SECTION 4 - TRANSPORTATION RATE ANALYSIS

DEVELOPMENT OF THE RATE SAMPLE

To form the basis of the transportation rate analysis, a sample of aggregated movements was selected from a subset of the 1989 Waterborne Commerce detail records database. Transportation rates were developed for this sample of movements. This process was accomplished as follows.

The records in the WCSC database represented individual barge-level movements that travelled any portion of the GIWW -Mississippi River to Sabine, GIWW - Morgan City to Port Allen Alternate Route, or the Innerharbor Navigation Canal waterways. In addition to tonnage and origin/destination information, these records also include a 4-digit commodity code, and a waterway routing indicator (alt code) for movements where alternative routings are applicable. Records with the same 4-digit commodity code, origin port, destination port and alt code were aggregated to produce annual port-level tonnage flows representing 6,223 records and 75.5 million tons. All subsequent processing was based on these aggregated annual flows. Separate files were constructed for those movements which used the IHNC lock and those movements which did not. These files were then aggregated into "cells". In the IHNC file these "cells" consisted of movements with a common origin PE, destination PE and 10-group commodity code, with its level of tonnage equal to the sum of those movements. A PE (Port Equivalent) code is defined by ranges of WCSC port-dock codes and represents a waterway section. Similarly, the non-IHNC file was aggregated into "cells", however, in this file the "cells" consisted of movements with a common origin PE, destination PE, and 10-group commodity code but also common alt codes. The alt codes, which indicate waterway use, were used in this file because more than one route over the modelled system was possible between the origin and destination.

At the outset, it was thought possible that a sample could be developed that would provide cell-level coverage of approximately 95 percent of the total system tonnage. To do this, 348 of the largest "cells" (by tonnage) were selected in the IHNC file and 597 of the largest "cells" (by tonnage) were selected in the non-IHNC file. Summing the tonnage in these 945 "cells" produced 71,354,000 million tons which represented 94.5 percent of the total system tonnage of 75,507,000 tons.

Next, within each "cell", individual movements were assigned a weight equal to its own tons divided by the total tonnage in the "cell". These percentages were then transformed into cumulative percentages and multiplied by 100 to produce and integer between 1 and 100 for each movement. Next, using a random number generator, a number between 1 and 100 was assigned to each "cell".

The first movement within each "cell" whose integer was greater than or equal to this random number was selected for the sample. The effect of this procedure was to select a single movement from each "cell" with the probability of selection for a given movement equal to that movement's "cell" tonnage proportion. The final product was a sample of 945 movements with a total of 34,441,000 tons, 46 percent of the total system tonnage. Table 4 - 1 displays the 1989 rate sample tonnage as a percent of 1989 system tonnage by commodity group.

TRANSPORTATION RATE ANALYSIS

The transportation rate analysis was conducted by the Tennessee Valley Authority (TVA) under contract with the New Orleans District. The objective of the study was to calculate line-haul transportation rates and supplemental costs for a sampling of 944 dock-to dock movements taken from the 1989 waterborne traffic base. (One movement in the 945 movement sample was determined to be non-commercial traffic and was removed, leaving 944 movements identified for analysis.)

For each sample movement, a calculation of freight rates was made by a system waterway route, and by one or more land routes utilizing an alternate mode of transportation. Total origin to destination shipping costs were calculated, including loading and unloading costs at origin and destination. The costs of subsequent overland movements and intermodal transfer costs at origin and destination were also calculated. Computations reflect those charges that were in effect during the third quarter of 1992. The following paragraphs detail the study's guidelines, methods of research and supporting assumptions.

ROUTING OPTIONS

With respect to land routes 911, 310 and 9 movements were evaluated for rail, truck, and pipeline rates respectively. As a general rule, all movements of 400 miles or less and less than 100,000 tons were evaluated for truck.

For 60 movements involving Intracoastal Waterway points east of New Orleans and points on the Middle and Upper Mississippi River, Illinois Waterway, Ohio River System, and Tennessee and Cumberland Rivers, an alternate

Table 4 - 1

1989 Rate Sample Tonnage As A Percent
Of 1989 System Tonnage

Commodity group	Sample Tons as a percent of System Tons	Sample Cells as a percent of System Cells	Sample Cell Tonnage as a percent of System Tonnage
Farm Products	33%	27%	77%
Metallic Ores and Products	42%	31%	82%
Coal	89%	58%	99%
Crude Petroleum	51%	66%	98%
Nonmetallic Minerals	48%	42%	93%
Forest products and pulp	82%	44%	87%
Industrial Chemicals	44%	44%	94%
Agricultural Chemicals	19%	24%	71%
Petroleum Products	33%	53%	96%
All Others	46%	41%	95%
Total	46%	42%	95%

non-system waterway routing was calculated via the Tennessee-Tombigbee Waterway.

Table 4-2 summarizes the routing options considered for the 944 movements of the rate sample.

ASSUMPTIONS

Actual shipment costs and supporting information were obtained from shipper, receivers, carriers, and riverport terminals wherever possible. In the absence of specific shipper/receiver information, it was assumed that the river origin and destination were the originating and terminating points for both the river route and alternate mode of transportation.

It was assumed that commodities loaded or unloaded to or from barges could also be loaded or unloaded to or from rail cars or trucks.

It was assumed that the alternate modes of transportation would have the physical capacity to accommodate the tonnages involved for each commodity movement, except that truck transportation was not considered to be a viable option for shipments involving tonnage of 100,000 tons or more.

It was assumed that for movements involving tonnages of less than 100,000 tons, shippers or receivers not served by rail would utilize truck transportation from or to the nearest railhead. It was further assumed that facilities would be available at the rail location to accommodate the transfer. For movements involving tonnages of 100,000 tons or more, it was assumed that rail facilities would be constructed by the carrier, shipper, or receiver. It was assumed that any construction costs incurred by the shipper or receiver would be assigned to the cost of production, rather than to the cost of transportation. While it is possible that construction costs incurred by carriers would be passed on to shippers or receivers in the form of higher rates, these costs were considered to be beyond the scope of this study.

METHODS AND PROCEDURES

As a result of transportation deregulation, it is virtually impossible to determine with absolute precision the exact rate charged by a carrier on a large-tonnage movement. Barge rates are a matter of negotiation between shipper and carrier and are not published in printed tariff form. Each carrier's rates are based on individual costs and will vary from one barge line to another.

Table 4 - 2

Rate Sample Observations by Commodity Group
And Transportation Mode

Commodity Group	Water	Alt Water Tenn-Tom	Rail	Truck	Pipeline
Farm Products	61	11	61	23	0
Metallic Ores	108	7	106	22	0
Coal	31	22	31	2	0
Crude Petroleum	92	0	78	66	0
Non-Metallic Minerals	117	4	114	24	0
Forest Products	7	2	7	4	0
Industrial Chemicals	168	1	167	27	0
Agricultural Chemicals	43	0	41	11	0
Petroleum Products	280	12	274	110	9
All Others	37	1	32	21	0
Total	944	60	911	310	9

Contract rates are prevalent in the rail and trucking industries and are not public knowledge. Rates are published in tariff form on bulk commodities; however it is difficult to determine those movements that are rated on a tariff basis as compared to those movements that are rated on a contractual basis.

Rates provided by carriers, shippers, receivers or riverport terminals were used wherever possible. All other rates were obtained from published sources or were constructed by TVA, depending on the mode of transportation or tonnages involved.

Barge Rates

With the exception of actual rates obtained from shippers, carriers, or riverport terminals, barge rates were calculated using a computerized barge costing model. The model, which was obtained from another government agency and modified by TVA, was programmed to include 1992 fixed and variable costs information obtained from the towing industry.

The costing model contains two modules--a general towing service module and a dedicated towing service module. The general service module calculates rates by simulating the use of general towing service conditions between origin and destination. This includes, among other things, interchange of barges between two or more carriers.

The dedicated service module calculates costs by simulating round-trip movements between origin and destination. This includes the use of the same towboat for the loaded movement from origin to destination and the return of the empty barge(s) from destination back to origin.

Both modules require various inputs, but among the more important are, towboat sizes (horsepower); barge types; shipment weights; and empty return ratios.

Barge rates on dry commodities were calculated using the general towing service costing module. Inputs based on information obtained from carriers and the Corps of Engineers' Lock Performance Monitoring System (LPMS) database were used in the module to simulate the average towboat size (horsepower) and corresponding tow size (barges) for each segment of the inland waterway system. Other inputs included barge types, waterway speeds and horsepower ratios.

Empty return ratios for dry commodity movements were generally calculated at 70 percent; however movements with both origin or destination on the Intracoastal Waterway east of Houston or origins or destinations on the Lower Mississippi south of Baton Rouge were calculated on a round-trip basis.

Depending on the type of movement, tonnage and barge size involved, rates on liquid commodities were calculated with the use of either the general towing service or the dedicated towing service module. For commodities that are normally transported in barges measuring 195 x 35 feet, rates were calculated with the use of the general towing service module. Since barge sizes are compatible, these shipments can be integrated into the same tows with dry commodities. Commodities that are normally transported in general towing service include sodium hydroxide, molasses, tallow, and certain chemical products.

The determination of general or dedicated service calculations for alcohols, benzene, chemicals, and miscellaneous chemical products was based on the volume involved. For movements with tonnages of less than 10,000 tons, rates were calculated with the use of the general towing service module. For movements with tonnages of 10,000 tons or more, rates were calculated with the use of the dedicated towing service module.

All rates on asphalt and crude and refined petroleum products were calculated with the use of the dedicated towing service module. All rates on liquid commodities were calculated on a round-trip basis, whether general or dedicated service towing.

Rail Rates

It was assumed that tariff rates would apply to all rail shipments with annual volumes of less than 5,000 tons. For shipments with annual volumes of 5,000 tons or more, contractual rates were constructed on the basis of a percentage reduction of the tariff rate or with the use of a computerized rail costing model developed by Reebie Associates.

Rates on grain, grain sorghum, and grain mill products were based on a percentage relationship to the published tariff rate. Multiple car or volume rates were utilized wherever possible. It was also assumed that all shipments of grain, grain mill products and rice would move in covered hopper cars owned by the carrier.

Rail rates on all other commodities were calculated with the use of the Reebie Associates costing model. This model identifies the rail carrier's variable and fixed costs between origin and destination and the relationship of these costs to the movement's published tariff rate.

Truck Rates

Actual truck rates were used wherever possible. All other rates were estimated on the basis of a formula derived from a comparison of rates published in tariffs, known contractual rates, costs applicable on an hourly rental basis, and private fleet truck costs.

Pipeline Rates

Published pipeline rates were used wherever possible. A number of movements from or to river terminals were routed via relatively short pipeline systems that were privately owned. Rates for these movements were estimated on the basis of rates published in tariffs for comparable distances.

Handling Charges

Handling charges between modes of transportation were estimated on the basis of information obtained from shippers, receivers, and terminal operators. Handling charges for transfer of commodities from or to ocean vessels were estimated on the basis of information obtained from ocean ports or stevedoring companies. In general, it was assumed that movements of bulk products, (e.g., grain) would be handled through elevator or storage facilities at both origin and destination.

Loading and Unloading Costs

Loading and unloading costs are not normally documented by shippers and receivers. Costs will vary from company to company and are often-times considered as part of the cost of production. A number of sources were utilized in obtaining loading and unloading costs, but for the most part reliance was placed on information obtained from shippers and receivers.

Attachment 1 of the appendix summarizes the results of this study. The attachment consist of the commodity, tons, original water rate, alternate water rate (Tenn-Tom), primary land rate and alternate land rate for each of the 944 sample movements.

EXPANDING THE RATE SAMPLE TO THE POPULATION

ASSIGNMENT PROCESS

As was mentioned previously, the sample movements evaluated by TVA represented 1989 WCSC data. However, after TVA completed their analysis, 1990 traffic was ready for use. In order to work with the most current data available, the decision was made to match the rates TVA calculated in the 1989 sample to the 1990 records. Table 4 - 3 shows how the 1989 rate sample applies to the 1990 system tonnage. Comparison of tables 4 - 3 and 4 - 1 clearly indicates that the origin-destination patterns for 1989 and 1990 traffic are quite similar.

The 1990 traffic file was processed in a manner that was essentially the same as described with the 1989 traffic. Records representing movements that travelled any portion of the GIWW -Mississippi River to Sabine, GIWW - Morgan City to Port Allen Alternate Route, or the Innerharbor Navigation Canal waterway segments were extracted by WCSC from the 1990 data base and provided as a single file. Tonnage with the same 5-digit commodity code (1990 WCSC uses a more detailed 5-digit commodity code rather than the previous 4-digit code used in the 1989 movement file), origin port, destination port and alt code was aggregated to produce annual port-level tonnage flows. At this level, system lock usage was assigned for each movement. The 1990 movement file had a total of 7,174 records and 73.4 million tons, 22.7 million tons of which represented IHNC movements.

To assist with the assignment of rates, the 1989 4-digit commodity code was added to the 1990 movement file, since the 1989 sample rate study only has the 4 digit commodity code. In addition, to facilitate further file processing and aggregation, each record in the 1990 movement file was assigned a commodity group number based on the 10-category classification scheme, described earlier in Section 2.

Records in the 1990 WCSC movement file were divided into two separate files, one representing IHNC traffic and the other representing non-IHNC traffic. As mentioned earlier, the reason for this distinction is due to the fact that alt codes, which indicate waterway use, are required for route identification for non-IHNC traffic since more than one waterway is possible between the origin and destination. The objective then was to match transportation rates from 1989 IHNC sample records to the 1990 IHNC records and non-IHNC 1989 sample records to 1990 non-IHNC records. To accomplish this task, it was necessary to match sampled

Table 4 - 3

1989 Rate Sample Tonnage As A Percent
Of 1990 System Tonnage

Commodity group	Sample Tons as a percent of System Tons	Sample Cells as a percent of System Cells	Sample Cell Tonnage as a percent of System Tonnage
Farm Products	39%	27%	91%
Metallic Ores and Products	32%	28%	63%
Coal	78%	55%	87%
Crude Petroleum	57%	52%	100%
Nonmetallic Minerals	38%	36%	72%
Forest products and pulp	67%	21%	71%
Industrial Chemicals	46%	42%	97%
Agricultural Chemicals	18%	23%	67%
Petroleum Products	37%	52%	100%
All Others	100%	29%	100%
Total	47%	39%	97%

records to the 1990 population at several levels of aggregation.

In the first level matching, records in the IHNC rate sample were matched to the 1990 IHNC records on the basis of common origin port, origin dock, destination port, destination dock, and 4-digit commodity code. The records in the non-IHNC rate sample were matched to 1990 non-IHNC records in the same fashion, but now common alt codes were also used as the basis for comparison. When a match was identified, total transportation costs for the original water route, alternate water route, and primary land route were assigned to the 1990 movement. (With the exception of two movements in the overall rate sample, which represented only 0.2 percent of the total tons in the sample, the primary land route was always less costly than the alternate land route. As a result, matching alternate land costs was considered unnecessary.) To make this assignment, the weighted average cost for IHNC sample movements grouped by origin port, origin dock, destination port, destination dock, and 4-digit commodity code was calculated. When an IHNC sample movement was matched to an IHNC 1990 population movement, the cost, which represent a cost per ton, was assigned to the IHNC 1990 population movement. This same method was employed when matching non-IHNC movements, except the weighted average cost calculation for non-IHNC sample movements included the use of alt codes when movements were grouped. This initial matching assigned costs to 6 percent of the total 1990 population movements representing 28 percent of the total tonnage. In the IHNC section alone, costs were assigned to 9 percent of the total IHNC movements representing 43 percent of the total IHNC tonnage. This degree of coverage is very good considering that at this level of grouping, the matching taking place is essentially on an individual movement basis.

In order to assign costs to those movements not initially matched, several more levels of matching needed to be performed. The second matching was based on common origin PE, destination PE, and 10-group commodity code for IHNC movements with the additional common alt codes for non-IHNC movements. As described in the first level of matching, this procedure assigned weighted average costs from the IHNC sample movements and non-IHNC sample movements, grouped as described for the second matching. When a sample movement was matched to a 1990 population movement, the costs per ton for the various means of transportation were assigned to the WCSC movement. After this second level of matching, 46 percent of the 1990 movements representing 66 percent of the total tonnage was assigned costs. In the IHNC section alone, costs were assigned to

30 percent of the total IHNC movements, representing 60 percent of the total IHNC tonnage.

The third level of matching was based on common waterway segment origin and destination (the 2-digit level of the 4-digit origin and destination PE codes), and 10-group commodity code for IHNC movements with the additional common alt codes for non-IHNC movements. At this level of matching, as well as the following ones, the weighted average costs per mile for the various means of transportation were calculated, grouped as described for this level of matching. Weighted average cost per mile was used instead of weighted average cost per ton, as was the case for level 1 and level 2, because from level 3 on, the potential for substantial mileage variation existed between the sample movement and the population movement matched to it. Since transportation costs are very much a function of distance, it was viewed as necessary to assign a mileage sensitive cost. When a sample movement was matched to a WCSC movement, the cost per ton mile for the sample movement was multiplied by the mileage of the 1990 movement. This product was the cost per ton assigned to the 1990 movement. For example, the weighted average cost per mile of an original water rate from a sample movement was multiplied by the water mileage of the 1990 movement. This method works well for assigning original water cost per ton estimates to 1990 population movements since in the 1990 file, water mileage estimates are already included in the WCSC file. However, when assigning primary land and alternate water cost per ton estimates, the appropriate original land mileage and alternate water mileage in the WCSC file had to be calculated externally.

To estimate primary land mileages and alternate water mileages in the file, a regression analysis was performed using data from the TVA rate sample. The primary objective of regression analysis is to predict the value of one variable (the dependent variable) given that the value of an associated variable (the independent variable) is known. The regression equation is the algebraic formula by which the predicted value of the dependent variable is determined.

Along with transportation costs for each of the sampled movements, TVA also provided estimates on original water mileage, primary land mileage, and alternate water mileage. By running a regression analysis, with original water mileage as the independent variable and land mileage as the dependent variable, the resulting regression equation could be used to predict a land mileage based on the original water mileage estimate in the 1990 file. The regression analysis, performed on the sample movements, was done on the 10-commodity code classification scheme. As a result, each of the 10 commodity codes has an individual regression equation.

The regression equations used to predict primary land mileage estimates, in the 1990 file, are provided in table 4 - 4. Also included, are the coefficient's of determination (R-squared) for each of the 10 equations. This coefficient indicates the proportion of the variance in the dependent variable (land mileage), explained by knowledge of the independent variable (original water mileage). Tests of significance indicate that there is a statistically significant relationship between these two variables.

In order to estimate alternate water mileage for the 1990 movements, another regression analysis was performed on the rate sample using the land mileage as the independent variable and the alternate water mileage as the dependent variable. This formulation for estimating the alternate water mileage was selected from a variety of other investigated specifications, because it produced the greatest degree of explanatory power. (In the sample, only movements with an alternate water mileage were included in the analysis.) The resulting regression equations were then used to predict the alternate water mileage based on the primary land mileage already calculated from the previous regression analysis. (For the 1990 movements, an alternate water mileage was calculated for only those movements where the Tenn-Tom Waterway was considered a reasonable alternate route.)

As before, the regression analysis was performed for each of the 10 commodity groups, however for crude petroleum, forest products, industrial chemicals, agricultural chemicals and the all other commodity group, there were not enough movements in the rate sample to perform a meaningful analysis. Therefore, the decision was made to perform the regression analysis on all the sample movements with an alternate water mileage, disregarding the commodity group distinction. This single regression equation was used to estimate alternate water miles for these five commodity groups. The resulting six different regression equations along with their coefficients of determination are also displayed in table 4 - 4. As with the previous regression equations, test of significance revealed a true relationship between the two variables.

With the above mileage estimates, the primary land and alternate water cost per ton calculations were performed in the same manner as the original water costs per ton. After this third level of matching, 81 percent of the total 1990

Table 4 - 4

Regression Equations Used to Predict
Primary Land Miles and Alternate Water Miles

Commodity	Primary Land Miles	R-Squared	Alternate Water Miles	R-Squared
Farm Products	37.4237 + .7498 x Original Water Miles	0.91	176.6945 + .9544 x Land Miles	0.91
Metallic Ores	176.0323 + .5210 x Original Water Miles	0.76	-195.3749 + 1.490 x Land Miles	0.82
Coal	166.4695 + .4512 x Original Water Miles	0.75	-4.9575 + 1.214 x Land Miles	0.73
Crude Petroleum	-17.2043 + .8719 x Original Water Miles	0.77	143.198 + .666 x Land Miles	0.77
Non-Metallic Minerals	114.1096 + .6871 x Original Water Miles	0.71	-1577.96 + 3.596 x Land Miles	0.46
Forest Products	102.5304 + .5338 x Original Water Miles	0.98	143.198 + .666 x Land Miles	0.77
Industrial Chemicals	102.1856 + .6853 x Original Water Miles	0.91	143.198 + .666 x Land Miles	0.77
Agricultural Chemicals	-6.5211 + .9087 x Original Water Miles	0.70	143.198 + .666 x Land Miles	0.77
Petroleum Products	81.7960 + .6604 x Original Water Miles	0.90	-149.816 + 1.5676 x Land Miles	0.72
All Others	31.7142 + .7048 x Original Water Miles	0.96	143.198 + .666 x Land Miles	0.77

movements, representing 90 percent of the total tonnage, were assigned costs. For the IHNC records only, 65 percent of the IHNC movements, representing 86 percent of the IHNC tonnage, were assigned costs.

The fourth level of matching was based on common waterway segment destination (the 2-digit level of the 4-digit PE code), and 10-group commodity code for both the IHNC movements and non-IHNC movements. As before, this procedure assigned a weighted average cost per mile, for the various means of transportation, to the 1990 movements when a sample movement matched a 1990 movement. This cost per mile was then multiplied by the appropriate mileage figure to produce a cost per ton estimate. After this fourth level of matching, 93 percent of the total 1990 movements, representing 96 percent of the total tonnage, were assigned costs. For the IHNC records only, 83 percent of the movements, representing 92 percent of the tonnage, were assigned costs.

In the fifth and last level of matching, those records that were still unassigned, were matched based only on the 10-group commodity code for both the IHNC movements and non-IHNC movements. As with the third and fourth level of matching, this assignment was accomplished using the product of the costs per mile from the sample movements, now grouped as described in this fifth level of matching, and the appropriate mileage of the movement to be assigned a cost. With this last level of matching, all 7,174 movements in the 1990 file were assigned an original water cost per ton, a land cost per ton, and an alternate water cost per ton.

SUMMARY OF RESULTS

For each of the movements in the 1990 file, an estimate of the difference between total water transportation cost (original water cost per ton) and total cost for the movement via the next least costly non-system alternative means of shipment (i.e., land cost per ton or alternate water cost per ton) was made. This difference is referred to as the net cost savings of the ton's potential movement via the system. These savings are deemed net as opposed to gross because the water costs are inclusive of system lock delays. Savings measured with lock delays taken out of water costs are referred to as gross cost savings. Table 4 - 5 shows the overall distribution of net gross cost savings for the entire system and IHNC movements only. Table 4 - 6 shows the distribution of these net cost savings broken down by the first two levels of matching and then by the next three levels of matching. As can be seen, two percent of the total number of records for the system,

Table 4 - 5

Net Cost Savings Distribution
For the Total System and IHNC Movements
(1992 Prices)

Net Cost Savings ($)	Total System # Of Records	Total System Tons	Total System % Of Total Tons	IHNC Movements # Of Records	IHNC Movements Tons	IHNC Movements % Of Total Tons
<0	144	591,681	0.8%	86	404,143	1.8%
>=0 <1.50	127	2,311,060	3.1%	109	2,184,755	9.6%
>=1.50 <4.00	242	7,420,020	10.1%	149	6,750,406	29.7%
>=4.00 <7.00	800	8,259,138	11.3%	224	1,996,185	8.8%
>=7.00 <11.00	1,187	11,346,176	15.5%	275	1,722,970	7.6%
>=11.00 <16.00	1,314	12,657,176	17.2%	419	3,633,923	16.0%
>=16.00 <24.00	1,408	15,126,602	20.6%	431	4,148,010	18.3%
>=24.00 <31.00	949	8,593,746	11.7%	142	1,177,214	5.2%
>=31.00 <36.00	427	3,154,898	4.3%	61	211,520	0.9%
>=36.00 <42.00	252	2,204,668	3.0%	28	339,245	1.5%
>=42.00 <50.00	141	839,068	1.1%	11	42,343	0.2%
>=50.00 <60.00	91	369,603	0.5%	15	42,715	0.2%
>=60.00 <70.00	51	273,492	0.4%	12	53,413	0.2%
>=70.00 <80.00	30	185,783	0.3%	1	300	0.0%
>=80.00	11	66,271	0.1%	2	15,654	0.1%
Total	7,174	73,399,382	100%	1,965	22,722,796	100%

Table 4 - 6

Net Cost Savings Distribution
by Levels of Matching
(1992 Prices)

Net Cost Savings ($)	Total System Levels of Matching 1 - 2: # Of Records	Tons	% Of Total Tons	Total System Levels of Matching 3 - 5: # Of Records	Tons	% Of Total Tons
<0	11	141,983	0.3%	133	449,698	1.8%
>=0 <1.50	51	1,841,923	3.8%	76	469,137	1.9%
>=1.50 <4.00	80	5,620,556	11.5%	162	1,799,464	7.3%
>=4.00 <7.00	464	6,707,686	13.7%	336	1,551,452	6.3%
>=7.00 <11.00	620	7,603,340	15.6%	567	3,742,836	15.2%
>=11.00 <16.00	572	7,861,151	16.1%	742	4,796,025	19.5%
>=16.00 <24.00	681	10,157,785	20.8%	727	4,968,817	20.2%
>=24.00 <31.00	387	4,652,304	9.5%	562	3,941,442	16.0%
>=31.00 <36.00	203	1,887,887	3.9%	224	1,267,011	5.2%
>=36.00 <42.00	109	1,440,415	3.0%	143	764,253	3.1%
>=42.00 <50.00	63	492,438	1.0%	78	346,630	1.4%
>=50.00 <60.00	47	178,059	0.4%	44	191,544	0.8%
>=60.00 <70.00	18	112,025	0.2%	33	161,467	0.7%
>=70.00 <80.00	18	98,542	0.2%	12	87,241	0.4%
>=80.00	5	30,405	0.1%	6	35,866	0.1%
Total	3,329	48,826,499	100%	3,845	24,572,883	100%

Net Cost Savings ($)	IHNC movements Levels of Matching 1 - 2: # Of Records	Tons	% Of Total Tons	IHNC movements Levels of Matching 3 - 5: # Of Records	Tons	% Of Total Tons
<0	9	105,005	0.8%	77	299,138	3.3%
>=0 <1.50	40	1,773,412	13.0%	69	411,343	4.5%
>=1.50 <4.00	31	5,173,796	37.9%	118	1,576,610	17.4%
>=4.00 <7.00	92	1,457,757	10.7%	132	538,428	5.9%
>=7.00 <11.00	60	556,582	4.1%	215	1,166,388	12.8%
>=11.00 <16.00	122	1,772,673	13.0%	297	1,861,050	20.5%
>=16.00 <24.00	157	1,860,184	13.6%	274	2,287,826	25.2%
>=24.00 <31.00	54	619,419	4.5%	88	557,795	6.1%
>=31.00 <36.00	13	48,901	0.4%	48	162,619	1.8%
>=36.00 <42.00	3	219,153	1.6%	25	120,092	1.3%
>=42.00 <50.00	2	5,687	0.0%	9	36,656	0.4%
>=50.00 <60.00	5	18,880	0.1%	10	23,835	0.3%
>=60.00 <70.00	4	31,573	0.2%	8	21,840	0.2%
>=70.00 <80.00	0	0	0.0%	1	300	0.0%
>=80.00	0	0	0.0%	2	15,654	0.2%
Total	592	13,643,222	100%	1,373	9,079,574	100%

representing one percent of the total tons has a negative net cost savings. This means that for these movements, using a non-system alternative means of transportation appears to be the least costly, suggesting that some shippers are behaving uneconomically. Those movements in the TVA sample with a negative net cost savings were only included in the first level of matching. For all subsequent levels of matching, the effect of the negative net cost savings sample movements were excluded from the calculation and assignment of weighted costs. These movements were excluded in order to minimize the distortions that the negative net cost savings movements produced in the subsequent levels of matching.

As a final illustration of the transportation rate analysis sample and the expansion of this sample to the population of movements, table 4 - 7 displays the weighted average net cost savings and weighted average mileage, for the system as a whole by commodity group.

<u>WITH-PROJECT SAVINGS ADJUSTMENT</u>

When TVA assigned water transportation costs to IHNC traffic, included in these rates is the cost of hiring assist vessels tow operators must incur whenever there is a need to cut the tow to transit the existing IHNC Lock. When analyzing a larger lock in the with project condition, the number of multiple-cut lockages would necessarily decrease. Therefore an adjustment was made to the with-project gross cost savings of IHNC traffic to reflect the corresponding reduction in assist cost.

Local towboat operators provided assist vessel cost information concerning double cut and triple cut lockages at the existing IHNC Lock. Using the percentages of double and triple cut IHNC lockages, provided by LPMS 1990 data, weighted average cost per ton estimates were calculated, by commodity group. The results of which are shown in table 4 - 8.

The simulation model, used in the calculation of capacity estimates, provided percentages of multiple-cut lockages that are likely to occur in the various with-project conditions. Utilizing this information, estimating the reduction in multiple-cut lockages, for the larger IHNC locks, was an easy matter. The gross cost savings of traffic transiting these larger locks were then increased by the product of this percentage reduction and the above calculated assist costs.

Table 4 - 7

Net Cost Savings & Mileage
By Commodity Group
Total System
(1992 Prices)

Commodity Group	Weighted Net Cost Savings ($)	Weighted Mileage
Farm Products	9.22	671
Metallic Ores	25.40	1,132
Coal	2.44	1,244
Crude Petroleum	15.98	237
Non-Metallic Minerals	21.26	977
Forest Products	7.52	884
Industrial Chemicals	18.83	935
Agricultural Chemicals	20.86	765
Petroleum Products	15.44	585
All Others	12.23	525

Table 4 - 8

Tug Assist Costs
for Commodities at IHNC lock
(Dollars per ton)
(1992 Prices)

Commodities	Cost per Ton
Farm Products	0.01
Metallic Ores	0.02
Coal	0.01
Crude Petroleum	0.01
Non-Metallic Minerals	0.01
Forest Products	0.02
Industrial Chemicals	0.01
Agricultural Chemicals	0.02
Petroleum Products	0.02
All Others	0.01