

## **APPENDIX D**

### **MODAL SHARES OF DAILY HAZMAT SHIPMENTS AND MOVEMENTS**

Appendix Table D1 is identical in content to Table 2 in the text portion of this report. It is reintroduced here to facilitate analysis of various figures and assumptions, particularly material presented elsewhere in these appendices.

Because of the nature of the materials in “Other Hazmat,” as well as the fact that the air mode hazmat share displayed in the Chemicals & Allied Products portion of Table D1 is presumed to include all air hazmat shipments, the vast majority of “Other Hazmat” shipments, movements, etc. are assumed to be captured by the truck mode. This predominance of the truck mode is assumed to apply even to products, such as those discussed in Appendix G, for which data gaps still exist.

It may also be noted that the 10,000 shipment figure (“at least 10,000”) for the *Other Hazmat* commodity group assumes the 7,180 component estimate for waste hazardous materials and that medical waste, other medical industry, and various other product category shipments would bring the daily total to well over 10,000. As indicated in Appendix Table G2, if the average medical waste shipment is any size smaller than 200 pounds per shipment, that category alone would contribute more than 4,000 additional shipments to the daily total.

Appendix Table D2 provides a detailed listing of assumptions and calculations used to estimate the shipment, movement, and tonnage figures provided in Appendix Table D1.

**Appendix Table D1: MODAL SHARES of DAILY HAZMAT SHIPMENTS and MOVEMENTS**

		(a)		(b)		(c)		(d)	
		Shipments	%	Movements	%	Tons Shipped	%	Tons Moved	%
Line		<b>CHEMICALS &amp; ALLIED PRODUCTS</b>							
1	Truck	445,218	90.30%	830,761	89.36%	808,662	55.52%	894,452	37.30%
2	Rail	3,723	0.80%	11,169	1.20%	335,070	23.00%	1,005,210	41.92%
3	Pipeline	34	0.00%	34	0.00%	127,500	8.75%	127,500	5.32%
4	Water	82	0.00%	164	0.02%	181,279	12.45%	362,558	15.12%
5	Air	43,750	8.90%	87,500	9.41%	4,049	0.28%	8,098	0.34%
6	<b>SUBTOTAL -- a</b>	<b>492,807</b>	<b>100%</b>	<b>929,628</b>	<b>100%</b>	<b>1,456,560</b>	<b>100%</b>	<b>2,397,818</b>	<b>100%</b>
7		<b>PETROLEUM PRODUCTS</b>							
8	Truck	313,689	99.50%	313,689	99.15%	2,857,470	40.04%	2,857,470	34.39%
9	Rail	448	0.10%	1,344	0.42%	40,320	0.57%	120,960	1.46%
10	Pipeline	839	0.30%	839	0.27%	3,146,250	44.09%	3,146,250	37.87%
11	Water	253	0.10%	506	0.16%	1,091,646	15.30%	2,183,292	26.28%
12	Air	-	0.00%	-	0.00%	-	0.00%	-	0.00%
13	<b>SUBTOTAL -- b</b>	<b>315,229</b>	<b>100%</b>	<b>316,378</b>	<b>100%</b>	<b>7,135,686</b>	<b>100%</b>	<b>8,307,972</b>	<b>100%</b>
14		<b>OTHER HAZMAT</b>							
15	<b>Truck -- c</b>	10,000	98.60%	10,000	95.90%	43,048	92.43%	43,048	80.27%
16	Rail	144	1.40%	432	4.10%	3,526	7.57%	10,578	19.73%
17	Pipeline	-	0.00%	-	0.00%	-	0.00%	-	0.00%
18	Water	-	0.00%	-	0.00%	-	0.00%	-	0.00%
19	Air	-	0.00%	-	0.00%	-	0.00%	-	0.00%
20	<b>SUBTOTAL</b>	<b>10,144</b>	<b>100%</b>	<b>10,432</b>	<b>100%</b>	<b>46,574</b>	<b>100%</b>	<b>53,626</b>	<b>100%</b>
21									
22		<b>TOTAL HAZMAT</b>							
23	Truck	768,907	93.98%	1,154,450	91.88%	3,709,180	42.94%	3,794,970	35.27%
24	Rail	4,315	0.53%	12,945	1.03%	378,916	4.39%	1,136,748	10.57%
25	Pipeline	873	0.11%	873	0.07%	3,273,750	37.90%	3,273,750	30.43%
26	Water	335	0.04%	670	0.05%	1,272,925	14.73%	2,545,850	23.66%
27	Air	43,750	5.35%	87,500	6.96%	4,049	0.05%	8,098	0.08%
28	<b>DAILY TOTALS -- d,e</b>	<b>818,180</b>	<b>100%</b>	<b>1,256,438</b>	<b>100%</b>	<b>8,638,820</b>	<b>100%</b>	<b>10,759,416</b>	<b>100%</b>
29									
30	<b>ANNUAL TOTALS -- f</b>	<b>298,635,700</b>		<b>458,599,870</b>		<b>3,153,169,300</b>		<b>3,927,186,840</b>	

-- " - " is negligible and, in some instances, may actually be zero.

-- a Daily shipment subtotal rounded to 500,000 in Table 1 and in text.

-- b Daily shipment subtotal rounded to 300,000 in Table 1 and in text.

-- c This figure is at least 10,000 and could range as high as 80,000 daily shipments or more. Waste hazmat, medical waste, various industrial products and other materials comprise this category. Virtually all "Other" hazmat are transported by truck. See Appendix G for detailed estimates within "Other" category.

-- d Daily shipment TOTAL rounded to > 800,000 in Table 1 and in text.

-- e Daily movement TOTAL rounded to: > 1.2 million in Table 1 and in text.

-- f Annual tons shipped and moved are rounded to > 3.1 billion and > 3.9 billion in Table 1 and in text.

## Appendix Table D2: MODE SHARE ESTIMATES -- LINE ITEM ASSUMPTIONS

**NOTE:** *These line item discussions also draw upon information in Appendix Tables A1 and A2, as well as information from Appendices E and G.*

**Line 1.** Column A: Truck figure based on Table A1 shipments. Reflects subtraction of air hazmat shipments from each of the first five (5) weight categories. Air shipment subtractions @ 35,000; 2,188; 2,188; 2,188; and 2,188 for a total subtraction of 43,750 air shipments. First seven weight categories in Table A1 are presumed to be truck & air, or truck exclusively. The 1993 CFS figures are indexed by a 1.178 growth factor (645/545) and factored by an 80% hazmat percentage assumption.

Column B: Weight categories 25 lb. - 875 lb. are considered small package or LTL shipments and are assumed to be moved twice; 5,500 lb. category assumed to be half LTL, half TL; next two weight categories assumed to be TL shipments, each moved once. Thus  $(364,818 \times 2) + (20,725 \times 2) + 59,675 \times 1 = 830,761$  movements.

Column C: Truck tonnage = no. of shipments x avg. weight per shipment/2,000 lbs. in each weight category. Most shipments are in < 1,000 lb. category, but most tonnage is in > 1,000 lb. category. Total truck tonnage = 28,795 tons + 779,867 tons = 808,662 truck tons shipped (see also Table A2).

Column D: Under 1,000 lb. tons are assumed to move twice; half the 5,500 lb. shipment tonnages are assumed to move twice (LTL), half move once (TL): Total =  $(28,795 \times 2) + (56,994 \times 2) + (722,874 \times 1) = 894,452$  truck tons moved daily.

**Line 2:** Column A: Rail shipments taken from AAR publication of 1996 hazmat shipments. Petroleum product shipments were subtracted from AAR total; Canadian percentage, assumed to be the same for chemicals as the Canadian percentage of petroleum product shipments, also subtracted to yield U.S. share.

Column B: All shipments assumed to move 3 times.

Column C: Average load assumed to be 90 tons --  $90 \times 3,723$ .

Column D: Column C x 3.

**Line 3:** Column A: Pipeline mode estimated as residual share after subtracting rail tonnage and water tonnage from Table A1 shipments that exceed 100,000 pounds; average shipment = 3,750 tons.

Column B: Movements and shipments assumed equivalent.

Column C:  $34 \times 3,750$  tons.

Column D: Tons shipped and tons moved assumed equivalent.

**Line 4:** Column A: Water figure based on Waterborne Commerce Statistics for 1996; for "Chemicals," 66,166,898 tons among 29,986 "vessel trips" implies 29,986 annual *shipments* at an average of 2,207 tons each. Daily shipments equal  $29,986/365 = 82$ .

Column B: Movements assumed to be double the number of trips.

Column C: Tons from Waterborne Commerce Statistics (66,166,898).

Column D: Tons moved assumed to be twice number of shipments.

**Line 5:** Column A: Air shipments described in Appendix E.

Column B: Movements assumed to be twice number of shipments, due to consolidated loads. (See also Appendix C discussion for assumption of 2 movements per air shipment.)

Column C: Tonnage estimate taken from Table E1 and described in Appendix E; figure hinges largely upon assumption that air hazmat is 8% of total.

Column D: Tons moved assumed to be twice tons shipped.

**Line 8:** Column A: Truck shipment totals taken from Appendix Table B2 and Appendix Table B3. As shown in Figure 1 of the report and discussed further in Appendix C, the number of shipments, movements, and deliveries for petroleum products are assumed to be equal, with transfers along distribution chain

**Appendix Table D2: MODE SHARE ESTIMATES -- LINE ITEM ASSUMPTIONS  
(Cont.)**

assumed to denote the end of one shipment and beginning of subsequent one. Each “milk run” delivery also assumed to correspond to one shipment and one movement.

Columns C and D: Tons from Table B2 and Table B3. Tons moved equal tons shipped.

**Line 9:** Column A: Shipment figure taken from AAR “Annual Report of Hazardous Materials Transported by Rail,” Calendar Year 1996 (November 1997).

Column B: Each rail shipment assumed to be moved 3 times.

Column C: Each loaded rail car assumed to be carrying 90 tons.

Column D: Each ton assumed to be moved 3 times.

**Line 10:** Column A: Pipeline shipment total based on Table B2 and B3 assumptions regarding distribution phases that utilize the oil pipeline system. “Shipment” size assumed to be 25,000 barrels.

Column B: Shipments assumed to “move” once.

Column C: Tons estimated at 42 gallons per barrel and approximately 7 pounds per gallon.

Column D: Tons *moved* assumed equal to tons *shipped*.

**Line 11:** Column A: Water shipments from Waterborne Commerce Statistics: Crude Petroleum @ 12,881 annual vessel trips carrying 128,089,274 annual tons for an average of 9,944 tons per vessel and 35 trips per day. Other Petroleum Products @ 79,407 annual vessel trips carrying 270,361,406 tons for an average of 3,405 tons per shipment and 218 trips (shipments) per day. Total daily shipments = 253.

Column B: Each shipment assumed to *move* twice.

Column C: Tons shipped from Waterborne Commerce Statistics.

Column D: Each shipment (vessel trip) assumed to move twice, primarily to reflect intermodal connection and subsequent modal movement.

**Line 12:** Air shipment of hazardous petroleum products assumed to be negligible.

**Line 15:** Column A: Shipment figure taken from data in Appendix G. Consists primarily of waste hazardous materials shipments. Infectious Substance (medical waste) component assumed to easily bring total over 10,000 but remains preliminary and unspecified at this time.

Column B: Because waste hazmat shipments are based on manifest count, which are supposed to correspond roughly to single movements of single shipments, and because of preliminary nature of other component estimates, a movement/shipment ratio of 1/1 assumed. (Occasional intermodal shipment implies movement/shipment ratio that slightly exceeds one.)

Column C: Tonnage figure, discussed in Appendix G and Appendix G tables, derived in part from EPA figures and 1993 Commodity Flow Survey estimates of truck and rail mode shares. Estimate in Column C is only for the 7,180 waste hazmat shipments. Other tonnage not estimated.

Column D: While intermodal shipments imply some tonnage is moved more than once, a 1/1 movement/shipment ratio is assumed for the tonnage of the 7,180 waste hazmat shipments.

**Line 16:** Figures contain estimate only for waste hazmat shipments, discussed in Appendix G.

**Line 17:** Hazmat other than chemicals and petroleum products assumed to be negligible.

**Line 18:** Hazmat other than chemicals and petroleum products assumed to be negligible.

**Line 19:** The amount of waste hazmat that travels by air is presumed to be negligible, if not actually zero. The amount of infectious substances, however, including diagnostic specimens, medical cultures, etc., that travels by air is not presumed negligible. Still, no reliable estimate is available at this time, and therefore such shipments are presumed included in the 43,750 daily shipments within the Chemical & Allied category.