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Transportation Impacts of the Chicago River Closure to Prevent an Asian Carp Infestation

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16. Abstract
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Abstract

This project developed a simple linear programming model of the Upper Midwest regions rail transportation network to test whether a closure of the Chicago River to freight traffic would impact the capacity constraint of the rail system. The results suggested that the rail network in the Upper Midwest regions are nowhere near approaching capacity and that a closure would have little impact on the rail network. Two noteworthy sets of commodities may be adversely affected, cereal grains and other agricultural product, as well as, gravel and crushed stone.

Chapter 1 Introduction

A safe and reliable transportation system is vital to the flow of goods and individuals within an economy. Environmental policies have the potential to drastically impact the transportation infrastructure in unknown ways. When one of the linkages with a system is closed, the shipment of goods does not stop but alternative routes are taken. By understanding the interconnected nature of the system, we can have a better estimate of the costs of environmental policy. The costs of environmental policy are not simply restricted to the direct economic and environmental costs but also include the indirect costs on the transportation of goods as well as the transportation infrastructure.

Recent evidence suggests that the Asian Carp [Bighead carp *(*Hypophthalmichthys nobilis)**,** black carp **(**Mylopharyngodon piceus)**,** grass carp (Ctenopharyngodon idella)**,** and silver carp **(**Hypophthalmichthys molitrix)] are within 30 miles of entering the Great Lakes in the Chicago and Illinois Rivers. Asian Carp are an invasive species that has the potential to destroy the commercial and recreational fisheries in the Great Lakes if left unchecked. They are able to outcompete the native species of fish so that commercial species have nothing on which to feed. At present, there is a lawsuit from the states of Michigan, Wisconsin, Ohio, Minnesota and Pennsylvania against the state of Illinois to physically close the link between the Mississippi River and the Great Lakes. The Army Corp of Engineers has stated that a study of the area will be completed by 2015 but opponents state that this is not quick enough to prevent the spread. (Watershed Council, 2012)

Two options for the physical barrier are currently on the table. The first would reverse the flow of the Chicago River to its original flow direction. The second involves removing the locks and dams that are currently present and replacing them with a permanent barrier. Each of these solutions would disrupt the shipping traffic that currently exists to take goods from the Great Lakes, at the Chicago port, to the Mississippi River. At present, there have been no estimates as to the economic impacts on transportation from the potential closure of the Chicago River to transportation with the exception of Taylor and Roach (2010). Having estimates of the economic impact would allow for a better evaluation of the costs of a closure of the Chicago River. By closing this major linkage between the Great Lakes and international ports, such as New Orleans, there is a potential for large impacts on the transportation infrastructure including the rail and highway system. The goal of this research was to provide two pieces to the benefit-cost analysis needed. First, the shadow value of infrastructure capacity if shipping through the Chicago River is no longer viable was calculated. Second, it was estimated where in the transportation infrastructure the impacts are most likely to be seen. Additionally, the modeling framework is flexible enough to allow for the evaluation of alternative closures other than the Chicago River.

Chapter 2 Transportation Data Availability

In order to consider a transportation network, the researchers needed to first identify the lowest possible aggregation for trade data on inter and intra-state trade. There are three main pieces of data that were needed in order to construct a model of the transportation network: (1) Supplies and demands at each node within the transportation network; (2) A definition of the nodes and edges for the transportation network; and (3) Capacities of the edges of the network. In order to have an interaction between each of these pieces, the data must be consistent. To achieve consistency in the aggregation of the data, the data was taken had the highest aggregation and all other datasets met this level of aggregation.

The starting point for data availability came from creating a baseline for trade across the transportation network. The lowest level of aggregation for intra and inter-state trade came from the Freight Analysis Framework (FAF) data available from the U.S. Department of Transportation (Freight Analysis Framework, 2012). The main focus of the FAF dataset was on road transportation but it was possible to back out the rail and water transportation from this dataset. Rail and water transportation were the only focuses for two reasons. First, if the Chicago River is closed to freight traffic, the goods that are shipped via waterways tend to be low valued, heavy commodities. Hence, a shift from water will probably be to rail rather than road. Second, the complexities of the road network are sufficient that the cost incurred in modeling them would not add sufficiently to the analysis.

The FAF data divides the United States into 123 unique domestic regions as well as 8 foreign regions. These 123 regions are divided between 74 metropolitan areas, 33 regions made up of the remainder of states that have large metropolitan regions and 16 regions that are entire states where no large metropolitan areas exist. Metropolitan areas do exist that cross state boundaries. In this case, the metropolitan area is broken into multiple regions for each state. For the purposes of this study, 18 of the regions were selected that are in close proximity to the Chicago Metropolitan area and have a greater potential to impact the transportation infrastructure from a closure of the Chicago River. Figure 2.1 displays a map of the area under consideration for this study together with the regions.

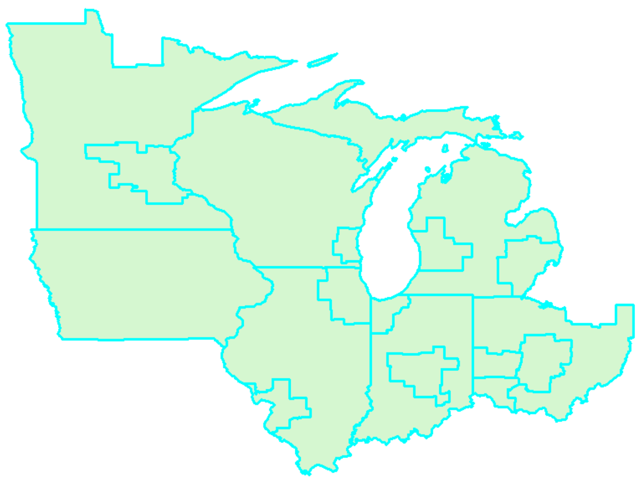

Figure 2.1 Upper Midwest Transportation Regions

Next, the rail infrastructure was considered and matched it in some fashion to the FAF data. As no trade data on a smaller spatial scale than the FAF data exists, researchers were forced to aggregate the rail transportation infrastructure to match that of the FAF. There are two pieces of information that were needed from the rail data: (1) the capacity from one region to another and (2) an aggregated rail capacity from one region to all of its neighboring regions. Research began with the CTA Railroad Network produced by the Oak Ridge National Laboratory. A map of the entire United States Rail Network appears in figure 2.2.

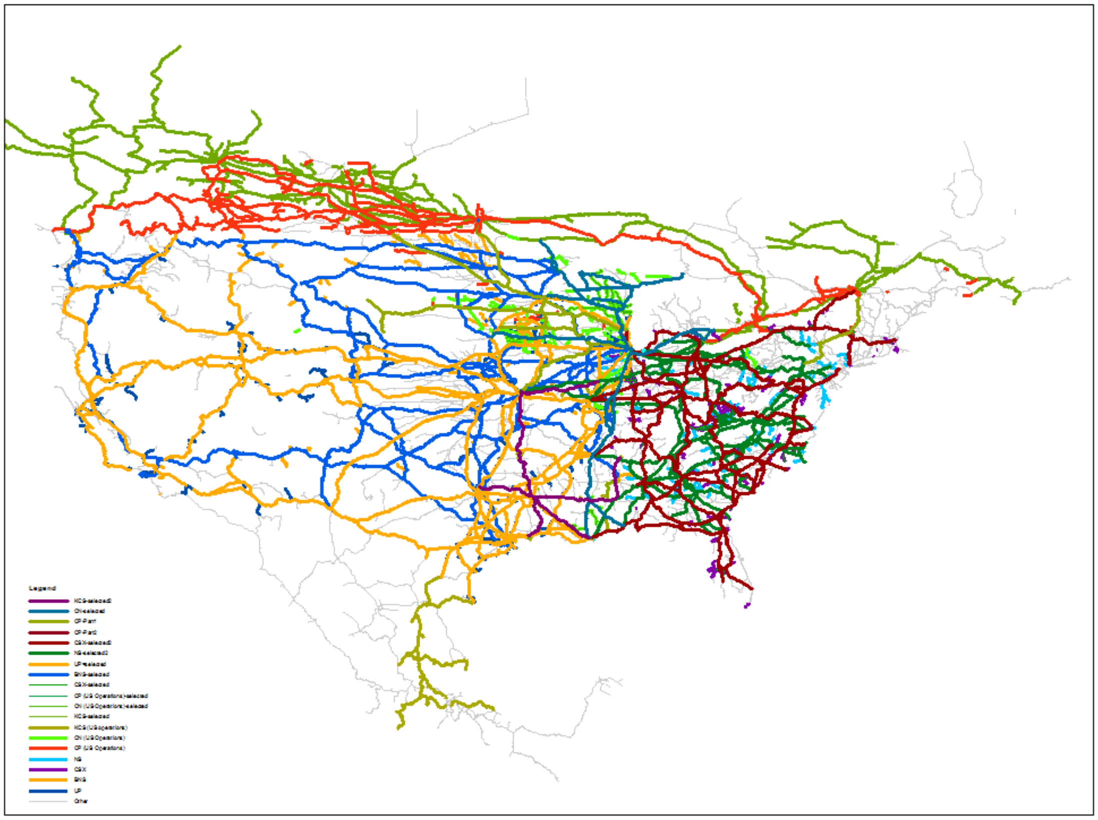

Figure 1.2 North American Rail Network

Using this map, each of the lines connect any two neighboring regions were aggregated individually. In order to aggregate the capacity across different lines with different line characteristics, a simple conversion employed in a study by Cambridge Systematics, Inc. that allows for the exploitation of only two of the characteristics of a rail line was used. Although there has been considerable attention paid to estimating rail capacity in the literature (for example see Morlok and Riddle, 1999), the simple conversion was used as there was bound to be considerable error in aggregating railways across different geographic areas. The conversion exploits the number of lines and the type of control on the line to estimate the maximum capacity of the rail line. These conversions appear in table 2.1 taken from the Cambridge Systematics study.

Table 2.1 Capacity by Rail Characteristics

		Trains per Day	
Number of Tracks	Type of Control	Practical Maximum If Multiple Train Types Use Corridor*	Practical Maximum If Single Train Type Uses Corridor**
1	N/S or TWC	16	20
1	ABS	18	25
2	N/S or TWC	28	35
1	CTC or TCS	30	48
2	ABS	53	80
2	CTC or TCS	75	100
3	CTC or TCS	133	163
4	CTC or TCS	173	230
5	CTC or TCS	248	340
6	CTC or TCS	360	415

Key: N/S-TWC – No Signal/Track Warrant Control.
ABS – Automatic Block Signaling.
CTC-TCS – Centralized Traffic Control/Traffic Control System.

Notes: * For example, a mix of merchandise, intermodal, and passenger trains.
** For example, all intermodal trains.

Source: Class I railroads' data aggregated by Cambridge Systematics, Inc.

Using this approach, the capacities for all of the region-to-region neighbors for the entire 18 region area were constructed. These capacities appear in table A.1 which can be found in Appendix A. It should be noted that these are two way capacities so that the capacity shown in table A.1 is the capacity from A to B plus the capacity from B to A. These provide the basis for understanding if there is a capacity constraint on the lines.

After the conversion the FAF data was considered. There was a variety of information that was exploited from the FAF data. The first area of data analyzed was shipments from all regions to all other regions by commodity type. There are 43 different commodity types that have 43 different characteristics for how they may impact the capacity constraint on the rail infrastructure. The FAF data lists the values of commodity flows and also tonnage. A variety of sources (Enviromodal Smart Transportation, 2012; Mitsui Rail Capital, 2012; Chicago Freight Car Leasing Co., 2012; Wilbur Smith Associates, 2003; Marvin and Klindworth, 2000) were used to convert this tonnage for railcars and eventually trains. To start, each type of freight car available for each of the commodities was considered and the capacity for each commodity and the appropriate freight car was determined. One of the first findings was that in most instances it is not the tonnage that provides the freight car capacity constraint but the volume. Table A.2 which can be found in Appendix A, shows the capacity by commodity for each of the types of freight cars. These conversions allowed for the conversion of tonnage into freight cars.

From there, freight cars were converted into trains. The public use Waybill survey available from the U.S. Department of Transportation (Surface Transportation Board, 2010) was used in order to create the average cars per train by commodity. The Waybill survey provided the total tonnage and the total number of carloads by train arrivals. Using this it was possible to construct train capacity by commodities for each of the 43 commodities within the FAF data. One of the problems with this portion of the analysis was that the commodities used in the Waybill survey did not perfectly align with the FAF data. An attempt was made to remedy this by using the commodity descriptions in each of the two datasets. The results appear in table 2.2.

Table 2.2 Coding Correspondence by Region

FID	FAF_ID	FAF_REGION
261	71	Detroit-Warren-Flint, MI CSA
269	72	Remainder of Michigan
391	74	Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)
394	75	Dayton-Springfield-Greenville, OH CSA
399	76	Remainder of Ohio
171	78	Chicago-Naperville-Michigan City, IL-IN-WI CSA (IL Part)
179	79	Remainder of Illinois
190	80	Iowa
271	81	Minneapolis-St. Paul-St. Cloud, MN-WI CSA (MN Part)
279	82	Remainder of Minnesota
559	84	Remainder of Wisconsin
189	90	Remainder of Indiana
172	94	St Louis, MO-IL MeSA (IL Part)
182	96	Indianapolis-Anderson-Columbus, IN CSA
181	97	Chicago-Naperville-Michigan City, IL-IN-WI CSA (IN Part)
551	98	Milwaukee-Racine-Waukesha, WI CSA
262	99	Grand Rapids-Wyoming-Holland, MI CSA
393	122	Columbus-Marion-Chillicothe, OH CSA

The last piece of data needed was a means to calculate costs. This was the major stumbling block for this research in that the marginal cost of transportation is difficult to obtain for rail transport. Additionally, many different lines were aggregated and the costs may differ for each of these lines. In order to overcome this, the Euclidean distances from the centroids of each of the regions were calculated, as it provided an average distance when moving between regions. However, it may fail to take into account the transportation hubs that are not major metropolitan areas. The distances were calculated by using the great circle distance given by:

$$RadiusEarth * ACOS\begin{pmatrix} COS\left(RADIANS\left(90 - Lat1\right)\right) \; * COS\left(RADIANS\left(90 - Lat2\right)\right) \\ + SIN\left(RADIANS\left(90 - Lat1\right)\right) \; * SIN\left(RADIANS\left(90 - Lat2\right)\right) \\ * COS\left(RADIANS\left(Long1 - Long2\right)\right) \end{pmatrix} \tag{2.1}$$

These distances appear in table 2.3 in kilometers. In addition, table 2.2 provides the translation from this study's identification to those of the FAF data.

Table 2.3 Distances between Regions

	261	269	391	394	399	171	179	190	271	279	559	189	172	182	181	551	262	393
261	0																	
269	293	0																
391	383	618	0															
394	307	542	77	0														
399	260	542	182	141	0													
171	406	385	439	391	490	0												
179	573	603	443	431	565	219	0											
190	832	696	846	815	928	441	426	0										
271	863	628	1012	960	1038	574	672	335	0									
279	967	707	1150	1094	1162	715	826	484	156	0								
559	584	349	777	716	777	360	386	401	282	386	0							
189	391	542	187	173	311	270	260	660	842	985	626	0						
172	693	740	498	507	647	357	137	470	759	915	651	337	0					
182	399	556	177	168	308	285	267	671	856	999	641	15	339	0				
181	342	395	338	289	391	102	234	537	675	813	447	180	363	195	0			
551	391	266	543	482	550	149	361	452	489	614	234	398	497	413	218	0		
262	192	187	438	364	389	248	451	648	674	784	398	357	585	370	224	201	0	
393	1379	567	135	107	48	481	538	913	1039	1167	783	280	613	275	379	553	405	0

Chapter 3 Modeling

This research's initial goal was to completely model the transportation costs of shipping and to minimize the total transportation costs given both the rail and waterway system. Then remove one of the waterway edges and see how adjustments to shipments increased transportation costs and if the capacity constraint was binding on any of the edges within the network. Since costs for transportation were unable to obtain, the second best solution was selected. A linear programing model was fitted to the data on shipments by just train. The objective of the linear programming model was to minimize the product of distance times trains on the network subject to the capacity constraints. First the supply and demand were calculated at each node in the network from the FAF data, as there was no manner to know what is traded within each zone. It was assumed that all goods within a commodity group were homogeneous with respect to demand and supply location. This resulted in differencing out demand from supply that can be met from the "home" node. That is, if supply and demand exists at a node, the difference of supply and demand was taken to arrive at a final demand or supply, depending on which was larger. An alternative assumption used in much of the "new" trade literature (for example see Ossa, 2010) is that supplies from different areas are imperfect substitutes but this would potentially complicate the analysis. Therefore, it was not included in this approach.

For notational convenience, S_i denotes the supply at node *i*, D_i denotes the demand at node *i*, and $ship_{ij}$ denotes shipments from node *i* to node *j*. This calculation of demand at node *j* takes the sum across all nodes that ship. Calculated as:

$$D_j = \sum_i ship_{ij} \tag{3.1}$$

Similarly, it was calculated the supply at node *i* as:

$$S_i = \sum_j ship_{ij} \tag{3.2}$$

where the shipments come from the FAF data.

The second simplifying assumption is that one can only ship between neighboring regions. If regions do not touch, then the materials must ship to neighboring regions and sum up the “shipping costs” by multiple shipments to neighboring regions. Hence, the linear program can be expressed as:

$$\begin{aligned} &\min \sum dis\tan ce * trains \\ &s.t. \\ &\sum_i ship_{ij} \geq D_j \\ &ship_{ij} \leq capacity_{ij} \end{aligned} \tag{3.3}$$

In addition, the shipments have to follow the network.

Chapter 4 Results

The initial run of the model used just the rail data and ran that data through the model. The important results appear in table 4.1. The most important result is that none of the rail connections are even close to their capacity.

Table 4.1 Important Calibration Results

Origin	Destination	Total Shipments	Total Capacity	%Capacity
190	279	4057.86	16800	0.24
261	269	5773.85	52500	0.11
271	279	3400.35	32900	0.23
399	261	5806.70	24850	0.23
559	279	1502.62	23100	0.07

There are three main trading routes that have significant rail transportation; they are between (1) Iowa and Minnesota, (2) Minneapolis and the rest of Minnesota and (3) Detroit and the rest of Ohio. Only the route between Iowa and Minnesota may be impacted by a closure of the Chicago River. There is considerable capacity to be utilized within the Upper-Midwest. There are a couple of caveats that need to be expressed but given the excess capacity, they should have relatively little impact on the analysis. First, the FAF data is a yearly aggregate and as such, the capacities have been aggregated to yearly aggregates. If particular times of the year where shipments are concentrated existed, transportation may more closely approach capacity constraints. However, this would mean that rail transportation would only occur during a 3 month period, which is highly improbable. Second, if trade does not originate or end in one of the regions, it has been excluded it from the analysis. Hence, shipments that passed through Chicago but did not start in the Upper-Midwest were not considered. This may be a significant portion of the trade that does occur from the Eastern to the Western states and vice-versa.

Lastly, a closure of the Chicago River was considered. In order to accomplish this, all trade that occurs via waterways within the study region was collected and allocated to rail. This produced an over estimate of the impacts of a closure of the Chicago River but it would be difficult, given the FAF data does not show trade between neighboring regions but between origin and destinations, to know which shipments actually go through the Chicago River as opposed to an alternative route. Given the lack of utilization of the rail capacity and the fact that waterway transportation is relatively small compared to the rail transportation, there is very little impact of the closure of all waterway traffic on the rail system. The main impact that would occur is in the shipment of cereal grains and other agricultural products, as well as, gravel and crushed stone. The latter of these, gravel and crushed stone, are a relatively low valued product that have considerable weight. It may be that given the differences in marginal cost of transport that it may not make sense to ship gravel and crushed stone over long distances. The analysis did not take into account that local sources may exist that could substitute these commodities if they become too expensive to ship. As a caveat, though, much of these shipments of gravel and crushed stone are originating in Michigan and headed to Minnesotan and Chicago. It is these shipments to Chicago that may cause an impact. There are roughly 3,000 tons of crushed stone shipped to Chicago every year via waterways. This is equivalent to roughly 30 trains added over the course of a year, not enough to have an impact on the capacity. Generally, closing the waterways would have limited impact on the rail capacity.

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Appendix A

Table A.1 Rail Capacity by Link

Origin	Destination	Min.	Max.
Chicago-Naperville-Michigan City, IL-IN-WI CSA (IL Part)	Remainder of Wisconsin	188	276
Chicago-Naperville-Michigan City, IL-IN-WI CSA (IL Part)	Remainder of Illinois	390	546
Chicago-Naperville-Michigan City, IL-IN-WI CSA (IL Part)	Chicago-Naperville-Michigan City, IL-IN-WI CSA (IN Part)	233	328
Milwaukee-Racine-Waukesha, WI CSA	Remainder of Wisconsin	192	273
Grand Rapids-Wyoming-Holland, MI CSA	Remainder of Michigan	48	73
Chicago-Naperville-Michigan City, IL-IN-WI CSA (IN Part)	Remainder of Indiana	273	373
Chicago-Naperville-Michigan City, IL-IN-WI CSA (IN Part)	Chicago-Naperville-Michigan City, IL-IN-WI CSA (IL Part)	233	328
Chicago-Naperville-Michigan City, IL-IN-WI CSA (IN Part)	Remainder of Michigan	30	48
Remainder of Minnesota	Minneapolis-St Paul-St Cloud, MN-WI CSA (MN Part)	175	243
Remainder of Minnesota	Remainder of Wisconsin	66	98
Remainder of Minnesota	Iowa	48	60
Minneapolis-St Paul-St Cloud, MN-WI CSA (MN Part)	Remainder of Wisconsin	94	141
Minneapolis-St Paul-St Cloud, MN-WI CSA (MN Part)	Remainder of Minnesota	175	243
Iowa	Remainder of Minnesota	48	60
Iowa	Remainder of Wisconsin	0	0
Iowa	Remainder of Illinois	140	205
Remainder of Wisconsin	Remainder of Michigan	48	60

Remainder of Wisconsin	Milwaukee-Racine-Waukesha, WI CSA	192	273
Remainder of Wisconsin	Remainder of Minnesota	66	98
Remainder of Wisconsin	Minneapolis-St Paul-St Cloud, MN-WI CSA (MN Part)	94	141
Remainder of Wisconsin	Iowa	0	0
Remainder of Illinois	Chicago-Naperville-Michigan City, IL-IN-WI CSA (IL Part)	390	546
Remainder of Illinois	St Louis, MO-IL MeSA (IL Part)	207	296
Remainder of Illinois	Iowa	140	205
Remainder of Illinois	Remainder of Wisconsin	0	0
Remainder of Illinois	Chicago-Naperville-Michigan City, IL-IN-WI CSA (IN Part)	0	0
Remainder of Illinois	Remainder of Indiana	71	105
St Louis, MO-IL MeSA (IL Part)	Remainder of Illinois	223	316
Remainder of Michigan	Remainder of Wisconsin	48	60
Remainder of Michigan	Grand Rapids-Wyoming-Holland, MI CSA	48	73
Remainder of Michigan	Detroit-Warren-Flint, MI CSA	150	240
Remainder of Michigan	Chicago-Naperville-Michigan City, IL-IN-WI CSA (IN Part)	30	48
Remainder of Michigan	Remainder of Indiana	30	48
Remainder of Michigan	Remainder of Ohio	30	48
Detroit-Warren-Flint, MI CSA	Remainder of Michigan	150	240
Detroit-Warren-Flint, MI CSA	Remainder of Ohio	71	105
Remainder of Indiana	Chicago-Naperville-Michigan City, IL-IN-WI CSA (IN Part)	273	373
Remainder of Indiana	Indianapolis-Anderson-Columbus, IN CSA	290	411
Remainder of Indiana	Remainder of Ohio	210	296

Remainder of Indiana	Dayton-Springfield-Greenville, OH CSA	83	128
Remainder of Indiana	Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)	18	25
Remainder of Indiana	Remainder of Michigan	30	48
Indianapolis-Anderson-Columbus, IN CSA	Remainder of Indiana	290	411
Remainder of Ohio	Detroit-Warren-Flint, MI CSA	71	105
Remainder of Ohio	Remainder of Michigan	30	48
Remainder of Ohio	Remainder of Indiana	210	296
Remainder of Ohio	Dayton-Springfield-Greenville, OH CSA	105	148
Remainder of Ohio	Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)	30	48
Remainder of Ohio	Columbus-Marion-Chillicothe, OH CSA	181	264
Dayton-Springfield-Greenville, OH CSA	Remainder of Indiana	83	128
Dayton-Springfield-Greenville, OH CSA	Columbus-Marion-Chillicothe, OH CSA	30	48
Dayton-Springfield-Greenville, OH CSA	Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)	135	196
Dayton-Springfield-Greenville, OH CSA	Remainder of Ohio	105	148
Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)	Remainder of Ohio	30	48
Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)	Columbus-Marion-Chillicothe, OH CSA	0	0
Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)	Dayton-Springfield-Greenville, OH CSA	135	196

Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)	Remainder of Indiana	18	25
Columbus-Marion-Chillicothe, OH CSA	Remainder of Ohio	181	264
Columbus-Marion-Chillicothe, OH CSA	Dayton-Springfield-Greenville, OH CSA	30	48
Columbus-Marion-Chillicothe, OH CSA	Cincinnati-Middletown-Wilmington, OH-KY-IN CSA (OH Part)	0	0

Table A.2 Car Capacity by Commodity

Car Type	Cubic capacity (ft^2)	Load limit (lbs)	Load limit (tons)	load limit (liters)	gross rail load		Commodities
Standard Boxcar (50')	6,269	211,800	106				rolled paper, pulp, newsprint, building materials, appliances, food products, bagged and palletized loads, grain products
High-cube boxcar (60')	7,580	206,500	103		286,000		newsprint, auto parts, scrap paper, building materials, bagged products
refrigerated boxcar	n/a	n/a					beer, wine, canned goods, food products, clay, cat litter, dog food, sale and other bagged, palletized commodities
flat car		226,000	113				structural steel, pipe, steel plate, lumber
double stack container car		166,000	83		220,000		
tank car				113,562			
coal/ open-top hopper	4,200	236,600	118		286,000		coal, coke, stone, sand, ores, and gravel
small hopper		233,000	117		286,000		cement, sand, roofing granules,
medium hopper	5,188	224,500	112		286,000		grains
large hopper	6,224	220,000	110		286,000		bulk commodities like grain, fertilizer, flour, salt, sugar, clay, and lime
coal gondola	5,520	244,300	122		286,000		coal
covered coil		220,000	110		286,000		coiled sheet steel
mill gondola		220,000	110		286,000		steel products, scrap, waste materials, pipe, construction materials

gondola	3,366	211,000	106				scrap metal, steel ingots, sheet steel, pipes, other metal products, aggregates, and other bulk commodities
centerbeam flatcar	n/a	224,000	112		286,000		lumber, wall board
Long log flatcar							unprocessed wood for manufacture of wood products, pulp board, and paper
Heavy Axle Load (HAL)	4,875	204,000	102		268,000		corn
BNSF High Capacity Hopper (small)	5,161	220,000	110		286,000		
BNSF High Capacity Hopper (large)		234,000	116		286,000		
BNSF Shuttle Train: 110-car train at 286,000							
Unit trains are usually 50, 54, or 58 railcar shipments, usually limited by elevator handling capacity							
source: http://www.enviromodal.com/files/railcar_guide.pdf							
source: www.mrc-rail.com							
commodities source: www.crdx.com/agricultural.html							
HAL, BNSF: http://www.dor.state.ne.us/rpt/pdfs/rail-study.pdf							
Unit Trains: http://ntl.bts.gov/lib/9000/9200/9245/latsrail.pdf							

Table A.3 Train Capacity by Commodity

STCC Commodities	2-Digit STCC	SCTG Commodities	2-Digit SCTG	Total Carloads	Total Tonnage	Average Tons/ Carload	Cars per Train
Farm Products	1	Live Animals and Live Fish; Cereal Grains; Other Agricultural Products	1,2,3	1,849,157	171,448,323	93	39
Forest Products	8	Other Agricultural Products	3	2,200	127,160	58	62
Fresh fish or Other Marine Products	9	Live Animals and Live Fish; Meat, Fish, Seafood, and their preparations	1,5	1,960	48,400	25	145
Metallic Ores	10	Metallic Ores and Concentrates	14	604,468	50,547,712	84	43
Coal	11	Coal	15	7,554,711	866,350,228	115	31
Crude Petroleum, Natural Gas, or Gasoline	13	Crude Petroleum; Coal and Petroleum Products, Not elsewhere classified	16,19	1,224	106,432	87	41
Non-metallic Minerals	14	Monumental or Building Stone; Natural Sands; Gravel and Crushed Stone; Nonmetallic Minerals, Not elsewhere classified	10,11,12,13	1,140,379	112,035,290	98	36
Ordinance or Accessories	19	Miscellaneous Manufactured Products	40	4,888	266,624	55	66

Food or Kindred Products	20	Other Agricultural Product; Animal Feed and Products of Animal Origin; Meat, Fish, Seafood, and their Preparations; Milled Grain Products and Preparations, and Bakery Products; Other Prepared Foodstuffs and Fats and Oils; Alcoholic Beverages	3,4,5,6,7,8	1,759,413	123,271,992	70	51
Tobacco Products, excluding Insecticides	21	Tobacco Products	9	80	1,280	16	224
Textile Mill Products	22	Textiles, Leather, and Articles of Textiles or Leather	30	24,680	332,400	13	266
Apparel or Other Finished Textile Products	23	Textiles, Leather, and Articles of Textiles or Leather	30	154,760	1,906,800	12	291
Lumber or Wood Products, excluding Furniture	24	Logs and other Wood in the Rough; Wood Products; Miscellaneous Manufactured Products	25,26,40	436,736	34,074,706	78	46
Furniture or Fixtures	25	Furniture, Mattresses and Mattress Supports, Lamps, Lighting Fittings, and Illuminated Signs	39	81,760	807,800	10	363
Pulp, Paper, or Allied Products	26	Pulp, Newsprint, Paper, and Paperboard; Paper or Paperboard Articles	27,28	721,280	40,814,680	57	63
Printed Matter	27	Printed Products	29	22,800	382,280	17	214

Chemicals or Allied Products	28	Basic Chemicals; Pharmaceutical Products; Fertilizers; Chemical Products and Preparations, Not elsewhere classified	20,21,22,23	1,284,484	113,322,040	88	41
Petroleum or Coal Products	29	Gasoline and Aviation Turbine Fuel; Fuel Oils; Coal and Petroleum Products, Not elsewhere classified	17,18,19	290,088	23,518,557	81	44
Rubber or Misc. Plastics Products	30	Plastics and Rubber	24	135,320	1,839,280	14	264
Leather or Leather Products	31	Textiles, Leather, and Articles of Textiles or Leather	30	2,960	33,880	11	313
Clay, Concrete, Glass, or Stone Products	32	Nonmetallic Mineral Products	31	462,897	44,041,976	95	38
Primary Metal Products	33	Base Metal in Primary or Semi-Finished Forms and in Finished Basic Shapes	32	466,103	39,460,868	85	42
Fabricated Metal Products	34	Base Metal in Primary or Semi-Finished Forms and in Finished Basic Shapes; Articles of Base Metal; Miscellaneous Manufactured Products	32,33,40	69,804	932,020	13	268
Machinery, excluding Electrical	35	Machinery	34	43,881	1,049,048	24	150

Electrical Machinery, Equipment, or supplies	36	Electronic and other Electrical Equipment and Components, and Office Equipment; Furniture, Mattresses and Mattress Supports, Lamps, Lighting Fittings, and Illuminated Signs	35,39	128,644	1,591,908	12	290
Transportation Equipment	37	Motorized and other Vehicles (incl. Parts); Transportation Equipment, Not elsewhere classified	36,37	1,542,889	31,474,482	20	176
Instruments, Photographic Goods, Optical Goods, Watches, or Clocks	38	Precision Instruments and Apparatus; Miscellaneous Manufactured Products	38,40	11,240	152,040	14	265
Misc. Products of Manufacturing	39	Miscellaneous Manufactured Products	40	55,520	706,400	13	282
Waste or Scrap Materials	40	Waste and Scrap	41	605,292	38,599,352	64	56
Misc. Freight Shipments	41	Mixed Freight	43	139,039	1,939,603	14	257
Containers, Carriers or Devices, Shipping, Returned Empty	42	Miscellaneous Transported Products	42	1,193,868	8,290,884	7	516
Mail	43	Miscellaneous Transported Products	42	32,320	364,920	11	318

Freight Forwarder Traffic	44	Miscellaneous Transported Products	42	2,032	33,480	16	218
Shipper Association or Similar Traffic	45	Miscellaneous Transported Products	42	760	16,160	21	169
Freight All kinds	46	Mixed Freight	43	7,512,444	103,921,208	14	259
Small Packages, LTC, or LTL	47	Miscellaneous Transported Products	42	106,360	1,073,000	10	355
Waste Hazardous Materials or Waste Hazardous Substances	48	N/A		17,416	1,261,436	72	49
Hazardous Materials	49	N/A		1,789,573	125,150,417	70	51
Bulk Movement in Boxcars	50	N/A		280	6,960	25	144