agricultural products. Bulk shipments make up much of the waterborne traffic on the upstream channel. A number of commodities, principally non-grain agricultural and food products and paper products, are shipped via container. Approximately 97 percent of down-bound container shipments are destined for Portland, Oregon with the remainder going to Vancouver, Washington. Historically, the bulk of upriver barge shipments have been made up of petroleum products.

Analysis of data from the Waterborne Commerce Statistics Center (WCSC) and the Corps' Lock Performance Monitoring System (LPMS) showed that in both 1996 and 1997 commodities from 37 commodity groups were shipped on the waterway. The commodity groups were aggregated into five groups for the purposes of this analysis—grain, petroleum products, wood chips and logs, wood products and other. Shipments for the period 1992—1996 are shown in Table 3.3-1.

**Table 3.3-1.** Tonnage of Shipments by Commodity Group on the Shallow Draft Portion of the Columbia-Snake Inland Waterway for 1992--1996

| Commodity Group | Thousand Tons | | | | |
|---|---|---|---|---|---|
| | 1992 | 1993 | 1994 | 1995 | 1996 |
| Grain | 4,612.9 | 4,902.3 | 5,671.4 | 5,883.3 | 5,710.4 |
| Petroleum Products | 1,567.1 | 1,746.1 | 1,693.1 | 2,164.6 | 2,023.2 |
| Wood Chips and Logs | 1,837.3 | 2,130.8 | 2,056.4 | 1,779.2 | 1,281.9 |
| Wood Products | 61.3 | 44.7 | 63.1 | 73.4 | 28.1 |

| | | | | | |
|---|---|---|---|---|---|
| Other | 1,224.7 | 761.9 | 615.3 | 626.9 | 629.6 |
| Total | 9,303.3 | 9,585.8 | 10,099.3 | 10,527.4 | 9,673.2 |

### 3.3.3.3 Lower Snake River

Commodity movement on the lower Snake River is dominated by grain (primarily wheat and barley), making up 75.8 percent of the tonnage passing through Ice Harbor lock during the period 1992--1997. During this same period, wood products, including wood chips and logs, accounted for 15.8 percent, petroleum products accounted for another 3.0 percent, paper and pulp accounted for 2.3 percent and all other commodities accounted for the remaining 3.0 percent. Table 3.3-2 provides a summary of the annual tonnage by commodity group passing through Ice Harbor lock for 1992 through 1997.

The Columbia-Snake Inland Waterway from Lower Granite pool through McNary Dam handled cumulative totals of approximately 6.7 million tons in 1990, 7 million tons in 1991, and 6.7 million tons in 1992. This included upbound and downbound cargo originating at Lower Granite, Little Goose, Lower Monumental, Ice Harbor, and McNary reservoirs (Corps and NMFS, 1994). Since 1980, cumulative cargo volumes have ranged from approximately 5 million tons to 8 million tons per year. Tonnage using at least a portion of the Snake River segment, as measured by data for Ice Harbor, averaged about 3.8 million tons per year from 1980 through 1990. This average increased slightly to about 4 million tons per year from 1992 through 1997 (Table 3.3-2).

**Table 3.3-2.** Tonnage by Commodity Group Passing Through Ice Harbor Lock 1992-1997 (Thousand Tons)

| Commodity Group | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | Average |
|---|---|---|---|---|---|---|---|
| Grain | 2,684 | 2,766 | 3,201 | 3,496 | 2,817 | 3,266 | 3,038 |
| Petroleum Products | 108 | 128 | 129 | 143 | 99 | 112 | 120 |
| Wood Products | 506 | 806 | 709 | 696 | 508 | 579 | 634 |
| Paper & Pulp | 94 | 83 | 110 | 126 | 38 | 95 | 91 |
| Other | 115 | 120 | 129 | 113 | 98 | 152 | 121 |
| Total | 3,510 | 3,907 | 4,281 | 4,577 | 3,565 | 4,207 | 4,008 |

Note: Totals do not add because the last three digits were dropped.

### 3.3.3.4 Projected Growth in Commodity Shipments

#### *General*

The forecast of commodity growth was prepared by the Corps' Institute for Water Resources for the major commodity groups that are presently shipped on the lower Snake River. The basis for the forecast was the commodity forecast developed for the Corps' Columbia River Channel Deepening Feasibility Study. Historical data for Snake River shipments were compiled for aggregated commodity groupings for the 10-year period from 1987 through 1996. This data set was used as the basis for projecting future growth as a share of forecast growth for the Columbia River. Projections were initially established at 5-year increments to encompass a 20-year period, 2002 through 2022. As stated earlier, for the dam breaching option, the implementation date is assumed to be 2007, therefore, the evaluation utilized projections for the period 1997 to 2017, with growth held constant thereafter. The rationale and basis for estimating future growth in volume for the respective commodity groups is described below.

#### *Grain*

Historic wheat and barley exports from the Lower Columbia are compared with shallow draft wheat and barley shipments from the Snake River above Ice Harbor in Table 3.3-3. As the data show, during the

1987 – 1996 period, shipments on the Snake River averaged about 23.4 percent of wheat and barley exports from the lower Columbia River and ranged from a high of 26.5 percent share in 1991 to a low of a 20.2 percent share in 1992. This is a relatively low range with fluctuations from year-to-year probably being driven by variations in grain production among the regions. Also shown in the table is the year-to-year change in percent share for the Snake River.

**Table 3.3-3.** Wheat and Barley Exports From the Lower Columbia Compared With Shipments From the Snake River Above Ice Harbor, 1987-1996. (000 tons)

| Wheat & Barley | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lower Columbia Exports** | 12,085 | 14,945 | 10,458 | 11,778 | 12,233 | 12,762 | 13,428 | 14,908 | 14,603 | 13,691 | 13,089 |
| **Snake River Shipments** | 2906 | 3981 | 2532 | 3109 | 3241 | 2612 | 2706 | 3135 | 3471 | 2821 | 3,051 |
| **Snake River Percent** | 24.0% | 26.6% | 24.2% | 26.4% | 26.5% | 20.5% | 20.2% | 21.0% | 23.8% | 20.6% | 23.38% |
| **Change in Percent** | -- | 2.6% | -2.4% | 2.2% | 0.1% | -6.0% | -0.3% | 0.9% | 2.7% | -3.2% | |

The average Snake River share of 23.38 percent of exports of wheat and barley from the lower Columbia River is used as the basis for forecasting future wheat and barley movements on the Snake above Ice Harbor. The forecast was made by applying this percentage to projected exports for wheat and barley developed for the Columbia River channel deepening study. The resulting forecast is summarized in Table 3.3-4.

### *Wood Chips and Logs*

In terms of tons, the next largest commodity group using the Snake River above Ice Harbor, after wheat & barley, is wood chips & logs. Between 1987 and 1996, shipments of wood chips and logs varied between a low of 303,800 tons (1990) and a high of 909,600 (1994), with an average of 716,100 tons for the period 1991-1996. Although 1997 data were not available as this report was being compiled, data from the Lock Performance Monitoring System (LPMS) suggest 1997 wood chips & logs traffic was about 594,000 tons at Lower Granite Lock & Dam. Using this information as a proxy for 1997 movements on the Snake River above Ice Harbor, it appears this commodity group recovered some of the traffic lost in 1996, but not to the robust traffic levels of the period 1993-1995. Adding in the 1997 estimate to the average base traffic calculation reduces this value to 694,200 tons. This is the amount carried forward into the forecast analysis.

With an R-squared of .37, the historic data for 1987-1997 do not indicate a clear linear trend that could be used for credible forecasting. The traffic in wood chips & logs appears to vary around an average level, increasing or decreasing with market conditions, but without the prospect of sustained long-term positive growth. This assessment has generally been confirmed in conversations between Portland District and commercial shippers who have reported future traffic expectations as “flat” or stable. For this reason, the forecast for wood chips & logs has been held steady at the adjusted (to include the 1997 estimate) average of 694,200 tons. Since no growth is being forecast for the base traffic, these figures are the same in each forecast year. The forecast is shown in Table 3.3-4.

### *Petroleum Products*

Petroleum products, the third largest commodity group transported on the lower Snake River, generally account for approximately 80 percent of all upriver commodity movements above Ice Harbor lock (Corps and NMFS, 1994). Annual petroleum product shipments ranged from 99,000 tons in 1996 to 143,000 tons in 1995, with an average of 120,000 for the period 1992 through 1997. Conversations with terminal managers indicated that shipments of petroleum by barge tend to decline when excess refinery production in the Great Plains and Rocky Mountain regions further east becomes available by pipeline in the Spokane area. From there petroleum products can be trucked in competitively. When those supply routes tighten and prices increase, barged petroleum from the Portland area becomes more competitive.

The forecast assumes these competitive supply dynamics will continue in the future, but with a generally upward trend in barge traffic as the demand for petroleum products in the Snake River hinterland increases with general population and economic growth. Historic population data for the Snake River hinterland counties indicates an average annual increase of 1.4 percent since 1980 and 1.7 percent since 1990. Forecast growth is based on the longer-term population growth rate of 1.4 percent. The resulting forecast is shown in Table 3.3-4.

***Wood Products and Other***

Of the commodity categories being assessed in the present analysis, it was observed that "Other Farm Products" (that is, all farm products other than wheat and barley) and "Wood Products" (including pulp and waste paper, paper products, and primary wood products) were most likely to be containerized. The forecast referenced above was adapted to the Lower Snake River through an analysis of container movements on the Columbia and Snake Rivers, with the assumption that Snake River's share of the total would remain unchanged over the forecast period. The forecast for chemicals, which primarily consist of fertilizer and ammonia, was based on the forecast for grain with the assumption that the ratio of the grain to chemicals ratio would remain constant over time. The resulting forecasts are shown in Table 3.3-4.

***Summary***

In all, projections were made for eight commodity groups. These groups were then combined into the five groups and were included in the transportation model. The "other" commodity group includes other farm products, chemicals, containers and all other. The medium or base forecast for each commodity group is shown in Table 3.3-4.

**Table 3.3-4** Waterborne Traffic Projections above Ice Harbor Lock 2002-2022 (in thousand tons)[1/]

| Commodity Group | Average | 2002 | 2007 | 2012 | 2017 | 2022 |
|---|---|---|---|---|---|---|
| Grain | 3,019 | 3,647 | 3,799 | 3,798 | 3,892 | 4,052 |
| Wood Chips and Logs | 716 | 694 | 694 | 694 | 694 | 694 |
| Petroleum Products | 118 | 127 | 136 | 145 | 156 | 167 |
| Wood Products | 52 | 66 | 79 | 101 | 128 | 148 |
| Other | 81 | 97 | 110 | 128 | 148 | 167 |
| Total | 3,986 | 4,631 | 4,818 | 4,866 | 5,018 | 5,228 |

1/ These projections are the medium or "most likely" values projected in the navigation analysis. The Portland District's analysis also provided low – "likely minimum" – and high – "likely maximum" – values for each year. The averages are computed across all three values for each year.

### 3.3.4 Base Condition Transportation Costs

#### 3.3.4.1 Modeling Considerations

***Grain Movements***

One of the key elements in determining commodity transport costs is identifying origins and destinations of product movements. Within the Columbia River Basin, country elevators located in one county may collect and store grain from sources in several adjacent counties. This means that grain may ultimately be transshipped to river elevators located in other counties. These movements, as such, tend to have a three dimensional aspect in terms of origins and interim destinations. In order to reduce the complexity of data management, country elevators were considered to be the starting point for the movement of grain down river, with the exception of those grain shipments made directly from farm to river elevators. This eliminated the need for a three dimensional approach that would vastly enlarge the magnitude and complexity of the commodity flow data. The effect of this modeling convention on estimated costs is to understate costs by the amount of the cost to move grain from farms to country elevators. However, it was judged that in total, the costs of moving grain from farms to country elevators or other interim holding facilities would not differ significantly between base and drawdown conditions. For modeling purposes, therefore, this simplifying assumption was applied except in those cases where grain is transported directly from farm to river elevators, without drawdown. With drawdown, modeling was based on the assumption that farm to river elevator shipments would move direct from farms to country elevators with unit train loading capacity. Obviously, this may not be the case for specific farms because some farm-to-river movements of grain may be determined by the relative location of farms to the river elevators. However, the assumption is considered to be valid in general because with drawdown other farms would be expected to be located near elevators with rail loading capacity.

***Modal and Other Costs***

The next step in computing transportation costs was to input modal costs for each origin/destination pair. As explained previously, modal costs were developed for the study using models developed and maintained by Reebie Associates. Costs assigned included the cost of the grain movements by truck from country elevators to river elevators within the drawdown reach, and then the cost to move the grain by barge to export terminals. Storage and handling costs are also included. These latter costs are based on rates charged for these services, rather than NED-based costs, as is the case with modal costs.

***Other Considerations***

In the process of evaluating data obtained and applied in this analysis, it was determined that grain from Montana and North Dakota is normally shipped to the CSRS as a backhaul for building materials that are transported to these states and eastward as far as Chicago. Since backhaul shipments are required to only generate sufficient revenue to pay the incremental costs of the shipment, this significantly reduces costs. For this evaluation, it was judged that backhaul shipments of grain by truck from Montana and North Dakota origins to Lewiston would continue in the future. With drawdown, however, the river destination would shift from Lewiston to the Tri Cities area. It was further assumed that all long distance grain movements (in excess of 150 miles) include backhauls. Accordingly, truck movements of grain of 150 miles or more were given a backhaul-based cost.

Storage and handling rates were obtained for each elevator type—country and river. However, in compiling these data it was noted that there is a significant variation in rates that are charged. Further analysis determined that the variation is due largely to market strategies of owners of multiple facilities. It was necessary to make adjustments to some of the raw data to derive the average rates that were used in the model.

#### 3.3.4.2 Transportation Costs - Base Condition

For the base condition, grain transportation, storage and handling costs were derived based upon current and projected levels of commodity flows. The methodology and assumptions in the analysis are explained above in paragraph 3.3.1. Model estimates of the costs displayed in Table 3.3-5 below are for projected grain movements for 2007. Costs are not shown for any of the other years included in the forecast because projected growth in the volume of grain does not have a significant effect on costs at the per bushel or even per ton levels. Costs are shown by State in terms of totals and costs per bushel and per ton. As shown in the table, model estimates of total costs per bushel range from a high of about $7.10 for Montana to a low of $0.34 for Oregon. The estimates for Montana should alert the reader to the fact that the costs are simply estimates. The costs, especially for storage and handling, at nearly $6.50 per bushel, are much higher than actual costs. Corps modelers are aware of this problem and have made corrections to the model. However, it was not possible to make the corrections in time to be included in this report. Also, readers should be aware that storage and handling costs for Montana are the same without and without drawdown, thus the net impact of drawdown is zero.

**Table 3.3-5** Base Condition Grain Shipments and Transportation, Storage and Handling Costs for 2007 Projected Volume, by State.

| | Grain | Transportation | Storage | Handling | Total |
|---|---|---|---|---|---|
| State/Unit Cost | Bushels/Tons | ($) | ($) | ($) | ($) |
| **Idaho** | 32,289,941 | 11,193,026 | 4,758,470 | 6,932,211 | 22,883,707 |
| Cost per bu. (cents) | 32,289,941 | 34.7 | 14.7 | 21.5 | 70.9 |
| Cost per ton ($) | 968,795 | 11.55 | 4.91 | 7.16 | 23.62 |
| **Montana** | 6,537,310 | 4,687,358 | 20,038,366 | 21,655,789 | 46,381,513 |
| Cost per bu. (cents) | 6,537,310 | 71.7 | 306.5 | 331.3 | 709.5 |
| Cost per ton ($) | 196,139 | 23.90 | 102.16 | 110.41 | 236.47 |
| **N. Dakota** | 2,458,172 | 3,262,017 | 0 | 0 | 3,262,017 |
| Cost per bu. (cents) | 2,458,172 | 132.7 | 0.0 | 0.0 | 132.7 |
| Cost per ton ($) | 73,753 | 44.23 | 0.0 | 0.0 | 44.23 |
| **Oregon** | 980,218 | 331,837 | 0 | 0 | 331,837 |
| Cost per bu. (cents) | 980,218 | 33.9 | 0.0 | 0.0 | 33.9 |
| Cost per ton ($) | 29,409 | 11.28 | 0.0 | 0.0 | 11.28 |
| **Washington** | 84,355,029 | 17,127,974 | 13,258,963 | 18,868,710 | 49,255,647 |
| Cost per bu. (cents) | 84,355,029 | 20.3 | 15.7 | 22.4 | 58.4 |
| Cost per ton ($) | 2,530,904 | 6.77 | 5.24 | 7.46 | 19.46 |
| **Totals** | 126,620,670 | 36,602,212 | 38,055,799 | 47,456,710 | 122,114,721 |
| Cost per bu. (cents) | 126,620,670 | 28.9 | 30.1 | 37.5 | 96.4 |
| Cost per ton ($) | 3,799,000 | 9.63 | 10.02 | 12.49 | 32.14 |

Costs associated with grain transport under the base condition were converted to average annual amounts over the period of analysis, 2007-2106. These average annual amounts, that reflect zero, 4.75, and 6.875 percent rates of interest, are presented in 1998 dollars as follows in Table 3.3-6.

**Table 3.3-6** Base Condition – Grain, Average Annual Costs, 2007 – 2106

| Interest Rate | Average Annual Costs ($) |
|---|---|
| 6.875% | $126,042,205 |
| 4.75% | $126,963,320 |
| 0.00% | $129,337,780 |

### *Non-Grain Commodities*

For purposes of grouping, non-grain commodities were combined into four additional groups: petroleum, logs and woodchips, wood products, and other, comprised of other farm products, containerized products, and chemicals. For the base condition, transportation costs reflect current and projected volume. Transportation costs associated with non-grain commodities for selected years under the base condition are presented below in Table 3.3-7.

**Table 3.3-7** Base Condition Total Annual Costs for Non-Grain Commodities for 2002, 2007, 2012 and 2017

| Year/Commodity Group | Base Case |
|---|---|
| **2002** | |
| Petroleum | $14,838,745 |
| Logs and Wood Chips | $47,879,179 |
| Wood Products | $4,380,282 |
| Other | $6,125,027 |
| Total | $73,223,233 |
| **2007** | |
| Petroleum | $15,893,106 |
| Logs and Wood Chips | 47,879,179 |
| Wood Products | 5,242,586 |
| Other | 6,946,350 |
| Total | $75,961,221 |
| **2012** | |
| Petroleum | $16,936,369 |
| Logs and Wood Chips | 47,879,179 |
| Wood Products | 6,703,299 |
| Other | 8,084,392 |
| Total | $79,603,239 |
| **2017** | |
| Petroleum | $19,511,230 |
| Logs and Wood Chips | 47,879,179 |
| Wood Products | 8,494,810 |
| Other | 9,345,900 |
| Total | $85,231,119 |

Costs associated with non-grain commodities were converted to average annual amounts over the period of analysis, 2007-2106 and are displayed below in Table 3.3-8. These average annual amounts, computed at zero, 4.75, and 6.875 percent, are expressed in 1998 dollars.

**Table 3.3-8** Base Condition Average Annual Costs for Non-Grain Commodities

| Discount Rate (%) | Average Annual Costs ($) |
|---|---|
| 6.875 | 82,274,899 |
| 4.750 | 83,006,143 |
| 0.000 | 84,671,628 |

### *Base Condition Summary*

Transportation costs associated with all commodities under the base condition are displayed below in Table 3.3-9. They have been computed at zero, 4.75, and 6.875 percent, are expressed in 1998 dollars, and converted to average annual amounts for the period of analysis, 2007-2106.

**Table 3.3-9** Summary of Base Condition Total Average Annual Costs– All Commodities

| Discount Rate (%) | Average Annual Costs ($) |
|---|---|
| 6.875 | 208,317,104 |
| 4.750 | 209,969,463 |
| 0.000 | 214,009,408 |

### *Adjustment of Annual Costs to the Base Year*

Average annual costs in Table 3.3-9 were adjusted to the base year of 2005 to be consistent with analyses of other fish restoration alternatives. This was done by discounting the values for 2007-2106 (Table 3.3-9) by two years at the appropriate discount rate. The adjusted annual costs are shown in Table 3.3-10.

**Table 3.3-10** Annual Costs Adjusted to the Base Year of 2005—All Commodities

| Discount Rate | Average Annual Costs ($) |
|---|---|
| 6.875 | 182,377,458 |
| 4.750 | 191,358,639 |
| 0.00 | 214,009,408 |

### *Cruise Ship Commerce*

Cruise-ship operations began on the Columbia-Snake River in 1980. The cruises originate in Portland, sail to Astoria and then go upriver to Lewiston before returning to Portland. In 1999 four companies are offering these cruises. One more company will begin operating on the river in 2000 and other companies are considering offering cruises. The growth in this industry is illustrated by the increase in the number of passengers for just one of the companies that had the number of passenger increase from 1,150 in its first year of operation in 1995 to 6,322 in 1999 (based on bookings).

### 3.3.5 Drawdown Condition

#### 3.3.5.1 Geographic Scope Of Impacts

The geographic scope of the analysis of transportation system impacts with breaching of the four lower Snake River dams of the Columbia/Snake River System includes all communities, port facilities and terminals physically located adjacent to the river that have direct access to the navigation channel. In addition, it includes inland areas geographically distant from the CSRS but which make significant use of the navigation system. Grain export-elevators on the Lower Columbia are part of the study area but as a practical matter, export destinations, such as Pacific Rim nations in Asia, are not. A fundamental premise of the analysis is that with drawdown, export markets will continue to be supplied with the same reliability as the existing system provides.

The analysis of the economic effects of drawdown on grain producers is limited to the potential changes in how grain is shipped to export terminals in the Portland area and the associated changes in costs. The analysis and results are general in nature and do not apply directly to specific grain producers.

#### 3.3.5.2 Alternative Transportation Modes And Costs

With loss of access to the Snake River portion of the CSRS, commodities would move by the next least costly available mode, such as rail direct to export elevators on the lower Columbia or by truck to river elevators located on the McNary pool. For the drawdown condition, the evaluation process in most cases considers the following two alternatives: the utilization of truck-barge combination to the closest river terminal unimpaired by drawdown; or, truck transport to the closest rail loading facility with multi-car loading facilities. Where rail access is presently available at country elevators, grain would either shift to rail direct from those locations, or be moved by truck to a rail distribution point where unit trains could be assembled. At country elevators where rail is presently the primary means of transport, this would remain the case with drawdown. As with the base condition, modal costs were prepared for rail, barge and truck movements using the Reebie models.

#### 3.3.5.3 Alternative Origins

With drawdown grain now shipped on the Snake River would shift to alternative modes of transportation, specifically to truck-rail and truck-barge through river ports on the Columbia River below its confluence with the Snake River to lower Columbia River ports. To evaluate the transportation, storage and handling costs associated with this shift, it was necessary to identify alternative origins and intermediate destinations. The alternative destinations were identified through review and revision of the alternative destinations identified for the System Operation Review (November 1995). The alternative rail origins (intermediate destinations) of grain shifted from the Snake River to rail are shown below in Table 3.3-11. Each of these facilities currently has the capability of loading unit-trains of 26 or more railcars. The actual number of elevator facilities with unit-train loading capability is significantly greater than the number of facilities included in the model. On the BNSF system there are actually 39 facilities in Eastern Washington and four in Northern Idaho. These facilities have a combined storage capacity of just slightly less than 53.6 million bushels. For grain now shipped through Snake River ports that would continue to be shipped by barge, the alternative barge origin (intermediate destination) is the area in the vicinity of the confluence of the Snake and Columbia Rivers, including the Tri Cities.

**Table 3.3-11** Alternative Rail Origins of Grain With Drawdown.

| Origin | County | Capacity (bu) | Railroad |
|---|---|---|---|
| **Washington** | | | |
| Coulee City | Grant | 2,038,000 | Palouse R. & Coulee City |

| | | | |
|---|---|---|---|
| Plymouth | Benton | 4,129,000 | Burlington No.-Santa Fe |
| Harrington (2) | Lincoln | 2,579,000 | Burlington No.-Santa Fe |
| Odessa (Lamona) | Lincoln | 638,000 | Burlington No.-Santa Fe |
| Spangle (3) | Spokane | 1,235,000 | PCC & BNSF |
| Spangle | Whitman | 3,440,000 | PCC & BNSF |
| **Idaho** | | | |
| Craigmont | Lewis | 1,744,000 | Camas Prairie RailNet |
| Grangeville | Idaho | 1,552,000 | Camas Prairie RailNet |
| Idaho Falls | Bonneville | na | Union Pacific |
| Pocatello | Bannock | na | Union Pacific |
| Nampa | Canyon | na | Union Pacific |
| Mountain Home | Elmore | na | Union Pacific |
| Bliss | Gooding | na | Union Pacific |
| Burley | Cassia | na | Union Pacific |
| American Falls | Power | na | Union Pacific |
| Blackfoot | Bingham | na | Union Pacific |
| **Oregon** | | | |
| Pendleton | Umatilla | na | Union Pacific |

Notes: There are multiple facilities at some locations, as indicated by the number in ( ).
na = not available.

### 3.3.5.4 Transportation Costs With Drawdown

For the drawdown condition, grain transportation costs were derived based upon projected commodity flows diverted to alternative modes and alternate intermediate destinations. Grain transport costs that reflect projected grain movements for the affected States for 2007 are displayed in Table 3.3-12 below. Storage and handling costs of grain movements are also shown. Costs are shown in terms of totals and costs per bushel (in cents) and per ton (in dollars). Data for the year 2007 are shown because that is the initial year of actual drawdown and the shift of commodity shipments away from the Snake River. As the data show, the estimated range in costs with drawdown is from a high of $7.30 per bushel for Montana to a low of 40.1 cents per bushel for Oregon. It should be noted that most of the cost for Montana is due to storage and handling costs. While these charges are unrealistic, they were handled in the model the same way with and without drawdown. As a result, the difference between the two cases appears to be more realistic than the estimates for each case.

**Table 3.3-12** Transportation, Storage, Handling and Total Costs for Grain Shipments with Drawdown, 2007 Projected Volume.[1]

| | Bushels/Tons | Transportation | Storage | Handling | Total |
|---|---|---|---|---|---|
| | | ($) | ($) | ($) | ($) |
| **Idaho** | 32,289,941 | 16,148,010 | 5,652,855 | 7,342,505 | 29,143,370 |
| Cost per bu. (cts) | 32,289,941 | 50.0 | 17.5 | 22.7 | 90.3 |
| Cost per ton ($) | 968,795 | 16.67 | 5.83 | 7.58 | 30.08 |

[1] Totals exclude an adjustment of $794,781 calculated by the model and added to the regional total to prevent costs for any movement with drawdown from being less than without drawdown.

| | | | | | |
|---|---|---|---|---|---|
| **Montana** | 6,537,310 | 6,063,389 | 20,038,366 | 21,655,789 | 47,757,544 |
| Cost per bu. (cts) | 6,537,310 | 92.8 | 306.5 | 331.3 | 730.5 |
| Cost per ton ($) | 196,139 | 30.91 | 102.16 | 110.41 | 243.49 |
| **N. Dakota** | 2,458,172 | 3,523,573 | 0 | 0 | 3,523,573 |
| Cost per bu. (cts) | 2,458,172 | 143.3 | 0.0 | 0.0 | 143.3 |
| Cost per ton ($) | 73,753 | 47.78 | 0.00 | 0.00 | 47.78 |
| **Oregon** | 980,218 | 393,165 | 0 | 0 | 393,165 |
| Cost per bu. (cts) | 980,218 | 40.1 | 0.0 | 0.0 | 40.1 |
| Cost per ton ($) | 29,409 | 13.37 | 0.00 | 0.00 | 13.37 |
| **Washington** | 84,355,029 | 28,714,849 | 14,838,964 | 19,605,738 | 63,159,551 |
| Cost per bu. (cts) | 84,355,029 | 34.0 | 17.6 | 23.2 | 74.9 |
| Cost per ton ($) | 2,530,904 | 11.35 | 5.86 | 7.75 | 24.96 |
| **Totals** | 126,620,670 | 54,842,986 | 40,530,185 | 48,604,032 | 143,977,203 |
| Cost per bu. (cts) | 126,620,670 | 43.3 | 23.0 | 38.4 | 113.7 |
| Cost per ton ($) | 3,799,000 | 14.44 | 10.67 | 12.79 | 37.90 |

Costs associated with grain transport under the drawdown condition were converted to average-annual amounts for the period of analysis, 2007-2016. These average annual amounts, computed at zero, 4.75 and 6.875 percent rates of interest, in 1998 dollars, are shown below in Table 3.3-13.

**Table 3.3-13** With Drawdown Condition – Grain, Average Annual Costs – 2007 – 2106.

| Discount Rate (%) | Average Annual Cost ($) |
|---|---|
| 6.875 | 148,870,766 |
| 4.750 | 149,958,712 |
| 0.000 | 152,763,231 |

### 3.3.5.5 Non-Grain Commodities

For purposes of grouping, non-grain commodities were combined into four additional groupings: petroleum, logs and wood chips, wood products, and other, comprised of other farm products, containerized products and chemicals. For the drawdown condition, transportation costs reflect projected commodity volumes. Transportation costs associated with non-grain commodities for selected years under drawdown conditions are displayed below in Table 3.3-14.

**Table 3.3-14** With Drawdown Condition Total Annual Costs for Non-Grain Commodities

| Year/Commodity Group | Drawdown Case ($) |
|---|---|
| **2002** | |
| Petroleum | 15,350,816 |
| Logs and Wood Chips | 49,320,040 |
| Wood Products | 5,444,873 |
| Other | 6,643,160 |
| **Total** | **76,758,889** |
| **2007** | |
| Petroleum | 16,441,562 |
| Logs and Wood Chips | 49,320,040 |

| | |
|---|---|
| Wood Products | 6,516,753 |
| Other | 7,533,960 |
| **Total** | **79,812,315** |
| **2012** | |
| Petroleum | 17,520,827 |
| Logs and Wood Chips | 49,320,040 |
| Wood Products | 8,332,480 |
| Other | 8,768,272 |
| **Total** | **83,941,619** |
| **2017** | |
| Petroleum | 20,184,544 |
| Logs and Wood Chips | 49,320,040 |
| Wood Products | 10,559,403 |
| Other | 10,136,495 |
| **Total** | **90,200,482** |

Costs associated with non-grain commodities under drawdown conditions are displayed below in Table 3.3-15 as average annual amounts for the period of analysis, 2007-2106. These average annual amounts, computed at zero, 4.75, and 6.875 percent, are expressed in 1998 dollars.

**Table 3.3-15** Drawdown Condition Average Annual Costs For Non-Grain Commodities, 2007 - 2106

| Interest Rate (%) | Average Annual Costs ($) |
|---|---|
| 6.875 | 86,898,809 |
| 4.750 | 87,715,836 |
| 0.000 | 89,575,894 |

### 3.3.5.6 Infrastructure Requirements And Costs

With drawdown and a shift of commodities from shipment on the Snake River to shipment by rail, there would a significant increase in demand on the region's land-based transportation and grain handling infrastructure. This section presents a summary of the need for, and cost of, improvements to the rail system, the need for additional rail cars, the need for highway improvements, and the need for expansion of elevator capacity and improvement of loading and unloading facilities with closure of the lower Snake River to commercial navigation. In all cases, a range of costs (low and high) was estimated due to uncertainties about actual needs and costs. Due to limitations on space in this summary infrastructure needs are described and a summary table of costs is shown, but the derivation of the costs is not shown. The derivation of cost estimates is contained in the DREW Transportation System Impacts Analysis report, 1999.

### *Rail System Requirements*

Rail system requirements with drawdown include improvements to existing rail lines in terms of interchanges between short-line and mainline carriers, track upgrades and bridge upgrades. In addition, the stock of grain cars would need to be expanded.

#### ***Mainline (Class 1) Railroads***

Both mainline railroads, Burlington Northern-Santa Fe and Union Pacific, would be impacted by drawdown through the shift of grain and other commodities from the Snake River to Rail. In this analysis, it is assumed that all commodities shifted to rail would eventually require the services of these mainline carriers to reach their final destinations at ports on the lower Columbia River. The increase in grain shipments alone would increase traffic on the mainline routes by from about 840 to about 940 railcar-trips per month. Assuming a train size of 108 cars, this represents an increase of from about eight to nine additional trains per month destined to ports on the lower Columbia River. This represents a significant increase in rail traffic and improvements to the existing mainline system may be needed.

In making the assessment of mainline railroad infrastructure needs and costs, estimates of diverted traffic and generic or "rule of thumb" measures were used. Generic measures for costing the construction or modification of line capacity were developed for this purpose by civil engineers at the University of Tennessee's Transportation Center. Preliminary estimates were discussed with engineering professionals from a number of Class 1 railroads and with experts from private construction firms that are routinely engaged in rail project construction. Officials of the BNSF, Union Pacific and others reviewed these estimates as they apply to the Pacific Northwest rail system. The range of costs using these procedures was from a low of $14 million to a high of $24 million.

The impact of the need to make infrastructure improvements to mainline railroads on long-run marginal costs of the railroads was evaluated in a study conducted for the Corps by the TVA and Marshall University.[2] This study examined the estimated increase in volume, assuming that all commodities now moving on the Snake River would be diverted to rail (a worst-case scenario), and a number of strategies for increasing line-haul capacity. The conclusion of the study was that the infrastructure improvements could be made without putting any upward pressure on long-run marginal costs or rates.

#### ***Short-Line (Class 2) Railroads***

With drawdown, short-line railroads in Idaho and Washington are expected to experience increased shipments of grain. However, the level of detail of the study does not permit identification of the magnitude of the increase that is projected for individual railroads or even to the short-line railroads as a group. Thus, the assessment of impacts on these carriers and the estimates of costs of improvements are general in nature. Cost estimates were not specifically developed for this study. In the case of Washington railroads, costs were taken from the following report: Lower Snake River Drawdown Study, Appendix B, Technical Memoranda, prepared by HDR Engineering, Inc., February 1999. In the case of Idaho railroads, information about the potential shift to of grain to rail was provided to representatives of each of the short-line railroads, with a request that they identify any improvements that might be needed and estimated costs, if any. Short-line railroads that would be affected and estimated costs of improvements required for these lines to effectively accommodate the increased traffic are discussed in this section.

**Current Conditions, Needs and Costs**. Infrastructure needs of the affected short-line railroads in Idaho and Washington would be relatively more impacted than the mainline railroads. The reason for this is that

[2] The Incremental Cost of Transportation Capacity in Freight Railroading: An Application to the Snake River Basin. The Tennessee Valley Authority and The Center For Business and Economic Research Lewis College of Business Marshall University, July, 1998.

these rail lines are generally in poor condition at present. The poor condition of the lines stems from the fact that most of the short-line railroads are spin-offs of low volume, low revenue/profit segments of the mainline system and maintenance was deferred. Traffic on most of the operating short-line railroads is limited to a speed of from 25 to 45 miles per hour. Assessments of current needs have been made for both Idaho and Washington and are included in the respective State railroad plans. These analyses identified current maintenance needs amounting to about $21 million. Completion of this maintenance work is needed even if dams on the lower Snake River are not breached.

**Incremental Infrastructure Needs with Drawdown**. To identify incremental improvements that might be needed with drawdown, representatives of the railroads that would be impacted by drawdown were contacted and asked to identify any additional improvements that would be needed. In addition, information from other sources was used to identify needed improvements and costs. Needed improvements that were identified include interchanges with mainline railroads, track upgrading and "other." All of the improvements that were identified were associated with railroads in Washington. To date no needs have been identified for railroads in Idaho. The cost of the improvements for Washington railroads was estimated to be in the range of from about $20 million to $24 million.

***Rail Car Capacity***

In the event of a drawdown, the analysis of alternative transportation modes shows that approximately 1.1 million tons of grain would transfer to rail. In analyzing available information on current railcar availability and costs, a range of the number of cars needed and costs were developed. At present there is a large surplus of grain cars. For example, the grain car utilization rate for the BNSF for June 1999 was only about 50 percent. In spite of this, the analysis for this study is based on the premise that over the long-term additional rail cars would need to be acquired to move the grain that would shift to rail with drawdown. A number of factors were considered in the analysis, including the size of the cars, the turn rate and the cost per car. The result was a range of costs of from a low of $14 million to a high of about $37 million.

***Rail System Congestion***

With drawdown the rail system will experience increased traffic, as has been discussed previously. This increase in traffic has the potential for causing congestion on mainlines and at loading and unloading facilities. Congestion on short-line railroads is not considered to be likely because those facilities are almost universally only lightly used at present. In the case of congestion at loading and unloading facilities, the Corps believes that with implementation of infrastructure improvements identified in this report, there will not be a significant increase in delays due to congestion. In fact, it is likely that the system will become more efficient as it adjusts to a more significant role in the transport of grain within the region. This issue was specifically addressed in a study conducted for the Corps by the TVA and Marshall University. The conclusions of the study were that (1) improvements to the system may be needed to avoid congestion and (2) needed improvements could be made without increasing long-run marginal costs or putting upward pressure on rates. The potential for congestion on BNSF and UP railroads was also reviewed by transportation analysts at both railroads.

***Highway System Requirements***

**Change in Highway Use**. Impacts on highway capital and maintenance cost with drawdown were determined on the basis of the change in the use of highways to transport grain. The change in highway use was computed as the change in truck miles with drawdown. Estimates of the change in truck miles with drawdown are shown in Table 3.3-16, by state. Also shown is the number of alternative origins/destinations for which truck miles would increase and decrease in each state. The range of the change is from a decrease of about 1.4 million miles in Idaho and an increase of nearly 3.0 million miles Washington. The decrease in Idaho is explained by the shift of grain to rail and the increase in Washington is explained largely by the change in the destination of truck shipments from ports on the Snake River to ports in the Tri Cities area. Maintenance cost savings for Idaho were not estimated and the change in truck miles for Oregon was considered to be too small to be significant. In the case of Washington, costs include miles for grain movements from Montana and North Dakota because the increase in miles would actually occur in Washington.

Table 3.3-16 Summary of the Change in Truck Miles, by State and the Number of Alternate Origins/Destinations with Increased and Decrease Miles

| | | | | No. of Alt Destinations & Change | | |
|---|---|---|---|---|---|---|
| State | Sum Of Total Bushels | Increase in Bushel-Truck Miles | Increase in Truck Miles 1/ | Miles Increased | Miles Decreased | Total Alt Dests |
| Idaho | 24,271,500 | (1,235,193,157) | (1,419,762) | 4 | 31 | 35 |
| Oregon | 736,804 | 30,198,573 | 34,711 | 1 | 0 | 1 |
| Washington | 63,407,459 | 2,577,756,664 | 2,962,939 | 11 | 4 | 15 |
| Montana | 4,913,924 | 757,607,372 | 870,813 | 6 | 0 | 6 |
| N. Dakota | 1,847,743 | 265,297,487 | 304,940 | 1 | 0 | 1 |
| Totals | 95,177,430 | 2,395,666,939 | 2,753,640 | 23 | 35 | 58 |

Notes:
*Montana is divided into regions.
**North Dakota is a single region.
1/ Number of bushels per truck equals 870.
Source: Summary8 file from the ACCESS database model, July 1999.

**Highway Infrastructure Improvement Needs.** Highway improvements that were identified, in order to maintain adequate highway performance and minimal travel delay include intersection improvements, pavement replacement or overlay, and more frequent maintenance. Total estimated costs for these improvements ranged from a low of about $84 million to a high of about $101 million. An increase in accident costs amounting to about $2 million was also estimated. These estimates were not computed by the Corps but were taken from the following report: Lower Snake River Drawdown Study, Appendix B, Technical Memoranda, HDR Engineering, Inc. February, 1999.

**Highway Congestion.** Based on an assumption of a truck capacity of 1,000 bushels (30 tons) of grain per truck-load, with drawdown there would be an increase of approximately 95,200 truck trips to the Tri Cities area in Washington. Based on assumptions used for this study, this would result in an increase of 370 average daily truck trips or about 45 trips per hour. With the implementation of the highway improvements identified in this report, highway congestion should not increase. However, additional, more detailed engineering and traffic studies will be required to determine what highway improvements would actually be needed.

## ***Elevator Capacity Requirements***

With drawdown, it is projected that about 1.1 million tons of grain would shift from the river to rail. In addition, it is projected that an additional 2.7 million tons of grain would be shifted from Snake River ports by truck to the Tri Cities for barging to ports on the lower Columbia River. Additional storage and handling capacity would be needed at both export facilities located on the lower Columbia River and at river ports in the Tri Cities area.

**Rail Car Unloading Capacity at Export Elevators.** Analysis of rail unloading capacity at export terminals showed a total daily capacity of about 85,000 tons (1.7 million tons per month), excluding new planned at Hayden Island of 6 million tons per year. To determine if existing capacity could accommodate the increased rail shipments of grain with drawdown, historical monthly rail car unloadings at Columbia River export elevators for the period 1988—1997 were analyzed. Based on this analysis of historic peak monthly volume and expected peak additional volume with drawdown, the maximum expected demand on rail unloading facilities with drawdown is estimated to be about 1.6 million tons, which is somewhat less than existing capacity. Based on this analysis, it was determined that no additional capacity would be needed with drawdown.

**Rail Car Storage at Export Elevators.** With drawdown there would be an increase of from eight to nine unit-trains of per month being delivered to export terminals, or from about 840 to about 940 rail cars. The actual amount of storage required, however, would be significantly less because of the turn rates. The turn rates used in the analysis of the additional rail cars that would be needed reduce the number of cars actually needing storage to from 280 to 670 cars. In addition, assuming an even flow of shipments only about one-half of the cars would be at the terminals for unloading. The other one-half would be in the process of being loaded. Thus, rail storage at export terminals or on rail sidings in the area would be needed for from only about 140 to 325 additional cars. Except at Kalama, a facility that primarily handles corn, rail cars are not stored at the export terminals, except for those that are actually being unloaded. Thus, on a daily basis loaded and empty cars must be shuttled between the terminals and sidings.

To meet this demand for additional rail car storage, the most likely option was determined to be construction of a single new siding long enough to accommodate the additional cars. The estimated cost of the siding, including track, rights-of-way, turnouts and control points ranges from a low of about $2.0 million to a high of $4.1 million.

**River Elevators.** Grain that would continue to be shipped to export terminals by truck/barge would be trucked to the Tri Cities area before being loaded on to barges for the remained of the trip. The estimated volume of grain is about 2.7 million tons (90 million bushels). Analysis of the operating characteristics of river elevators showed that additional capacity needed at the confluence or the Tri-Cities area would range from 10.8 million bushels to 36 million bushels of storage and put through capacity, depending on the turnover ratio ultimately achieved. The range of cost estimated for this range of capacity is from a low of $58.7 million to a high of $335.4, depending the type of facility (barebones or state-of-the-art) and capacity. The range of estimates includes the cost of rail trackage and access roads.

**Country Elevators.** Based on information obtained from country elevator operators for the System Operation Review and updated for this study, it was determined that capacity at country elevators is adequate. However, the range of costs for improvements to upgrade railhead facilities in Washington was estimated to be from a low of $14.0 million to a high of $16.9 million. Loading and unloading facilities at railhead country elevators in Idaho are considered to be adequate to accommodate the increase in rail shipment without any improvements.

### 3.3.5.7 Cruise-Ship Commerce

An assessment of cruise-ship operations revealed that no viable alternatives exist for continued service to the destinations now included in cruise itineraries. With drawdown, up river access to cruise ships would be limited to the Tri Cities area. Analysis of impacts of limiting the length of cruises to the Tri Cities resulted in a finding that there is a high probability that extended cruises on the Columbia would not be marketable and the river would be abandoned by the industry, except for companies that offer day trips. Based on expenditure data from the Port of Clarkston, and estimated passenger trips for 1999, it is estimated that there would be an annual revenue loss to the Lewiston/Clarkston economy of about $2.6 million. The estimate does not include personal expenditures by passengers, nor does it include expenditures by the cruise ships from Astoria to the Snake River. Cruise ship operators reported to the Port of Clarkston that these expenditures are about equal to the amounts expended in the

Lewiston/Clarkston area. Adding these expenditures to the estimate for the Lewiston/Clarkston area would increase total expenditures and potential revenue loss with drawdown to over $5 million annually.

#### 3.3.5.8 Summary – Drawdown Condition

***Annual NED Transportation Costs***

Annualized transportation costs associated with all commodities under the drawdown condition are displayed below in Table 3.3-17. Annual costs are shown for discount rates of zero, 4.75, and 6.875 percent, are expressed in 1998 dollars, and are based on a 100-year period of analysis, 2007 – 2016.

**Table 3.3-17**. Drawdown Condition Summary of Average Annual Costs for All Commodities, 2007 – 2106

| Discount Rate (%) | Average Annual Cost ($) |
|---|---|
| 6.875 | $235,769,575 |
| 4.750 | $237,674,548 |
| 0.000 | $242,339,125 |

***Adjustment of Annual Costs to the Base Year 2005***

Average annual costs in Table 3.3-17 were adjusted to the base year of 2005 to be consistent with analyses of other fish restoration alternatives. This was done by discounting the values for 2007-2106 (Table 3.3-17) by two years at the appropriate discount rate. The adjusted annual costs are shown in Table 3.3-18.

**Table 3.3-18** Annual Costs Adjusted to the Base Year of 2005—All Commodities

| Interest Rate | Average Annual Costs ($) |
|---|---|
| 6.875 | 206,411,548 |
| 4.750 | 216,608,063 |
| 0.000 | 242,339,125 |

***Infrastructure Capital Costs***

In addition to the annual NED costs shown above expenditures on transportation infrastructure would also be required prior to actual implementation of drawdown to increase the capacity of the system. These costs are not part of the cost of the federal project to drawdown the Snake River, but would be required as a direct result of implementation of drawdown. Shipping, handling and storage costs used in the analysis include the amortized capital and operating costs of all of the components of the transportation system. A key assumption in the analysis is that capacity can be added to the system at a cost that is no higher than the cost of the capacity that now exists. On this basis, the annual cost of infrastructure improvements is already embedded in the shipping, storage and handling costs used in the analysis. Therefore, it is appropriate that infrastructure costs not be included in the estimated transportation costs with drawdown. A summary of infrastructure improvements that would be needed and estimated ranges of costs is below in Table 3.3-19.

**Table 3.3-19**. Summary of Estimated Costs of Infrastructure Improvements Needed with Drawdown

| | Estimated Costs ($) | |
|---|---|---|
| Infrastructure Improvements | Low | High |

| | | |
|---|---|---|
| Mainline Railroad Upgrades | 14,000,000 | 24,000,000 |
| Short-Line Railroad Upgrades | 19,900,000 | 23,800,000 |
| Additional Rail Cars | 14,000,000 | 26,850,000 |
| Highway Improvements | 84,100,000 | 100,700,000 |
| River Elevator Capacity | 58,700,000 | 335,400,000 |
| Country Elevator Improvements | 14,000,000 | 16,900,000 |
| Export Terminal Rail Car Storage | 1,985,000 | 4,053,000 |
| **Total** | **$206,685,000** | **$531,703,000** |

## 3.3.6 Comparison of Base and Drawdown Conditions

### 3.3.6.1 Increase In Transportation Costs Of Grain

The increased costs of transporting grain with drawdown are displayed below in Table 3.3-20. In terms of the cost per bushel, the increase in cost with drawdown ranges from a high of about 37 cents per bushel for Idaho to a low of just about 6 cents per bushel for Oregon. The change in costs for storage and handling are explained by the increased use of country elevators that have a slightly higher cost than river elevators whose use would be decreased with drawdown. The change in transportation costs is due to the difference in cost between alternative modes and changes in distance.

**Table 3.3-20**. Increase in Grain Shipments and Shipping Costs With Drawdown for 2007 Projected Volume, by State.[3]

| State/ Unit Cost | Volume (bushels) | Transportation ($) | Storage ($) | Handling ($) | Total ($) |
|---|---|---|---|---|---|
| **Idaho** | 32,289,941 | 4,954,984 | 894,385 | 410,294 | 6,259,663 |
| Cost per bu (cents) | 32,289,941 | 15.3 | 2.8 | 1.3 | 19.4 |
| Cost per ton ($) | 969,668 | 5.11 | 0.92 | 0.42 | 6.46 |
| **Montana** | 6,537,310 | 1,376,031 | 0 | 0 | 1,376,031 |
| Cost per bu (cents) | 6,537,310 | 21.0 | 0.0 | 0.0 | 21.0 |
| Cost per ton ($) | 196,139 | 7.02 | 0.00 | 0.00 | 7.02 |
| **N. Dakota** | 2,458,172 | 261,556 | 0 | 0 | 261,556 |
| Cost per bu (cents) | 2,458,172 | 10.6 | 0.0 | 0.0 | 10.6 |
| Cost per ton ($) | 73,753 | 3.55 | 0.00 | 0.00 | 3.55 |
| **Oregon** | 980,218 | 61,328 | 0 | 0 | 61,328 |
| Cost per bu (cents) | 980,218 | 6.3 | 0.0 | 0.0 | 6.3 |
| Cost per ton ($) | 29,409 | 2.09 | 0.00 | 0.00 | 2.09 |
| **Washington** | 84,355,029 | 11,586,875 | 1,580,001 | 737,028 | 13,903,904 |
| Cost per bu (cents) | 84,355,029 | 13.7 | 1.9 | 0.9 | 16.5 |
| Cost per ton ($) | 2,530,904 | 4.58 | 0.62 | 0.29 | 5.49 |
| **Totals** | 126,620,670 | 18,240,774 | 2,474,386 | 1,147,322 | 21,862,482 |

[3] Costs shown do not include an "adjustment" cost that was calculated by the model to prevent the cost of any movement with drawdown from being less than it was estimated to be in the base condition. The total regional adjustment amounts to $794,781.

| | | | | | |
|---|---|---|---|---|---|
| Cost per bu (cents) | 126,620,670 | 14.4 | 2.0 | 0.9 | 17.3 |
| Cost per ton ($) | 3,802,423 | 4.80 | 0.65 | 0.30 | 5.75 |

The estimated additional costs for transport of grain as a result of drawdown were converted to average annual values for the period of analysis, 2007-2106. These annual amounts, in terms of totals, cost per ton and cost per bushel and computed at three different discount rates are displayed in Table 3.3-21. The values shown reflect 1998 price levels.

**Table 3.3-21**. Average Annual Change in Shipping Costs of Grain With Drawdown at Selected Discount Rates[4]

| Cost Increase | Discount Rate | | |
|---|---|---|---|
| | 6.875% | 4.75% | 0.00% |
| **Transportation Cost Increase** | | | |
| Total ($) | 18,827,438 | 18,965,029 | 19,319,712 |
| Cost per Ton ($) | 4.96 | 4.99 | 5.09 |
| Cost per Bushel (cents) | 14.87 | 14.98 | 15.26 |
| **Storage Cost Increase** | | | |
| Total ($) | 2,553,967 | 2,572,632 | 2,620,745 |
| Cost per Ton ($) | 0.67 | 0.68 | 0.69 |
| Cost per Bushel (cents) | 2.02 | 2.03 | 2.07 |
| **Handling Cost Increase** | | | |
| Total ($) | 1,184,223 | 1,192,877 | 1,215,186 |
| Cost per Ton ($) | 0.31 | 0.31 | 0.32 |
| Cost per Bushel (cents) | 0.94 | 0.94 | 0.96 |
| **Total Annual Cost Increase** | | | |
| Total ($) | 22,565,628 | 22,730,538 | 23,155,643 |
| Cost per Ton ($) | 5.94 | 5.98 | 6.10 |
| Cost per Bushel (cents) | 17.82 | 17.95 | 18.29 |

Note: Unit costs are computed from the volume of grain projected for 2007.

| | |
|---|---|
| Total Bushels | 126,620,670 |
| Total Tons (33.33 bu/ton) | 3,799,000 |

### 3.3.6.2 Increase In Transportation Costs Of Non-Grain Commodities.

The estimated additional transportation costs of non-grain commodity movements as a result of drawdown were computed for each commodity group and for the same selected years as were used for grain. As with grain, no additional increase in volume is forecast beyond 2017. These costs are shown below in Table 3.3-22.

[4] Values exclude adjustments calculated by the model to prevent estimated costs with drawdown from being less than costs without drawdown, as follows: 0.00 percent interest, $269,805; 4.75 percent interest, $264,855; and, 6.875 percent interest $262,933.

**Table 3.3.22**. Average Annual Change in Shipping Costs for Non-Grain Commodities With Drawdown, by Commodity Group and at Selected Discount Rates

| **Year/Commodity Group** | **Cost Increase ($)** |
|---|---|
| **2002** | |
| Petroleum | 512,071 |
| Logs and Wood Chips | 1,440,861 |
| Wood Products | 1,064,591 |
| Other | 518,133 |
| **Total** | **3,535,656** |
| **2007** | |
| Petroleum | 548,456 |
| Logs and Wood Chips | 1,440,861 |
| Wood Products | 1,274,167 |
| Other | 587,610 |
| **Total** | **3,851,094** |
| **2012** | |
| Petroleum | 584,458 |
| Logs and Wood Chips | 1,440,861 |
| Wood Products | 1,629,181 |
| Other | 683,880 |
| **Total** | **4,338,380** |
| **2017** | |
| Petroleum | 673,314 |
| Logs and Wood Chips | 1,440,861 |
| Wood Products | 2,064,593 |
| Other | 790,595 |
| **Total** | **4,969,363** |

The estimated additional transportation costs of non-grain commodity movements were also converted to average annual values for the period of analysis, 2007 - 2106. These annual amounts, computed at each three discount rates, are displayed in Table 3.3-23, below. As with grain, costs reflect the 1998 price level.

**Table 3.3-23**. Average Annual Change in Shipping Costs for Non-Grain Commodities With Drawdown, by Commodity

| **Discount Rate** | **Average Annual Cost ($)** |
|---|---|
| 6.875 | 4,623,910 |
| 4.75 | 4,709,693 |
| 0.00 | 4,904,266 |

#### 3.3.6.2 Increase In Transportation Costs - All Commodities

Data presented below in Table 3.3-24 represent the average annual costs in current dollars of commodity transport attributable to closure of the Lower Snake River to commercial navigation. The costs include the adjustments referred to in footnote 4.

**Table 3.3-24.** Average Annual Shipping Cost Increase for all Commodities.

| Discount Rate | Average Annual Cost ($) |
|---|---:|
| 6.875 | 27,452,471 |
| 4.750 | 27,705,085 |
| 0.000 | 28,329,717 |

#### 3.3.6.3 Adjustment of Annual Costs to the Base Year

Average annual costs in Table 3.3-24 were adjusted to the base year of 2005 to be consistent with analyses of other economic impacts. This was done by discounting the values for 2007-2106 (Table 3.3-24) by two years at the appropriate discount rate. The adjusted annual costs are shown in Table 3.3-25.

**Table 3.3-25.** Average Annual Cost Increase--All Commodities, Adjusted to the Base Year of 2005

| Discount Rate | Average Annual Costs ($) |
|---|---:|
| 6.875 | 24,034,173 |
| 4.750 | 25,249,421 |
| 0.000 | 28,329,717 |

### 3.3.7 Risk And Uncertainty

#### 3.3.7.1 Sources of Risk and Uncertainty

The plan to breach the Federal dams on the lower Snake River raises a considerable amount of uncertainty with regard to the magnitude of economic and/or financial impacts that could potentially be experienced with plan implementation. One primary area of uncertainty as it relates to drawdown is the capability of the existing transportation system to adjust to accommodate the types of changes among modes and routings that are projected with river closure. A second area of uncertainty is the magnitude of financial impact that may be experienced by producers and shippers of commodities given the extensive transformation that would occur within the transport sector of the Pacific Northwest. Issues of risk and uncertainty include concerns about system capacity, the cost of improvements that may be needed, potential transportation rate impacts, impacts to roads and highways, and impacts on the rail system. To address the potential impacts of these and other related issues, several sensitivity analyses were developed in an attempt to identify the range of additional economic and financial costs that could potentially be experienced with river drawdown. Following is a listing of sources of risk and uncertainty that are addressed in the DREW Transportation System Impacts Analysis Report, 1999. In addition, the sensitivity to the transportation model to alternative assumptions was assessed. A summary of this assessment is presented below in Section 3.3.7.2.

Sources of risk and uncertainty that were assessed during the study:

- Capacity
  - Railroad
  - Export elevators
  - River elevators

- Roads and highways
- Modal rates
- NED efficiency loss with monopoly increase in rates
- Transportation system reliability
- Construction of a petroleum pipeline
- Grain forecast
- Potential impacts on the export market for grain
- Duration of transition to equilibrium with drawdown
- The incidence of infrastructure costs.

### 3.3.7.2 Sensitivity Of Model Results To Input Values And Assumptions

The ACCESS database model used for the analysis of transportation system costs required a number of assumptions and estimated input values. Changes to any of these assumptions would change the results produced by the model. Key assumptions and input values used in the model were reviewed and effects of the use of alternative assumptions and values were determined. The review, however, was limited to a qualitative assessment. An attempt at establishing probable ranges of values was not made nor were additional model runs made using alternative assumptions. Summary results of the review and assessment are presented in Table 3.3-26.

**Table 3.3-26.** Qualitative Assessment of the Effect of Using Alternative Assumptions and Input Values in the Transportation Analysis Model.

| Variable and Existing and Alternative Assumptions | Effect on Model Results |
|---|---|
| **Base Commodity Level**<br>• Assumption: Base commodity levels used are for 1996.<br>• Alt Assumption: Use 1997 levels. | • The assumption used results in a higher base volume for grain than if the volume for 1997 were used. If the volume in 1997 is representative of the future, the impact of drawdown is overstated (1997 grain shipments decreased by about 20 percent from 1996).<br>• Use of 1997 as the base would decrease the total volume of grain in the system and the amount that would be affected by drawdown. This would reduce the estimated increase in cost by a proportional amount: i.e., by as much as 20 percent. If 1997 shipments are a deviation from the norm rather than the basis for a new trend, this would understate long-term impacts of drawdown. |
| **Commodity Forecast**<br>• Assumption: Forecasts were derived from forecasts developed for the Columbia River Channel Deepening Study. In the context of Snake River shipments, these are demand-based forecasts.<br>• Alt Assumption: Develop forecasts specific to Snake River by analysis changes in production by commodity group. | • The accuracy of the forecast used is entirely dependent on the accuracy of the forecast developed for the Columbia River Channel Deepening Study. The effect on model results is unknowable without development of an alternate forecast. Costs for grain are not sensitive to the forecast at the per-ton or per-bushel level.<br>• The alternate forecast methodology would link the forecast directly to production in the Snake River hinterland. As a result, such a forecast might be more defensible. It is not possible to predict whether this forecast would be higher or lower than the forecast used. |
| **Commodity Origins**<br>• Assumption: Origins for grain are at the county level, except for Montana (six regions) and North Dakota (one region for the entire state). Origins for non-grain commodities (except farm commodities) are specifically defined.<br>• Alt Assumption: Expand the model to include greater detail. | • Distance for farm direct to river or rail is computed from the center of the origin county. Distance is not computed for farm to country elevator movements. Accuracy of the cost estimates is reduced for grain and other farm commodities.<br>• The level of detail could be expanded the farm level. This would improve accuracy and would allow all transportation costs to be estimated. Modeling cost would be much higher. |

**Table 3.3-26.** Qualitative Assessment of the Effect of Using Alternative Assumptions and Input Values in the Transportation Analysis Model.

| Variable and Existing and Alternative Assumptions | Effect on Model Results |
|---|---|
| **Storage Costs**<br>• Assumption: Storage costs are charged at country elevators and at river elevators. Duration of storage is the same. Average costs for each type of facility are used.<br>• Alt Assumption: Base storage duration and costs on actual industry practice, including shipments during harvest that do not require harvest. | • The assumption that river elevators are used for long-term storage is questionable. Also, the assumption that all grain is stored is questionable. The assumption almost certainly overstates storage costs.<br>• Would increase the accuracy of the model. Would require more detailed data on storage costs by type of facility (river, country and railhead) and inclusion of a demand function in the model. Revisions would improve the accuracy of the model and estimated costs would be expected to be reduced. |
| **Handling Costs**<br>• Assumption: Handling costs are charged at each facility that grain moves through, except at export elevators. Costs used are for river elevators and country elevators. Costs at railhead facilities are assumed to the same as for other country elevators. And, costs at export terminals are assumed to be the same for rail and barge shipments.<br>• Alt Assumption: Develop and include in the model estimates of handling costs for all types of elevators for both rail and barge modes. | • Assumptions that handling costs at railhead facilities are the same as at country elevators and that handling costs at export terminals are the same for rail and barge shipments are probably incorrect. Handling costs may be over or understated.<br>• Would provide for a greater level of detail and would change estimated costs but the direction of the change is not certain. |
| **Transportation Costs**<br>• Assumption: Reebie model estimates of modal costs are used.<br>• Alt Assumption: Use existing rates in the model. | • Reebie model estimates may contain errors in both truck and barge costs. Truck costs appear to be high and barge costs may be low. Correction of the errors is needed. Since costs tend to be lower than rates (except for long-haul truck) use of costs reduces estimated impacts of drawdown.<br>• Use of rates would change estimated changes in modal shift of grain and costs. Truck rates are lower than estimated costs so use of rates would decrease cost impacts. Rail costs slightly lower than rates so use of rates may not change the result by a significant amount. Barge rates are much higher than rail rates so their use would make rail a much more attractive alternative and would reduce the estimated cost impact of drawdown. |

**Table 3.3-26.** Qualitative Assessment of the Effect of Using Alternative Assumptions and Input Values in the Transportation Analysis Model.

| Variable and Existing and Alternative Assumptions | Effect on Model Results |
|---|---|
| **Elevator Capacity**<br>• Assumption: The model does not include capacity or a capacity constraint.<br>• Alt Assumption: Include a capacity function in the model. | • The absence of a capacity function in the model does not allow for analysis of system capacity requirements or identification of potential capacity constraints at specific locations. This may lead to underestimation of capacity requirements.<br>• To be very useful the capacity function would need to be elevator specific and alternative routings of grain movements in the event of a capacity constraint would need to be included in the model. This type of optimization model would greatly improve the accuracy of assessment of capacity needs with drawdown but would require a significant data gathering and modeling effort. |
| **Seasonality of Shipments**<br>• Assumption: The model does not include a demand function.<br>• Alt Assumption: Include a demand function in the model. | • The capability of the system to meet seasonal fluctuations in grain shipments was assessed by examining the peak historic single-month demand adjusted to what it would be with increased rail shipments. This showed that there is sufficient capacity. A number of factors could cause this estimate to be either high or low.<br>• Including a demand function in the model could potential identify grain- handling constraints at hinterland and terminal elevators. Accurate modeling would require detailed data on handling capacity of all elevators, including rail car handling and unloading. This would require a significant modeling effort and it would be difficult because of the numerous variables to consider. The effect on model results is not predictable. |

## 3.3.8 Unresolved Issues

### 3.3.8.1 General

There are a number of unresolved issues relating to the analysis, especially the modeling of the transportation system with and without drawdown. These issues are identified and briefly described below.

### 3.3.8.2 Commodity Forecasts

Commodity forecasts used for the analysis were developed from forecasts of commodity movements on the lower Columbia River deep-draft navigation channel. These forecasts were developed for the Corps' study of the feasibility of deepening the deep-draft channel from Portland to the ocean. The forecasts developed for this study were obtained by simply prorating the forecast for the lower river to the Snake River on the basis of the Snake River's historic share of shipments on the lower Columbia River. Arguments have been made that this type of forecast is inappropriate because it does not actually include consideration of sources of commodities in the Snake River hinterland.

### 3.3.8.3 Modeling Logic and Use of Adjustments

The transportation system model is based on the logic that the current pattern of commodity shipments must be an optimized least-cost system. On this basis, modelers designed the model to prevent the cost of any commodity movement from being less costly with drawdown than it was without drawdown. The modeler's objective was accomplished by including an adjustment in the model that is equal to the difference between the cost of commodity movement with drawdown and cost without drawdown. If the cost of the movement with drawdown is less than it was estimated to be without drawdown, the difference is added to the estimated cost with drawdown, thus making the costs the same for both conditions.

The IEAB questions the validity of the use of the adjustment on the basis that it distorts (or rigs) the results of the modeling effort. They point out that all models are extractions from reality and that it is inappropriate to make adjustments to try to make them match reality. In the case of the DREW model, there are a number of reasons why the model would show lower costs for some movements with drawdown than without drawdown. First, and foremost is the fact that some people do things for other than economic reasons. This kind of non-economic behavior cannot be captured in a model. Secondly, the problem could be due to errors in the model: i.e., errors in transportation, storage or handling costs. The IEAB has stated that the adjustment should be deleted from the model.

### 3.3.8.4 Truck Costs

Truck costs used in the transportation system model are significantly higher than truck costs estimated for the Corps in a study by the Upper Great Plains Transportation Institute. A preliminary review of Reebie Model truck costs for a sampling of movements showed that there is an error in the way driver costs were calculated, making them much higher than they apparently should be. For example, the UPGTI study reported a total allocated cost for long-haul truck movement of grain of $1.04 per mile, with a driver cost of $0.29 per mile. By comparison the cost for one movement of 870 miles (round-trip) in the transportation system model has a cost of $2.716 per mile, with a driver cost of $1.315 per mile. Correction of errors in truck costs used in the model would significantly lower the cost of truck movements of commodities and could change (decrease) the volume of grain that is predicted to shift to rail with drawdown.

### 3.3.8.5 Barge Costs

There is a large difference between barge costs as estimated by the Reebie Barge Model and rates that are actually charged by the barge industry. For example, the cost estimated by the Reebie Model for shipping grain from Almota, WA to Portland is $3.07 per ton compared with the actual rate charged by the industry of about $6.07 per ton. Industry representatives have stated on numerous occasions that the costs estimated by the Reebie Barge Model are incorrect (too low). In response to the comments by representatives of the barge industry, Corps analysts reviewed three other studies of barge costs. The finding was that all of the studies showed that rates are significantly higher than costs. In addition, input data for the Reebie Model were provided to an industry representative for review and comment. That review has not been completed. If barge costs are in fact higher than the Reebie Model costs used in the transportation system model, use of actual costs in the model would tend to offset the effect of using lower truck costs as described above.

### 3.3.8.6 Storage and Handling Costs

Model estimates of storage and handling costs for grain shipped to the Northwest from the states of Montana and North Dakota amount to nearly $6.50 per bushel. This is almost double the market value of wheat and clearly is not representative of the long-run equilibrium condition that the model is supposed to represent. Corps modelers are aware of this problem and, in fact, have corrected the problem. However, revised model results were not available for inclusion in the draft report. For the draft report, it is important for readers to understand that the error has no effect on the primary objective of the model—to estimate the change in costs with drawdown—because these costs are the same with and without drawdown.

Another issue with storage and handling costs is the use of “rates” rather than costs. In this regard, the model is inconsistent because costs are used for alternative transportation modes, but rates are used for handling and storage. One effect of the use of rates is that the model uses the same handling rate for rail and barge shipments at the downriver export terminals. This is consistent with actual practice because the terminals do in fact charge the same handling rate for both rail and barge shipments. However, industry representatives have stated that handling costs for rail shipments are actually about 40 percent higher than for barge shipments.

### 3.3.8.7 NED Effects of Redirected Cross-River Road Traffic

The Lower Monumental Dam is the connecting link between Lower Monumental Road (south side) and Devils Canyon Road (north side) and the Lower Granite Dam is the link between Lower Deadman Road (south side) and Almota Road (north side). Alternate routes are Washington 126 that crosses the river at Lyons Ferry and Washington 127 that crosses the river at Central Ferry, respectively. Use of the alternate routes could increase overall travel distance of users, depending on their origin and destination. While the other two dams, Ice Harbor and Little Goose, have road crossings, they do not appear to link major state or county roads and so appear to be primarily used by project operators and tourists. The IEAB has stated that the NED effects of severing the roadways that are linked by the Snake River dams should be quantified.

### 3.3.8.8 Inconsistency in Truck Long-Haul Distances

The transportation system model defines long-haul truck movements of grain as movements of 150 miles or more and uses a cost that is based on the availability of a two-way haul (backhaul). However, the study conducted for the Corps by the Upper Great Plains Transportation Institute found that the break between short-haul (local market) and long-haul-truck movements is 250 miles. This distance was defined on the basis of the finding that this is the distance where rail shipment of grain becomes competitive with truck shipment. The UGPTI study further found that long-haul shipment of grain only occurs in the presence of two-way haul opportunities. This finding is consistent with modeling done by the Corps that assumes the presence of backhaul for all long distance (150 miles or more) truck shipments of grain. The IEAB has stated that there should be consistency in long-haul assumptions between the two studies.

### 3.3.8.9 Continued Use of Existing Snake River Elevators With Drawdown

With drawdown and closure of the Snake River to barge traffic, 12 river elevators could become abandoned. In 1998 these facilities handled a combined total of over 100 million bushels of grain.[5] With drawdown, the alternate river port becomes the Tri Cities area. Construction of replacement facilities in the Tri Cities could cost over $300 million. A less costly alternative may be to continue using some of the existing facilities as railroad loading facilities. In particular, the location of the facilities at Central Ferry might make them an attractive railhead alternative. Additional study would be needed to determine if conversion of these facilities to a railhead would lower overall costs.

### 3.3.8.10 Cruise Ship Industry Impacts

The industry position is that with dam removal, cruise operators would most likely abandon the Columbia River and relocate vessels to other rivers where longer cruises are possible. However, the Corps believes that this may not actually happen and that in fact the industry will remain in the region, even with removal of the dams. Additional study is needed to determine the feasibility of cruise operations on the Columbia River without access to the Snake River to the Lewiston/Clarkston area. Without these studies estimates of potential regional impacts of dam removal range from no impact to a total of about $5 million annually. Also, it is not known whether dam removal would result in any NED impacts to the industry—the present analysis is based on an assumption there would be no NED impacts.

[5] Tidewater Barge Lines, Inc. July 1999. "Yearly Estimated Volumes of Grain by Facility—1998."