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EI-7366

W/J. DUBIN ATTACHMT.

May 15, 2008

Ms. Victoria J. Rutson, Chief
Section of Environmental Analysis
Surface Transportation Board
395 E Street, S.W.
Washington, D.C. 20423-0001

Re: ***Canadian National Railway Company and Grand Trunk Corporation – Control – EJ&E West Company*** **(STB Finance Docket No. 35087)**

Dear Ms. Rutson:

I am writing to supplement CN's response, made in my letter to you of April 21, 2008, to SEA Information Request #3 ("CN's initial response"). The Board's Decision No. 9 (served April 23, 2008) ruled that construction of the six proposed connections between CN's and EJ&E's existing lines, as described in the Application and Operating Plan, does not require STB approval. Thus, CN, without any further STB approval, and assuming satisfactory commercial arrangements with EJ&E, would be able to re-route more of its current cross-Chicago trains to the EJ&E line than were identified in CN's initial response to Information Request #3. Therefore, the number of "but for" trains described in CN's initial response has been revised downward, as shown in the attachments to this letter and as discussed below.

As explained in CN's initial response, under governing law and precedents, the STB's NEPA review of a proposed transaction should extend to those impacts that are caused by the STB's action.[1] In this case, the relevant STB action is the granting of a license for CN to acquire control of EJ&EW, which will have acquired most of the lines of EJ&E. And the impacts that are properly part of the Board's NEPA analysis of this Transaction are those that would be caused by the trains that could not move over the EJ&E lines "but for" the STB's grant of the requested licenses, as those trains are the only ones that the Board, by denying approval of the Transaction, could prevent from moving over those lines.

[1] As noted in CN's initial response, the Supreme Court has held that "where an agency has no ability to prevent a certain effect due to its limited statutory authority over the relevant actions, the agency cannot be considered a legally relevant 'cause' of the effect." *Dep't of Transp. v. Public Citizen*, 541 U.S. 752, 770 (2004), *quoted in* CN's initial response at 6.

At the time of CN's initial response, the Board was still considering whether construction of the connections described in the Operating Plan was subject to its regulatory jurisdiction under 49 U.S.C. § 10901. CN therefore made the conservative assumption that regulatory approval for those connections was required, and that the "but for" trains would include the trains that could not practicably be re-routed to the EJ&E line unless the connections were built pursuant to that approval. Now that the STB has determined that those connections do not in fact require prior regulatory approval, the number of trains that could currently shift to EJ&E has increased, and the number of "but for" trains has correspondingly decreased. With fewer "but for" trains, the impacts that could be caused by the STB approving the Transaction would be substantially reduced.

As shown in the attachments to this letter, the number of "but for" trains on each of the segments from Leithton, IL to Matteson, IL is under 8 trains per day – the Board's threshold for analysis for almost all of its environmental impacts. Further, Revised Attachment #4 shows that even if the traffic over those segments could be expected to grow at the rate of U.S. railroad traffic over the latest 20-year period available, it would take at least 64 years for the "but for" trains on any of those segments to grow to the level reflected in the operating plan. While the segments from Matteson, IL to Gary, IN have higher numbers of "but for" trains, Revised Attachment #4 shows that it would take a minimum of 25 years at that rate of growth for the number of "but for" trains to reach the levels reflected in the Operating Plan. CN therefore continues to believe that the train counts reflected in the Operating Plan provide the best basis for assessing the reasonably foreseeable impacts of the changes resulting from the Transaction.

In any event, as explained in CN's initial repsonse, any attempt to predict rail traffic several years into the future, especially over individual rail line segments, would be inaccurate and arbitrary. Thus, the figures provided in the Operating Plan, which substantially overstate the number of trains that would not move to EJ&EW "but for" the Board's approval of this Transaction, are as likely to be an accurate indication of future traffic over any affected line segment as would train counts computed by applying any arbitrary growth rate to the "but for" trains for which re-routing to the EJ&E line would be made possible by STB approval of the Transaction. Thus, CN maintains, it is appropriate for SEA to use the train counts reported in the Operating Plan for its analysis of the Transaction under NEPA.[2]

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[2] CN understands that it has been suggested that SEA should study the environmental impacts from traffic on the EJ&E line as if the line were double-tracked for its entire length and the line were then operated at its full capacity. Leaving aside the fact that this would amount to a "worst-case" scenario of the kind that the Supreme Court has indicated is not required under NEPA, such an assumption does not reflect the realities of how CN adds rail capacity. First of all, CN does not simply increase the capacity of its lines on an assumption that capacity will attract demand for CN rail service; rather, CN increases its capacity to accommodate actual or

CN's perspective here is supported by the enclosed memorandum of Jeffrey A. Dubin, Ph.D, who is an expert in the field of forecasting.[3] Professor Dubin explains why projections of the type that have been suggested by commenters provide no better indication of future traffic than does recent actual activity. He identifies five fundamental sources of uncertainty that sharply limit the utility of making long-term forecasts of rail traffic over the EJ&EW line. These include horizon uncertainty, model uncertainty, parameter uncertainty, disaggregation uncertainty, and exogenous factor uncertainty.

As Professor Dubin explains, all of these sources of uncertainty would apply to forecasting rail traffic growth over the EJ&EW line segment. Of particular note, he points out that forecast accuracy in general decreases rapidly as the forecast horizon grows. Moreover, he

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anticipated demand for that service. Second, double-tracking an entire line is the ultimate step CN would take to increase the capacity of that line, and would only come after it had taken a series of lesser steps and derived the maximum benefit from them.

Measures such as increasing the length of existing trains, placing signals closer together, and increasing train speed or the power pulling the trains would be more cost-effective means of increasing the capacity of rail lines than would improvements to track infrastructure. (And if track infrastructure improvements were necessary, double-tracking the entire EJ&E line would probably be unnecessary, because physical constraints such as diamonds at crossings with other railroads and the bridge over the Des Plaines River would act as choke points preventing CN from realizing the full benefit of double-tracking, unless CN undertook the great additional expense of grade-separating the railroad crossings or replacing or widening the bridge (which would also require obtaining approval from the Coast Guard).)

An example of why double tracking is often not the answer to capacity issues is the fact that, CN's main route south of Chicago does not carry enough traffic to justify double-tracking for most of its length. In fact, during the 1980s, IC found that it was more cost-effective to dismantle the existing double-tracking on much of its north-south line and provide capacity by improved signaling. While CN would likely restore the second main track to that line if traffic grew to the point where that became necessary, CN has no reason to believe such traffic growth is reasonably foreseeable, and it would be highly unrealistic to assume that growth making such infrastructure improvements necessary would occur on the EJ&E line before it did on CN's main line south of Chicago.

[3] Professor Dubin, who was formerly a Professor of Economics at California Institute of Technology, has recently accepted a position at UCLA's Anderson School of Management where, among other things, he will be heading the School's economic forecasting group. A copy of his Curriculum Vitae, including a complete list of his publications is attached to his memorandum as Appendix 1.

discusses the particularly difficult challenge of forecasting rail traffic volumes down to the specific level of a segment of a line such as EJ&EW, including the need not only to estimate volumes of likely future traffic but also to deal with micro issues such as routing, modal shifts, and intramodal and other competitive shifts in volumes.

Another challenge in forecasting rail traffic that Professor Dubin discusses is the fact that many of the underlying drivers of rail activity are themselves subject to tremendous and seemingly increasing volatility, making them hard to predict. For example, U.S. Department of Energy forecasts concerning energy prices, a major driver of the economy and rail traffic, have been very inaccurate, and especially inaccurate over the long term. Not surprisingly, as Professor Dubin observes, historic growth rates for rail traffic have varied greatly, leading him to conclude that the use of such growth rates as a means of forecasting, whether those growth rates are based on CN or overall U.S. rail traffic, would not be the best or even an appropriate approach for projecting future rail traffic over the EJ&EW line. He concludes that SEA should instead rely on the rail traffic volumes in CN's Operating Plan, noting that the number of "but for" trains that are appropriately the subject of that review is sufficiently small in comparison to the number of trains in the operating plan that even if historic growth rates could properly be applied to those "but for" trains for an extended period of time, they would still not exceed the volumes in the operating plan.

For these reasons, CN believes the use of the train traffic levels reflected in the Operating Plan provide the most sound basis for analyzing the environmental impacts of the Transaction. The use of any projections of future traffic growth is unwarranted and unnecessary. SEA should adhere to its well-established precedent, and calculate impacts on the basis of the train levels reflected in the Operating Plan and the vehicle counts that are currently observed.

Very truly yours,

Paul A. Cunningham

Counsel for Canadian National Railway Company
and Grand Trunk Corporation

Enclosures

cc: John H. Morton
Normand Pellerin

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 14
Leithton - Spaulding

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
118	Winnipeg	Chicago	Leithton	Matteson	Matteson	1.0
119	Chicago	Winnipeg	Matteson	Leithton	Matteson	1.0
198	Prince Rupert	Chicago	Leithton	Matteson	Matteson	1.0
199	Chicago	Prince Rupert	Matteson	Leithton	Matteson	1.0
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
342	Prince George	Memphis	Leithton	Matteson	Matteson	1.0
343	Jackson	Winnipeg	Matteson	Leithton	Matteson	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0

Trains reflected in the Operating Plan	15.0
Trains likely to operate over EJ&EW post-implementation[2]	13.0
Operating plan trains that could operate today over EJ&E without further STB review	11.0
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	2.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 13
Spaulding - Munger

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
118	Winnipeg	Chicago	Leithton	Matteson	Matteson	1.0
119	Chicago	Winnipeg	Matteson	Leithton	Matteson	1.0
198	Prince Rupert	Chicago	Leithton	Matteson	Matteson	1.0
199	Chicago	Prince Rupert	Matteson	Leithton	Matteson	1.0
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
342	Prince George	Memphis	Leithton	Matteson	Matteson	1.0
343	Jackson	Winnipeg	Matteson	Leithton	Matteson	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
COAI	Galatia	Spaulding ICE	Matteson	Spaulding	Matteson	0.0
COAJ	Spaulding ICE	Galatia	Spaulding	Matteson	Matteson	0.0

Trains reflected in the Operating Plan	17.0
Trains likely to operate over EJ&EW post-implementation[2]	15.0
Operating plan trains that could operate today over EJ&E without further STB review	11.0
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	4.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 12
Munger - West Chicago

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
118	Winnipeg	Chicago	Leithton	Matteson	Matteson	1.0
119	Chicago	Winnipeg	Matteson	Leithton	Matteson	1.0
198	Prince Rupert	Chicago	Leithton	Matteson	Matteson	1.0
199	Chicago	Prince Rupert	Matteson	Leithton	Matteson	1.0
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
337	Markham	Waterloo	Matteson	Munger	Munger/Matteson	1.0
338	Waterloo	Markham	Munger	Matteson	Munger/Matteson	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
342	Prince George	Memphis	Leithton	Matteson	Matteson	1.0
343	Jackson	Winnipeg	Matteson	Leithton	Matteson	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
COAI	Galatia	Spaulding ICE	Matteson	Spaulding	Matteson	0.0
COAJ	Spaulding ICE	Galatia	Spaulding	Matteson	Matteson	0.0

Trains reflected in the Operating Plan	19.0
Trains likely to operate over EJ&EW post-implementation[2]	17.0
Operating plan trains that could operate today over EJ&E without further STB review	13.0
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	4.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 11
West Chicago - East Siding (Eola)

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
118	Winnipeg	Chicago	Leithton	Matteson	Matteson	1.0
119	Chicago	Winnipeg	Matteson	Leithton	Matteson	1.0
198	Prince Rupert	Chicago	Leithton	Matteson	Matteson	1.0
199	Chicago	Prince Rupert	Matteson	Leithton	Matteson	1.0
250	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.3
260	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.1
280	West Chicago UP	Michigan	W Chicago	Griffith	Existing connections	0.1
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
337	Markham	Waterloo	Matteson	Munger	Munger/Matteson	1.0
338	Waterloo	Markham	Munger	Matteson	Munger/Matteson	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
342	Prince George	Memphis	Leithton	Matteson	Matteson	1.0
343	Jackson	Winnipeg	Matteson	Leithton	Matteson	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
707	Lansing	W. Chicago UP	Griffith	W Chicago	Existing connections	0.4
708	W. Chicago UP	Lansing	W Chicago	Griffith	Existing connections	0.0
COAI	Galatia	Spaulding ICE	Matteson	Spaulding	Matteson	0.0
COAJ	Spaulding ICE	Galatia	Spaulding	Matteson	Matteson	0.0

Trains reflected in the Operating Plan	20.9
Trains likely to operate over EJ&EW post-implementation[2]	18.9
Operating plan trains that could operate today over EJ&E without further STB review	13.9
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	5.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 10
East Siding (Eola) - Walker

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
118	Winnipeg	Chicago	Leithton	Matteson	Matteson	1.0
119	Chicago	Winnipeg	Matteson	Leithton	Matteson	1.0
198	Prince Rupert	Chicago	Leithton	Matteson	Matteson	1.0
199	Chicago	Prince Rupert	Matteson	Leithton	Matteson	1.0
250	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.3
260	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.1
280	West Chicago UP	Michigan	W Chicago	Griffith	Existing connections	0.1
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
337	Markham	Waterloo	Matteson	Munger	Munger/Matteson	1.0
338	Waterloo	Markham	Munger	Matteson	Munger/Matteson	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
342	Prince George	Memphis	Leithton	Matteson	Matteson	1.0
343	Jackson	Winnipeg	Matteson	Leithton	Matteson	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
707	Lansing	W. Chicago UP	Griffith	W Chicago	Existing connections	0.4
708	W. Chicago UP	Lansing	W Chicago	Griffith	Existing connections	0.0
760	Eola BNSF	Monroe	Eola	Griffith	Existing connections	0.0
761	Monroe	Eola BNSF	Griffith	Eola	Existing connections	0.1
762	Eola BNSF	Ecorse	Eola	Griffith	Existing connections	0.1
7649	Eola BNSF	Durand	Eola	Griffith	Existing connections	0.1
765	Durand	Eola BNSF	Griffith	Eola	Existing connections	0.1
766	Eola BNSF	Whiting	Eola	Griffith	Existing connections	0.2
767	Whiting	Eola BNSF	Griffith	Eola	Existing connections	0.2
769	Ecorse	Eola BNSF	Griffith	Eola	Existing connections	0.1
COAI	Galatia	Spaulding ICE	Matteson	Spaulding	Matteson	0.0
COAJ	Spaulding ICE	Galatia	Spaulding	Matteson	Matteson	0.0

Trains reflected in the Operating Plan	23.8
Trains likely to operate over EJ&EW post-implementation[2]	21.8
Operating plan trains that could operate today over EJ&E without further STB review	14.8
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	6.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 9
Walker - Bridge Junction

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
118	Winnipeg	Chicago	Leithton	Matteson	Matteson	1.0
119	Chicago	Winnipeg	Matteson	Leithton	Matteson	1.0
198	Prince Rupert	Chicago	Leithton	Matteson	Matteson	1.0
199	Chicago	Prince Rupert	Matteson	Leithton	Matteson	1.0
250	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.3
260	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.1
280	West Chicago UP	Michigan	W Chicago	Griffith	Existing connections	0.1
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
337	Markham	Waterloo	Matteson	Munger	Munger/Matteson	1.0
338	Waterloo	Markham	Munger	Matteson	Munger/Matteson	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
342	Prince George	Memphis	Leithton	Matteson	Matteson	1.0
343	Jackson	Winnipeg	Matteson	Leithton	Matteson	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
707	Lansing	W. Chicago UP	Griffith	W Chicago	Existing connections	0.4
708	W. Chicago UP	Lansing	W Chicago	Griffith	Existing connections	0.0
760	Eola BNSF	Monroe	Eola	Griffith	Existing connections	0.0
761	Monroe	Eola BNSF	Griffith	Eola	Existing connections	0.1
762	Eola BNSF	Ecorse	Eola	Griffith	Existing connections	0.1
7649	Eola BNSF	Durand	Eola	Griffith	Existing connections	0.1
765	Durand	Eola BNSF	Griffith	Eola	Existing connections	0.1
766	Eola BNSF	Whiting	Eola	Griffith	Existing connections	0.2
767	Whiting	Eola BNSF	Griffith	Eola	Existing connections	0.2
769	Ecorse	Eola BNSF	Griffith	Eola	Existing connections	0.1
COAI	Galatia	Spaulding ICE	Matteson	Spaulding	Matteson	0.0
COAJ	Spaulding ICE	Galatia	Spaulding	Matteson	Matteson	0.0

Trains reflected in the Operating Plan	23.8
Trains likely to operate over EJ&EW post-implementation[2]	21.8
Operating plan trains that could operate today over EJ&E without further STB review	14.8
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	6.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 8
Bridge Junction - Rock Island Junction

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
118	Winnipeg	Chicago	Leithton	Matteson	Matteson	1.0
119	Chicago	Winnipeg	Matteson	Leithton	Matteson	1.0
198	Prince Rupert	Chicago	Leithton	Matteson	Matteson	1.0
199	Chicago	Prince Rupert	Matteson	Leithton	Matteson	1.0
250	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.3
260	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.1
280	West Chicago UP	Michigan	W Chicago	Griffith	Existing connections	0.1
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
337	Markham	Waterloo	Matteson	Munger	Munger/Matteson	1.0
338	Waterloo	Markham	Munger	Matteson	Munger/Matteson	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
342	Prince George	Memphis	Leithton	Matteson	Matteson	1.0
343	Jackson	Winnipeg	Matteson	Leithton	Matteson	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
707	Lansing	W. Chicago UP	Griffith	W Chicago	Existing connections	0.4
708	W. Chicago UP	Lansing	W Chicago	Griffith	Existing connections	0.0
760	Eola BNSF	Monroe	Eola	Griffith	Existing connections	0.0
761	Monroe	Eola BNSF	Griffith	Eola	Existing connections	0.1
762	Eola BNSF	Ecorse	Eola	Griffith	Existing connections	0.1
7649	Eola BNSF	Durand	Eola	Griffith	Existing connections	0.1
765	Durand	Eola BNSF	Griffith	Eola	Existing connections	0.1
766	Eola BNSF	Whiting	Eola	Griffith	Existing connections	0.2
767	Whiting	Eola BNSF	Griffith	Eola	Existing connections	0.2
769	Ecorse	Eola BNSF	Griffith	Eola	Existing connections	0.1
COAI	Galatia	Spaulding ICE	Matteson	Spaulding	Matteson	0.0
COAJ	Spaulding ICE	Galatia	Spaulding	Matteson	Matteson	0.0

Trains reflected in the Operating Plan	23.8
Trains likely to operate over EJ&EW post-implementation[2]	21.8
Operating plan trains that could operate today over EJ&E without further STB review	14.8
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	6.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 7
Rock Island Junction - Matteson

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
118	Winnipeg	Chicago	Leithton	Matteson	Matteson	1.0
119	Chicago	Winnipeg	Matteson	Leithton	Matteson	1.0
198	Prince Rupert	Chicago	Leithton	Matteson	Matteson	1.0
199	Chicago	Prince Rupert	Matteson	Leithton	Matteson	1.0
250	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.3
260	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.1
276	Joliet BNSF	Michigan	Joliet	Griffith	Existing connections	0.0
278	Joliet BNSF	Michigan	Joliet	Griffith	Existing connections	0.1
280	West Chicago UP	Michigan	W Chicago	Griffith	Existing connections	0.2
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
337	Markham	Waterloo	Matteson	Munger	Munger/Matteson	1.0
338	Waterloo	Markham	Munger	Matteson	Munger/Matteson	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
342	Prince George	Memphis	Leithton	Matteson	Matteson	1.0
343	Jackson	Winnipeg	Matteson	Leithton	Matteson	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
707	Lansing	W. Chicago UP	Griffith	W Chicago	Existing connections	0.4
708	W. Chicago UP	Lansing	W Chicago	Griffith	Existing connections	0.0
760	Eola BNSF	Monroe	Eola	Griffith	Existing connections	0.0
761	Monroe	Eola BNSF	Griffith	Eola	Existing connections	0.1
762	Eola BNSF	Ecorse	Eola	Griffith	Existing connections	0.1
7649	Eola BNSF	Durand	Eola	Griffith	Existing connections	0.1
765	Durand	Eola BNSF	Griffith	Eola	Existing connections	0.1
766	Eola BNSF	Whiting	Eola	Griffith	Existing connections	0.2
767	Whiting	Eola BNSF	Griffith	Eola	Existing connections	0.2
769	Ecorse	Eola BNSF	Griffith	Eola	Existing connections	0.1
COAI	Galatia	Spaulding ICE	Matteson	Spaulding	Matteson	0.0
COAJ	Spaulding ICE	Galatia	Spaulding	Matteson	Matteson	0.0

Trains reflected in the Operating Plan	21.9
Trains likely to operate over EJ&EW post-implementation[2]	19.9
Operating plan trains that could operate today over EJ&E without further STB review	14.9
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	6.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 6
Matteson - Chicago Heights

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
148	Chicago	Montreal	Matteson	Griffith	Matteson	1.0
149	Montreal	Chicago	Griffith	Matteson	Matteson	1.0
250	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.3
260	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.1
276	Joliet BNSF	Michigan	Joliet	Griffith	Existing connections	0.0
278	Joliet BNSF	Michigan	Joliet	Griffith	Existing connections	0.1
280	West Chicago UP	Michigan	W Chicago	Griffith	Existing connections	0.2
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
393	Toronto	Proviso UP	Griffith	Matteson	Matteson	1.0
395	Toronto	Glenn Yard BNSF	Griffith	Matteson	Matteson	1.0
399	Toronto	Salem UP	Griffith	Matteson	Existing connections	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
707	Lansing	W. Chicago UP	Griffith	W Chicago	Existing connections	0.4
708	W. Chicago UP	Lansing	W Chicago	Griffith	Existing connections	0.0
760	Eola BNSF	Monroe	Eola	Griffith	Existing connections	0.0
761	Monroe	Eola BNSF	Griffith	Eola	Existing connections	0.1
762	Eola BNSF	Ecorse	Eola	Griffith	Existing connections	0.1
763	Convent	Dearborn	Matteson	Griffith	Existing connections	0.0
764	Dearborn	Convent	Griffith	Matteson	Existing connections	0.0
7649	Eola BNSF	Durand	Eola	Griffith	Existing connections	0.1
765	Durand	Eola BNSF	Griffith	Eola	Existing connections	0.1
766	Eola BNSF	Whiting	Eola	Griffith	Existing connections	0.2
767	Whiting	Eola BNSF	Griffith	Eola	Existing connections	0.2
769	Ecorse	Eola BNSF	Griffith	Eola	Existing connections	0.1

Trains reflected in the Operating Plan	22.9
Trains likely to operate over EJ&EW post-implementation[2]	20.9
Operating plan trains that could operate today over EJ&E without further STB review	11.9
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	10.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 5
Chicago Heights - Griffith

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
148	Chicago	Montreal	Matteson	Griffith	Matteson	1.0
149	Montreal	Chicago	Griffith	Matteson	Matteson	1.0
250	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.3
260	West Chicago UP	Michigan	West Chicago	Griffith	Existing connections	0.1
276	Joliet BNSF	Michigan	Joliet	Griffith	Existing connections	0.0
278	Joliet BNSF	Michigan	Joliet	Griffith	Existing connections	0.1
280	West Chicago UP	Michigan	W Chicago	Griffith	Existing connections	0.2
301	Toronto	Edmonton	Griffith	Leithton	Existing connections	1.0
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
393	Toronto	Proviso UP	Griffith	Matteson	Matteson	1.0
395	Toronto	Glenn Yard BNSF	Griffith	Matteson	Matteson	1.0
399	Toronto	Salem UP	Griffith	Matteson	Existing connections	1.0
407	Pontiac	Wausau	Griffith	Leithton	Existing connections	1.0
408	Wausau	Pontiac	Leithton	Griffith	Existing connections	1.0
707	Lansing	W. Chicago UP	Griffith	W Chicago	Existing connections	0.4
708	W. Chicago UP	Lansing	W Chicago	Griffith	Existing connections	0.0
760	Eola BNSF	Monroe	Eola	Griffith	Existing connections	0.0
761	Monroe	Eola BNSF	Griffith	Eola	Existing connections	0.1
762	Eola BNSF	Ecorse	Eola	Griffith	Existing connections	0.1
763	Convent	Dearborn	Matteson	Griffith	Existing connections	0.0
764	Dearborn	Convent	Griffith	Matteson	Existing connections	0.0
7649	Eola BNSF	Durand	Eola	Griffith	Existing connections	0.1
765	Durand	Eola BNSF	Griffith	Eola	Existing connections	0.1
766	Eola BNSF	Whiting	Eola	Griffith	Existing connections	0.2
767	Whiting	Eola BNSF	Griffith	Eola	Existing connections	0.2
769	Ecorse	Eola BNSF	Griffith	Eola	Existing connections	0.1
TUP1	Chicago Heights UP	Flint	Chicago Heights	Griffith	Existing connections	1.0

Trains reflected in the Operating Plan	23.9
Trains likely to operate over EJ&EW post-implementation[2]	21.9
Operating plan trains that could operate today over EJ&E without further STB review	12.9
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	10.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 4
Griffith - Van Loon

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
251	Detroit	Gibson IHB	Griffith	Cavanaugh (to Shearson)	Graselli	1.0
275	Oshawa	Gibson IHB	Griffith	Cavanaugh (to Shearson)	Graselli	0.9

Trains reflected in the Operating Plan	21.0
Trains likely to operate over EJ&EW post-implementation[2]	19.0
Operating plan trains that could operate today over EJ&E without further STB review	3.9
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	12.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 3
Van Loon - Ivanhoe

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
251	Detroit	Gibson IHB	Griffith	Cavanaugh (to Shearson)	Graselli	1.0
275	Oshawa	Gibson IHB	Griffith	Cavanaugh (to Shearson)	Graselli	0.9

Trains reflected in the Operating Plan	20.0
Trains likely to operate over EJ&EW post-implementation[2]	18.0
Operating plan trains that could operate today over EJ&E without further STB review	3.9
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	12.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 2
Ivanhoe - Cavanaugh

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0
251	Detroit	Gibson IHB	Griffith	Cavanaugh (to Shearson)	Graselli	1.0
275	Oshawa	Gibson IHB	Griffith	Cavanaugh (to Shearson)	Graselli	0.9

Trains reflected in the Operating Plan	20.0
Trains likely to operate over EJ&EW post-implementation[2]	18.0
Operating plan trains that could operate today over EJ&E without further STB review	3.9
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	12.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #1

Minimum Number Of Operating Plan Trains That Could Be Re-routed Over EJ&E Without Further STB Review

Segment 1
Cavanaugh - Gary

CN Train ID[1]	From	To	Could Enter EJ&E	Could Exit EJ&E	With Connection at	Daily count
340	Winnipeg	Kirk NS	Leithton	Kirk to NS	Kirk	1.0
341	Kirk NS	Winnipeg	Kirk from NS	Leithton	Kirk	1.0

Trains reflected in the Operating Plan	20.0
Trains likely to operate over EJ&EW post-implementation[2]	18.0
Operating plan trains that could operate today over EJ&E without further STB review	2.0
Operating plan trains that likely would not shift to EJ&E but for the transaction[3]	12.0

1. These train IDs represent the trains CN anticipated operating when it built the Operating Plan, so some trains may not currently operate with these IDs.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

3. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

Revised Attachment #4

Train Growth Required to Absorb Difference Between Operating Plan and "But For" Trains

Segment No.	Segment Endpoints	Trains reflected in the Operating Plan	Trains likely to operate over EJ&EW post-Transaction[1]	Operating Plan trains that could operate today over EJ&E without further STB review	Operating Plan trains that likely would not shift to EJ&E but for the Transaction[2]	Length of time (in years) at specified growth rate it would take "but for" trains to reach the levels reflected in the Operating Plan				
						Years @ 0.50%	Years @ 1.00%	Years @ 1.50%	Years @ 2.00%	Years @ 2.04%[3]
14	Leithton - Spaulding	15.0	13.0	11.0	2.0	404.0	202.5	135.3	101.7	99.8
13	Spaulding - Munger	17.0	15.0	11.0	4.0	290.1	145.4	97.2	73.1	71.6
12	Munger - West Chicago	19.0	17.0	13.0	4.0	312.4	156.6	104.7	78.7	77.2
11	West Chicago - East Siding	20.9	18.9	13.9	5.0	286.8	143.7	96.1	72.2	70.8
10	East Siding - Walker	23.8	21.8	14.8	6.0	276.3	138.5	92.5	69.6	68.2
9	Walker - Bridge Jct.	23.8	21.8	14.8	6.0	276.3	138.5	92.5	69.6	68.2
8	Bridge Jct. - Rock Island Jct.	23.8	21.8	14.8	6.0	276.3	138.5	92.5	69.6	68.2
7	Rock Island Jct. - Matteson	21.9	19.9	14.9	6.0	259.6	130.1	87.0	65.4	64.1
6	Matteson - Chicago Heights	22.9	20.9	11.9	10.0	166.1	83.3	55.7	41.8	41.0
5	Chicago Heights - Griffith	23.9	21.9	12.9	10.0	174.7	87.6	58.5	44.0	43.1
4	Griffith - Van Loon	21.0	19.0	3.9	12.0	112.2	56.2	37.6	28.3	27.7
3	Van Loon - Ivanhoe	20.0	18.0	3.9	12.0	102.4	51.3	34.3	25.8	25.3
2	Ivanhoe - Cavanaugh	20.0	18.0	3.9	12.0	102.4	51.3	34.3	25.8	25.3
1	Cavanaugh - Gary	20.0	18.0	2.0	12.0	102.4	51.3	34.3	25.8	25.3

1. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

2. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments, the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

3. Average annual rate of growth in U.S. railroad tonnage originated for the twenty year period from 1986-2006. See, Policy and Economics Department, Assocation of American Railroads, Railroad Facts, 1996 ed. at 28, and Policy and Economics Department, Assocation of American Railroads, Railroad Facts, 2007 ed. at 28. Tons originated is a better indicator of train growth than carloads originated because, depending on the year, carloads originated data may not include intermodal traffic. Additionally, depending on the way intermodal units are counted, use of carloads originated data could lead to a significant overstatement of train growth.

Revised Attachment #5

Pro Forma Train Growth Over 10 Years Calculated Using Hypothetical Growth Rates[1]
(For Illustration Only)

Segment No.	Segment Endpoints	Trains reflected in the Operating Plan	Trains likely to operate over EJ&EW post-Transaction[2]	Operating Plan trains that could operate today over EJ&E without further STB review	Operating Plan trains that likely would not shift to EJ&E but for the Transaction[3]	Additional "but for" trains after 10 years at the stated level of growth				
						0.50%	1.00%	1.50%	2.00%	2.04%[4]
14	Leithton - Spaulding	15.0	13.0	11.0	2.0	0.1	0.2	0.3	0.4	0.4
13	Spaulding - Munger	17.0	15.0	11.0	4.0	0.2	0.4	0.6	0.9	0.9
12	Munger - West Chicago	19.0	17.0	13.0	4.0	0.2	0.4	0.6	0.9	0.9
11	West Chicago - East Siding	20.9	18.9	13.9	5.0	0.3	0.5	0.8	1.1	1.1
10	East Siding - Walker	23.8	21.8	14.8	6.0	0.3	0.6	1.0	1.3	1.3
9	Walker - Bridge Jct.	23.8	21.8	14.8	6.0	0.3	0.6	1.0	1.3	1.3
8	Bridge Jct. - Rock Island Jct.	23.8	21.8	14.8	6.0	0.3	0.6	1.0	1.3	1.3
7	Rock Island Jct. - Matteson	21.9	19.9	14.9	6.0	0.3	0.6	1.0	1.3	1.3
6	Matteson - Chicago Heights	22.9	20.9	11.9	10.0	0.5	1.0	1.6	2.2	2.2
5	Chicago Heights - Griffith	23.9	21.9	12.9	10.0	0.5	1.0	1.6	2.2	2.2
4	Griffith - Van Loon	21.0	19.0	3.9	12.0	0.6	1.3	1.9	2.6	2.7
3	Van Loon - Ivanhoe	20.0	18.0	3.9	12.0	0.6	1.3	1.9	2.6	2.7
2	Ivanhoe - Cavanaugh	20.0	18.0	3.9	12.0	0.6	1.3	1.9	2.6	2.7
1	Cavanaugh - Gary	20.0	18.0	2.0	12.0	0.6	1.3	1.9	2.6	2.7

1. CN is aware of no basis for the use of the hypothetical growth rates or for any other reliable basis for forecasting growth in the "but for" trains attributable to the Transaction.

2. The figures reflected in the Operating Plan include two trains that CN interchanges with CSX that CN expected to route over EJ&EW from Leithton to Kirk Yard. However, as a result of conversations with CSX, CN no longer expects those trains to be operated over EJ&EW.

2. Because there is not a one-to-one correlation between operating plan trains and trains currently operated by CN that could be re-reouted over EJ&E ("shift" trains), on some segments, the "but for" trains may not equal the difference between the operating plan trains and the shift trains. For all segments, the number of "but for" trains has been independently calculated by CN's operating department.

4. Average annual rate of growth in U.S. railroad tonnage originated for the twenty year period from 1986-2006. See, Policy and Economics Department, Assocation of American Railroads, Railroad Facts, 1996 ed. at 28, and Policy and Economics Department, Assocation of American Railroads, Railroad Facts, 2007 ed. at 28. Tons originated is a better indicator of train growth than carloads originated because, depending on the year, carloads originated data may not include intermodal traffic. Additionally, depending on the way intermodal units are counted, use of carloads originated data could lead to a significant overstatement of train growth.

FINAL

MEMORANDUM

To: Harkins Cunningham LLP

From: Professor Jeffrey Alan Dubin

Date: May 12, 2008

Re: Long-Term Forecasting Issues

BACKGROUND

You have asked me to comment on issues related to forecasts of possible future rail traffic being considered by the Section of Environmental Analysis of the Surface Transportation Board ("SEA"), in connection with SEA's environmental review of the proposed acquisition by Canadian National Railway Company and Grand Trunk Corporation (together, "CN") of the EJ&E West Company, a wholly owned subsidiary of Elgin Joliet & Eastern Railway Company ("EJ&E"). My understanding is that the EJ&EW would form an arc around the outskirts of Chicago and be used primarily as an intermediate route segment for the large volumes of CN's traffic routed to, from, or through Chicago. You have asked me to comment in particular on SEA's interest in the feasibility and utility of forecasts for rail traffic on the EJ&EW through 2015. In addition, you have asked me whether the general principles of statistics and economics related to the uncertainty of such forecasts would similarly apply to long-term forecasts for vehicular traffic.

SUMMARY OF CONCLUSIONS

For the reasons I discuss below, I conclude that long-term forecasts of rail traffic are unlikely to be reliable or helpful for use in determining the future environmental impacts due to the acquisition. Instead, SEA should utilize the rail traffic volumes in the CN Operating Plan, which are based on existing EJ&E and CN traffic plus extended haul traffic identified in CN's traffic study and additional traffic anticipated from the Port of Prince Rupert. It is my understanding that the difference between trains that are likely to run under the operating plan and trains that could move today with no additional STB authority is small. I also understand that it is these so-called "but for" trains that are appropriately within the purview of the environmental review. These "but for" trains are sufficiently small in number that the operating plan may already overstate the great majority of whatever rail traffic could reasonably be expected in the future to be subject to SEA's environmental analysis.

Of equal importance is the uncertainty and lack of confidence that a long-term forecast would yield in this instance for other traffic, rail and vehicular alike. Nothing will be gained by relying on speculative long-term forecasts for such traffic.

DISCUSSION

I. GENERAL ISSUES PERTINENT TO LONG-TERM FORECASTING

A prediction or forecast is a statement concerning unknown or future events. It is impossible to remove all uncertainty about the future. A forecast is useful when it reduces the uncertainty that prevailed before the forecast. A forecast that does not help reduce uncertainty is not helpful. It is not always the case that forecasts help reduce

uncertainty. For instance, when the future to be forecast is inherently uncertain or when analysts attempt to forecast for long time horizons, forecasts may become useless.

Most, but not all, forecasts have associated levels of certainty. For instance, statistical forecasts have so-called confidence bands. A statistician can make a statement that a given confidence band will contain the likely outcome being forecasted with a given degree of certainty. A 95 percent confidence interval is an interval that contains the true but unknown outcome with 95 percent certainty. In some cases the confidence band is simply too wide to be useful for decision making (*e.g.,* it includes a very large range of outcomes for a given degree of certainty). In these situations, the forecast is not helpful. The mere existence of a forecast does not help determine whether it is helpful or not. The issue turns on the precision of the forecast.

All forecasts are subject to uncertainty. The components of this uncertainty include: (i) horizon uncertainty; (ii) model and parameter uncertainty; (iii) disaggregation uncertainty; and (iv) exogenous factor uncertainty. I discuss each of these forms of forecast uncertainty in turn. It is important to understand that the SEA request for long-term rail forecasts is specifically subject to <u>all</u> of these types of uncertainty and, in this instance, the magnitude of the uncertainties make the forecasting exercise of little or no value.

(i) Horizon Uncertainty

There are well known statistical properties of so-called optimum or optimal forecasts. An optimum forecast uses all available information and has the greatest precision among all unbiased forecasts. In theory, optimum forecasts use all available information known at the time of the forecast (the information set). Mathematicians have

the ivory-tower luxury of studying the properties of this best-case situation. In the real world, matters only get worse. More precisely, sub-optimum predictions are less accurate than optimum predictions. While the mathematical development is not trivial the intuition is clear enough. The further ahead one forecasts, the less precise the forecast.

Mathematically, any time-series can be represented according to the Wold representation theorem by a moving-average process:

$$X_t = \sum_{j=0}^{m} C_j \varepsilon_{t-j} \qquad C_0 = 1 \tag{1}$$

where m may be infinite. In particular, any standard auto-regressive moving-average may be represented by (1). The future value X_{n+h} (the value of X projected h periods in the future from time period n) is given by:

$$X_{n+h} = \sum_{j=0}^{h-1} C_j \varepsilon_{n+h-j} + \sum_{j=h}^{m} C_j \varepsilon_{n+h-j}$$

The first term consists of random variables that are unknown at time period n. This term has zero expected value and is non-forecastable. The components in the second term are potentially knowable at time period n because they consist of realizations of past random shocks (*i.e.* historical influences). The second component is consequently the optimum forecast $f_{n,h}$. The forecast error is:

$$e_{n,h} = x_{n+h} - f_{n,h} = \sum_{j=0}^{h-1} C_j \varepsilon_{n+h-j}$$

The forecast error has variance:

$$\text{var}(e_{n,h}) = \left(\sum_{j=0}^{h-1} C_j^2 \right) \sigma_\varepsilon^2$$

Moreover,

$$\text{var}(e_{n,h}) - \text{var}(e_{n,h-1}) = C_{h-1}^2 \sigma_\varepsilon^2$$

that cannot be negative. Hence, forecasts become less accurate as the forecast period h increases. The variance of $e_{n,h}$ when plotted against h will generally be increasing, and as h gets large enough, the forecast error will have as much variance as the process being forecast. An alternative way of saying this is that as one tries to forecast very far ahead, the less well one does; the "information set" ceases to contain anything of relevance in performing the forecast. As h gets large, the forecast $f_{n,h}$ tends to the average value of X_t so that $e_{n,h}$ and x_{n+k} have equal variance. In this case, the forecast is not helpful.

As an example, consider the forecast of the auto-regressive model $y_t = a_0 + a_1 y_{t-1} + \varepsilon_t$. Updating one period we obtain $y_{t+1} = a_0 + a_1 y_t + \varepsilon_{t+1}$. The forecast is $E_t y_{t+1} = a_0 + a_1 y_t$ where $E_t y_{t+j}$ is the conditional expectation of y_{t+j} given information available at time t. In the same way,

$$y_{t+2} = a_0 + a_1 y_{t+1} + \varepsilon_{t+2}$$

$$E_t y_{t+2} = a_0 + a_1 E_t y_{t+1} = a_0 + a_0 a_1 + a_1^2 y_t$$

and more generally:

$$E_t y_{t+j} = a_0 \left(1 + a_1 + a_1^2 + \ldots + a_1^{j-1}\right) + a_1^j y_t .$$

The forecast error

$$e_{t,j} = y_{t+j} - E_t y_{t+j} = \varepsilon_{t+j} + a_1 \varepsilon_{t+j-1} + \ldots + a_1^{j-1} \varepsilon_{t+1}$$

has the variance

$$\text{var}\left(\varepsilon_{t,j}\right) = \sigma^2 \left(1 + a_1^2 + a_1^4 + \ldots + a_1^{2(j-1)}\right).$$

Since the one-step forecast error variance is σ^2, the two-step forecast variance is $\sigma^2\left(1 + a_1^2\right)$ and so forth.

The essential point is that the forecast variance increases dramatically with forecast length. A time-series with significant auto-correlation $\left(a_1 = 0.9\right)$ will have nearly double the variance in a two-period forecast than in a one-period forecast and the confidence band will be correspondingly larger and hence the forecast less precise. In other words, the ninety-five percent confidence interval (the interval in which we expect that with 95 percent certainty the future value will fall) increases with forecast length. This, in turn, means that as the forecast horizon increases the forecast itself must encompass a broader and broader range of values to maintain the same degree of confidence. Therefore, it does not surprise me that CN does not find it worthwhile for business purposes to make route specific forecasts of its rail traffic beyond one year in the future. Forecasts for longer horizons are simply less accurate than for short horizons.

(ii) Model and Parameter Uncertainty

There are two other sources of uncertainty that make the task of forecasting even more difficult and hence less precise. The discussion above assumed that the model for the process that determines the variable of interest is known, but in the real world it is not reasonable to presume that the model is known with certainty. "Model uncertainty" is uncertainty due to not knowing the correct theoretical or empirical model. It pertains to not being sure what the right model is in advance of a study or forecast. For instance, we may not be sure whether a deterministic inventory based model of traffic demand is correct or whether historical or regulatory or other constraints best fit the facts. An econometric or engineering model may or may not capture relevant aspects of the

decision process as compared to the practice of a railroad planner or expert. Getting the model wrong or having an incomplete model leads to error due to model uncertainty. Very little is known about model uncertainty except that researchers often proceed as if it does not exist.

A related issue is parameter uncertainty. Even when it may be assumed that the model is certain (Newtonian gravitation might be an example), the parameters of that model may still be unknown and require estimation. In equation (1) above, we assumed that the parameters "C" were known. In reality they must be estimated and estimation may be difficult or impossible when there is little data.

That would certainly be the case for a rail volume forecast for a network as complex as CN's. Much of the discussion of model uncertainty in the Transportation Research Board special report on Metropolitan Travel Forecasting, 2007, would be applicable to such an effort. As noted in that report, characteristics of goods movement can vary considerably due to a lack of understanding of real-world logistics. Importantly, these authors note that most existing forecasting models produce a single answer even though they are estimated, calibrated, and validated using data and models that are subject to many sources and ranges of error. As I discuss further below, many transportation forecasts rely on exogenous forecasts of underlying factors that are themselves subject to considerable uncertainty. The state of affairs in transportation forecasting has not greatly improved in the last fifty years. Unfortunately, transportation forecasting remains highly inaccurate (Flyvbjerg (2005, 2006)).

(iii) Disaggregation Uncertainty

Aggregate rail traffic models fall into two broad categories. One type of model concerns itself primarily with the level of activity or commodity shipped in aggregate or by rail segment or corridor. The focus of these models is on projecting traffic growth. I will have more to say on the difficulties of such growth projections in Part II, below.

Other models are used to estimate or forecast the choice of mode of transportation among truck or rail or the market share of traffic that might move along a particular corridor or segment. Models of this kind are summarized by Winston (2007) and Abdelwahab and Sargious (1992). The perspective of these models is based on either the demand side (demand by firms to transport commodities) or the supply side (*e.g.*, the inventory theoretic model of Baumol and Vinod (1970)). Models of this kind would also include the opinions of experts regarding likely rail diversion between competitors. Given imperfect available information and the difficulties of predicting competitive behavior in markets, these models are inherently subject to significant error.

For purposes of forecasting traffic down to the specific level of a segment of a line such as EJ&E's, one would not only have to determine future volumes of likely future traffic moving between areas, but also deal with such issues as routing, modal shifts, and intramodal and other competitive shifts in volumes.

The difficulty of accomplishing all of these tasks in order to project rail traffic growth over a line segment are well illustrated by the three examples of rail forecasts discussed in the SEA's Information Request # 3 (attached to the letter from Victoria J. Rutson (Chief, SEA), to Normand Pellerin (Assistant Vice President, Environment, CN)

(March 25, 2008)) and CN's April 21, 2008 response[1] – the CREATE study, the AASHTO study, and the Association of American Railroads ("AAR") study produced by Cambridge Systematics, Inc. These studies either ignore or at best fail to fully account for such fundamental factors as changes in markets, technology or regulation, rail competition, intermodal competition, or future investment issues and capacity constraints. My review of these forecasts suggests that none does a good job (to the extent they even purport to do so) of forecasting traffic down to small segments or corridors. I fundamentally agree with the critique of each of these forecasts in CN's April 21, 2008 letter. To the extent these models are able to forecast changes in rail volumes at all, they do best at summarizing overall traffic relationships and are simply not designed to forecast individual segments with great specificity.

The problem faced by these studies is inherent in any attempt to use a model designed for macro (aggregate) analysis at the micro level. Macro forecasting relies on the aggregation of many individual economic decisions. The law of large numbers comes into play to reduce the variability of the aggregate prediction and makes averages more precise as sample sizes are increased. The confidence band around the estimated average shrinks so that the range of uncertainty around the estimate is reduced. Conversely, smaller samples lead to less accurate forecasts. Generally speaking, it is simply much more difficult to do useful and accurate individual level forecasting as compared to forecasting aggregates. Thus, it may be possible to forecast the demand for McDonald's hamburgers in a given month, but much more difficult to predict whether any individual

[1] Letter from Paul A. Cunningham (counsel to CN) to Victoria J. Rutson (Chief, SEA), dated April 21, 2008.

consumer will eat at McDonald's in that same month. The idiosyncratic variation from micro observation to micro observation makes the prediction effort difficult at best, and often unreliable.

(iv) Exogenous Factor Uncertainty

Even if a rail travel model were correctly specified and even if we could accurately determine the parameters of the model, there remains the issue of the degree of certainty with which we can forecast the underlying factors in the model. Many statistical and econometric models (as well as deterministic models, that is, models in which outcomes are precisely determined through known mathematical relationships among states and events) rely on underlying factors or drivers that are assumed to determine or somehow influence the variable of interest. These factors are called the model's exogenous factors. There are two polar assumptions that can be made about the exogenous factors: (1) one is that they are known with certainty and (2) the other is that the exogenous factors are as endogenous to the process being modeled as is the variable of interest. The reality lies somewhere between these two extremes, but exogenous factor uncertainty is as important as any other uncertainty in forecasting. Statisticians and econometricians attempt to use a model to substitute the uncertainty in the variable of interest with the uncertainties of the underlying factors that determine the particular variable of interest.

When econometric (or deterministic) models are assessed for accuracy, it is often presumed that the exogenous factors are known with certainty for a test period, and that the predictions of the model are compared to what actually happened. This process is called *ex-post* forecasting and asks how well the model does if the exogenous factors are

known or could have been known with certainty for the test period. For a time-series model used to forecast the future this is equivalent to saying that we know the future perfectly for the underlying factors. This is simply unreasonable when *ex-ante* (real-world) forecasts are required because no one has a crystal ball with which to predict the future for the exogenous drivers. A mathematical result from probability theory states that the unconditional variance of a random variable is equal to the expectation of the variance of the random variable conditioned on another factor plus the variance of the conditional mean of the variable of interest given the other factor (Lindgren, 1976, p.130). This theorem implies that variance of a forecast equals the expected variance conditional on the exogenous factors (*i.e.* assuming they are known) plus the variance of the conditional mean. The first component is the forecast variance assuming certainty in the exogenous factors, while the second reflects the uncertainty in the exogenous factors themselves. The important point is that exogenous factor uncertainty adds to the other uncertainties that I have discussed and these exogenous factors cannot be assumed away.

Additionally, optimal forecasting theory demonstrates that the degree to which the exogenous factors are expected to differ from historical experience influences the overall predicative power of the model. For instance, engineers had little experience launching the space shuttle on very cold days. It was later learned that very cold temperatures caused the "o-rings" to shrink in the solid fuel boosters, leading to the tragic explosion of the Challenger space shuttle. Although engineers relied on a statistical model that related o-ring shrinkage and cold temperatures, they unfortunately had too little experience with extremely cold days to adequately understand and model that relationship. The forecast

interval for performance of the Challenger o-rings was apparently too wide and the shuttle tragically exploded.

The factors that determine rail traffic growth and movements are complex. Certainly, we should expect that the production of and demand for commodities carried by rail (*e.g.*, coal, grain, containers, chemicals, forest products), which are themselves heavily influenced by factors such as the gross domestic product and the price and availability of crude oil or crude derivatives such as diesel, are important drivers of changes in rail traffic. The reality, however, is that such factors are getting harder rather than easier to forecast. One measure of this is the volatility of the exogenous factor measured by the coefficient of variation in the factor. The coefficient of variation is the ratio of the factor's standard deviation to its mean. A large coefficient of variation means that the factor has occurred with large swings or volatility in its realized levels relative to its historical average. Factors, for which the volatility is increasing, reveal increasing levels of uncertainty, which then makes the *ex-ante* forecast even less precise.

Consider, for example, the present situation for crude oil. It is not too much of a stretch to believe that crude oil and crude oil derivatives are commodities in which price volatility has been increasing. The energy market has become increasingly volatile. For instance, the coefficient of variation (standard deviation divided by average) for West Texas Intermediate crude real oil prices increased from 0.15 in the period 1986-1989 to 0.25 in the period 1990-1999, and to 0.36 in the period 2000-2006. Clearly, the past two to three years have been particularly troublesome for worldwide petroleum consumers. The next decade is more likely to face increased price volatility. No one can predict future global/regional crises, their frequency, their duration, or how much supply would

be lost relative to the system's then available spare capacity, but it seems certain that crises will occur. Meanwhile, volatility has increased while the ability to do long-term forecasting of key factors has diminished. Consider just two commodities that are clearly relevant to rail traffic: iron ore and crude oil (including petroleum distillates). The coefficient of variation for iron ore prices has increased from roughly 0.18 to 0.24 during the last 30 years. The coefficient of variation for real oil prices has increased from 0.1 to 0.4 in the last 30 years alone. The backdrop of changing volatility does not portend well for stable forecasting especially using overly simplistic simulations based on constant growth for long time frames.

Neither have the sophisticated models of federal agencies shown any realized ability to forecast the future even for relatively short horizons. Consider the forecasts by the Energy Information Administration ("EIA") just over a decade ago in 1996. Figure 1 shows the EIA forecast made in 1996 of U.S. Crude Oil production, while Figure 2 shows the EIA forecast made in 1996 of Crude Oil prices.

FIGURE 1: ACTUAL VS FORECASTED U.S. CRUDE OIL PRODUCTION

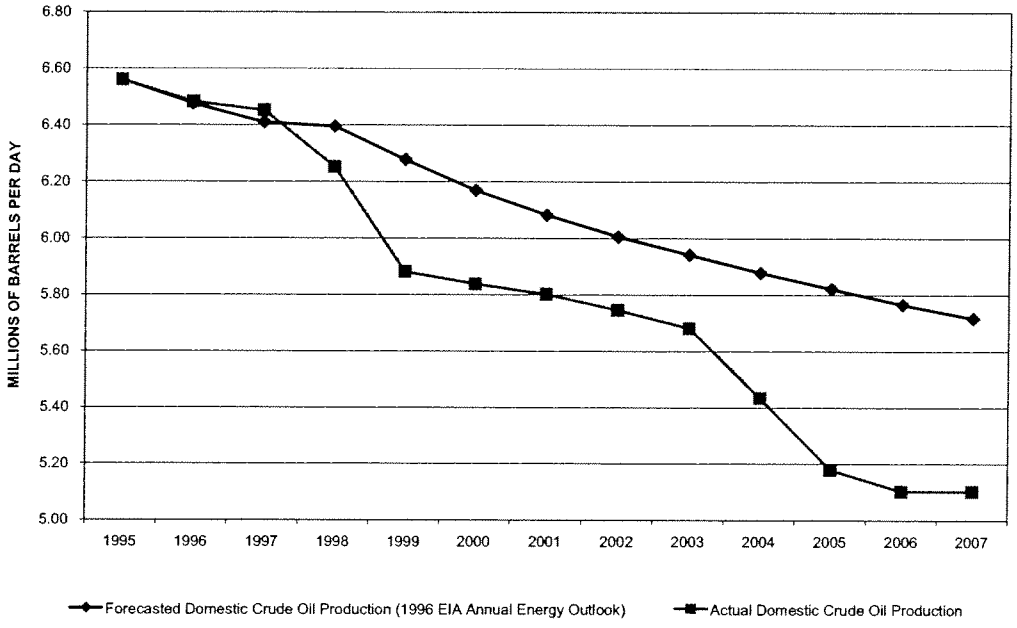
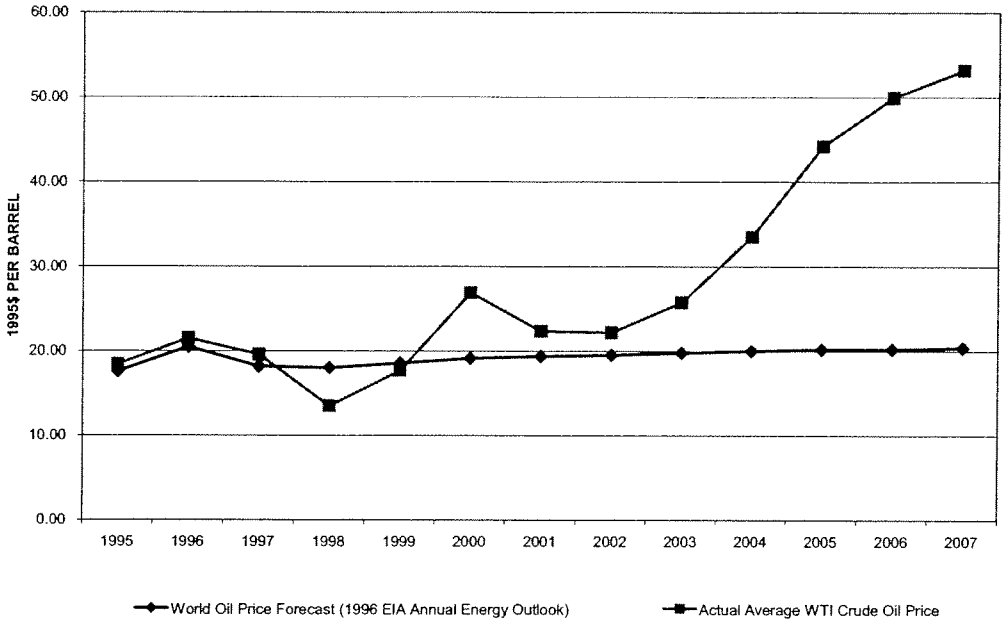


FIGURE 2: ACTUAL VS FORECASTED CRUDE OIL PRICES



These figures illustrate that even sophisticated government models have difficulties the making reliable long-term forecasts regarding the major driver of economic activity. There is no reason to suggest that a forecast of rail traffic which itself is driven by factors that are difficult to forecast will demonstrate any accuracy beyond even a few years into the future. Of course this situation becomes even worse when a forecast is required for an individual rail line or corridor or a street crossing.

II. ADDITIONAL ISSUES REGARDING THE USE OF GROWTH RATES

The application of constant growth rates to current baseline data is likely to produce an inaccurate forecast, particularly over a multi-year period. While the application of a constant growth rate is simple enough to understand, the situations in which this would be an optimal forecast are nearly nonexistent. In other words, a growth

rate extrapolation is very unlikely to be correct unless the underlying process is extremely simplistic. In the case of rail traffic, it clearly is not.

Rail traffic growth models concern themselves with the level of activity or commodity shipped in aggregate or by rail segment or corridor. Very little literature surrounds such models. Nonetheless, an approach was developed by Jordon and Thompson (1984) that relies on aggregate final demand in the U.S. economy and a 20-sector input-output table. The idea is to use the input-output Leontieff tables to split final demand into the levels of commodities that are required to produce the total final demand. The change in the levels of commodities required over some time period produces an expected growth rate that is then applied to segment estimates of rail traffic based on the Board's one-percent waybill sample. This approach is similar in many respects to the traffic forecasting methodologies discussed by SEA in its Information Request #3, each of which relied upon assumed growth rates either for traffic or by commodity and region. Unfortunately for such models, growth rates by commodity on the CN system reveal considerable variation that depends on the time-period upon which they were based or the commodity.

The fact that growth rates in rail traffic are all over the map is discussed by CN in its April 21, 2008 letter. A constant growth rate projection cannot factor the myriad influences that affect overall demand let alone the specifics that would be germane to traffic in a single corridor. This is true whether a single growth rate is applied to all rail traffic or separate growth rates are applied by type of traffic or commodity group. Rail traffic shows unusually high volatility that can only be magnified when considering the traffic movements on a particular segment. The uncertainty in the forecast of future rail

traffic that would result from application of a growth rate suggests that use of such a forecast for determining environmental impact is extremely suspect or, at best, subject to so much uncertainty that it should not be relied on.

III. CONCLUSIONS

After reviewing the CN letter of April 21, 2008, and the supplement to that letter, I concur with the analysis represented to the SEA. I see no value in extrapolating the rail traffic in the operating plan using an arbitrary growth rate. The uncertainty in the rate of growth in rail traffic is clear. Moreover, even if a growth rate could be applied, there is no reason to believe that a system-wide CN growth rate or a general U.S. railroad growth rate would have any applicability to EJ&EW. There is no procedure available to the SEA that could give it any confidence in such a methodology. These problems are exacerbated as one moves from the macro to the micro (*e.g.,* in the examination of segments of the EJ&E line).

Similarly, I have explained that forecasts are subject to various sources of uncertainty. These include model uncertainty, parameter uncertainty, horizon uncertainty, disaggregation uncertainty, and exogenous factor uncertainty. I have explained that each source of uncertainty in this instance makes efforts to forecast rail traffic an exercise with very limited utility. These same concerns apply to the highly complex and difficult task of attempting to make long-term forecasts for vehicular traffic. Whether in the context of a statistical model or some other type of model, horizon uncertainty alone makes the reliability of forecasts problematic. Additionally, we have seen that exogenous factor uncertainty has been increasing for many factors that plausibly affect rail and vehicular traffic.

Finally, my understanding of the number of "but for" trains gives me comfort that the operating plan contemplates a level of rail activity that is generally much larger than the "but-for" traffic that is the apparent purview of SEA. Indeed, as shown in Attachment No. 4 to CN's supplement to its response to SEA Data Request No. 3, that differential appears to be sufficiently great that even if SEA were to apply a range of assumed growth rates to the "but for" traffic over extended time frames it would not result in volumes exceeding those in the operating plan. It appears, therefore, that, although there is no sound basis for extrapolating from historic growth rates, the rail traffic included in the operating plan may appropriately be reviewed by SEA as representing at least as much traffic as one might reasonably forecast for "but for" traffic in 2015 using historic growth rates.

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APPENDIX 1

Curriculum Vitae of Professor Jeffrey A. Dubin, Ph.D.

May 12, 2008

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Jeffrey A. Dubin is Co-Founder and Partner in Pacific Economics Group. His research focuses on microeconomic modeling with particular emphasis on discrete-choice econometrics. Current research topics include: discrete-choice econometrics, energy economics, tax compliance, sampling and survey methods, valuation of intangible assets, and studies of ballot proposition voting. Some examples of his work include:

INTELLECTUAL PROPERTY

- For a defendant law firm, Dr. Dubin developed a damage estimate for patent infringement litigation involving a computer upgrade chip patent.

- For a photographic equipment manufacturing company involved in patent infringement litigation, Dr. Dubin developed an econometric model to measure the relevant market, the product demand in that market and the damages resulting from the infringement.

- For a major computer company involved in patent litigation, Dr. Dubin reanalyzed a survey of computer purchase decisions offered by plaintiffs as evidence of historical damages. Dr. Dubin also designed and implemented a survey of computer users to measure potential damages.

- For a large U.S. food and beverage company, Dr. Dubin has developed econometric theory and models to assign values to several intangible assets. His approach is based on the comparison of the demand for branded and private label products.

- For a Japanese manufacturer of fractional horsepower micro-motors used in automobile power door locks and power mirrors allegedly infringed by a Hong Kong manufacturer, Dr. Dubin developed an econometric model of the world demand for micro-motors. This model was used in conjunction with an international pricing model to calculate lost profits from foregone sales and

price erosion.

- For a large manufacturer of a top-50 chemical, Dr. Dubin developed a model of the world supply and demand for this chemical in order to calculate the damage resulting from a process patent infringement.

- In federal court litigation brought in New Orleans, Dr. Dubin assisted in developing a celebrity goodwill value assessment for appropriating a nationally known chef's likeness.

- For a developer of software, which provides credit card scoring, Dr. Dubin assisted counsel in developing alternative damage theories.

- For a manufacturer of a branded car wax, Dr. Dubin assisted counsel in damage calculations under alleged tradedress and trademark issues.

- For a manufacturer of artificial joint implants, Dr. Dubin developed an econometric model of product selection by orthopedic surgeons in order to quantify potential lost profits.

ANTITRUST

- For generic manufacturers of several leading pharmaceuticals, Dr. Dubin analyzed higher prices paid by consumers that resulted from delaying the time when manufacturers branded patented drugs go off patent.

- For the generic manufacturers of a leading anti-cancer chemotherapy drug, Dr. Dubin considered the anti-competitive effects of patent extensions by these patent holders. He also analyzed the demand for chemotherapy agents and the extent of the market.

- For the Oakland Raiders, Dr. Dubin analyzed the demand for NFL football. He designed an econometric model to test audience effects on individual demand, as well as how aspects of team performance affect demand. This model established that opening season box office performance could have lingering effects for a football team in terms of demand for

tickets.

- For the Department of Justice, Dr. Dubin was the lead economist and expert in a multinational merger analysis of major cardio ultrasound equipment manufacturers. Dr. Dubin utilized nested logit techniques to determine the patterns of substitution for purchasing ultrasound equipment. He then used these models to determine the price consequences for cardio ultrasound equipment that would likely occur as a result of the merger.

- For a manufacturer of agricultural silage bags, Dr. Dubin assessed geographic market definition and considered the joint market power of distribution of agricultural silage bags as evidenced by their boycott of specific manufacturers.

- For a group of corn-syrup manufacturers accused of price-fixing, Dr. Dubin provided econometric rebuttal testimony to demonstrate that the opposing expert did not demonstrate price-fixing.

- For a group of merging railroads, Dr. Dubin developed rebuttal testimony to demonstrate that the opposing expert had overstated the likely diversion from rail to truck.

- For architectural hinge manufacturers accused of price collusion, Dr. Dubin developed a model of hinge pricing based on hundreds of thousands of individual transactions.

- For the U.S. Department of Justice, using scanner data, Dr. Dubin developed econometric models of the demand for white bread. These models were used to demonstrate a proposed merger's likely price consequence.

- For a telecommunications company, Dr. Dubin developed an econometric model of the choice by individuals of market versus self-insurance and showed that the damages resulting from alleged unfair marketing were substantially mitigated.

- In an antitrust action filed in New York, Dr. Dubin assisted in preparing a report assessing the divisional capital asset pricing model (CAPM) betas for

an international copier and printer company.

STRATEGIC AND MANAGEMENT CONSULTING

- For a large refining company, Dr. Dubin developed an econometric model of gasoline demand.

- For Canada Post, Dr. Dubin developed an econometric model of the demand for various mail products and evaluated the simulation of a previously estimated econometric model.

- For a company doing credit card scoring analysis, Dr, Dubin evaluated the financial consequences that losing a sole-supply contract would have on market capitalization.

- For a major bank, Dr. Dubin analyzed the effects of automatic teller machines on the market for travelers checks.

- For the State of California, Dr. Dubin examined the effects of state income tax enforcement.

- For a gas pipeline restructuring under FERC Order 636a, Dr. Dubin developed a model analyzing the competitiveness of various market segments.

- For a gas pipeline, Dr. Dubin analyzed the competitive nature of the market for gas storage.

- For a top-five mail order company, Dr. Dubin analyzed historical purchase and promotion data at the individual level to model retail mail order demand, promotion effectiveness, and purchase behavior over time.

- For a large-scale manufacturer of architectural windows, Dr. Dubin has analyzed a new manufacturing process using structural econometric techniques and has designed an optimal production process.

- For the American Gaming Association, Dr. Dubin assisted in the development of economywide multiplier benefits from the gaming industry.

- For the Canadian Postal Service and Canadian Direct Marketing Association, Dr. Dubin prepared an econometric model of the demand for addressed admail and related complimentary products. This model was used to access the consequences of a proposed price increase in addressed admail.

- For a major oil-producer in Alaska, Dr. Dubin assisted in developing a model of crude oil pricing and determined the effects of natural gas liquids on crude prices.

- For a major energy company operating in Bolivia, Dr. Dubin analyzed the appropriate capital asset pricing model beta and quantified country risk and project risk.

- For a gas pipeline seeking market-based rates, Dr. Dubin conducted a discounting and elasticity of demand study to demonstrate the workable competitive nature of the market.

NATURAL RESOURCE DAMAGE ASSESSMENT

- For a major mining corporation operating in the State of Montana, Dr. Dubin developed a discrete-choice model of river choice for recreational fishing and calculated the level of damages sustained from the diminished quality of a specific river.

- For the owner of a mining operation in Colorado, Dr. Dubin analyzed a residential pricing model offered as evidence by the plaintiffs in a class-action suit alleging loss of property values due to pollution of a river.

- For several potentially responsible parties in California, Dr. Dubin developed an econometric model of commercial fishing and determined the magnitude of potential damages from the effects of alleged ocean pollution.

- For a major oil company operating in the State of Texas, Dr. Dubin analyzed the level of damages sustained to property holders due to proximity

to a toxic waste site.

- For several chemical companies operating in the state of Massachusetts, Dr. Dubin reanalyzed a property value-pricing model offered as evidence by the U.S. government in a superfund suit alleging damages from the pollution of a harbor near Boston.

- In litigation involving a superfund site in Los Angeles, Dr. Dubin assisted defense counsel in deposing plaintiff's expert economic witnesses regarding the design and findings of a CVM survey utilized to compute non-use damages. Dr. Dubin assisted in critiquing the CVM survey design methodology and in proposing and redesigning the survey.

- For a major electronic manufacturer operating in Phoenix, Arizona, Dr. Dubin assisted in the development of hedonic pricing regression models to measure the affect of ground water contamination on residential housing prices.

SURVEY RESEARCH

- For the City of Los Angeles, Dr. Dubin analyzed the LAPD's use of force reports. He accomplished this using stratified sampling methods across the various reporting districts in Los Angeles.

- Dr. Dubin assisted lawyers for merging railroads in determining whether a proposed merger would affect hazardous materials shipments. Dr. Dubin used sampling methods to determine the traffic volume that would have to be sampled in order to produce reliable hazardous material shipment estimates.

- For a major psychiatric hospital in the U.S., Dr. Dubin designed a survey of hospitals in the U.S. to measure patient overcharges.

- For a major food products manufacturer, Dr. Dubin designed a sample for the valuation of inventory and fixed assets.

- Dr. Dubin has analyzed survey results from several national surveys of

individuals (NIECS, SIPP, BPA).

- For a major computer hardware company involved in litigation, Dr. Dubin designed a survey of computer software users regarding their purchase decisions.

- For counsel representing two merging railroads, Dr. Dubin critiqued a well known engineering model of railroad traffic.

- For counsel representing an intervening railroad, Dr. Dubin assisted in preparing discovery and deposition questions of an opposing statistical expert.

- For counsel representing two merging railroads, Dr. Dubin has performed a statistical sampling of traffic movements in order to measure potential divertible traffic.

- For the Los Angeles Police Department, Dr. Dubin developed statistical random samples of specific police activity in connection with the consent degree between LAPD and the Department of Justice.

UTILITY MERGERS

- In several proposed mergers of electric and gas utilities, Dr. Dubin explored and analyzed the projected synergies associated with the merger of two utilities. Dr. Dubin projected energy requirements for both stand-alone utilities and the combined utility over a period of ten years. Future capital requirements and savings resulting from the merger were calculated and projected over a ten-year period for both the merged and stand-alone scenarios.

- Dr. Dubin developed the BEARS and BULLS Merger model to analyze potential synergy savings and pro-forma balance sheets for proposed utility mergers. Dr. Dubin has applied this model in several utility merger cases.

CIVIL LITIGATION

- For the Internal Revenue Service, Dr. Dubin implemented measures of shareholder common control from voluminous monthly shareholder data covering a five-year period.

- Dr. Dubin assisted in determining the appropriate refund level due to the California Independent System Operator (CAISO) from their electricity purchases in the California wholesale energy market. Dr. Dubin developed models to calculate the natural gas spot price from published ranges and average prices.

- For several tobacco companies, Dr. Dubin addressed the issue of whether cigarette smoking and asbestos exposure were synergistic in causing lung cancer. Dr. Dubin has analyzed several aspects of the tobacco-asbestos synergy issue to determine whether a combined exposure to smoking and asbestos raise the likelihood, above the individual risks, that an individual will contract lung cancer. Dr. Dubin reanalyzed the American Cancer Society database, and also conducted meta-analyses of early studies.

- For the City of San Francisco, Dr. Dubin developed a model that measured damages resulting from a major bank's failure to escheat municipal bond interest.

- For a major energy supplier in the Northwest, Dr. Dubin developed a model that measured damages resulting from a major bank's failure to escheat bond interest.

- For the City of San Francisco and the State of California, Dr. Dubin developed a model of fee overcharge and hidden interest collected by a large California title company.

- For the state of Alaska, Dr. Dubin developed a model that measured damages resulting from a major bank's failure to escheat bond interest.

- For a defendant bus company, Dr. Dubin calculated the present

discounted value of future medical costs under various life scenarios.

- For the IRS, Dr. Dubin helped develop a shareholder value model that demonstrated that a packaging company's reorganization was a tax sham.

- For a grocery store chain, Dr. Dubin developed models of the demand for hamburgers to demonstrate the stigmatic effect on sales from bad publicity.

- For a gas company operating in the west, Dr. Dubin helped develop an econometric pricing model for carbon dioxide gas.

TESTIMONY

Before the United States Court of Appeals, Ninth Circuit, Writ of Certiorari. Docket Nos. 06-1457, 06-1462, November, 2007. pdf (2.02mb)

Before the Public Utility Commission of Oregon, Affidavit on behalf of Pacificorp. Docket No. UM 1002, November 19, 2007. pdf (449kb)

Before the United States District Court, District of Maryland Southern Division, Deposition Testimony on behalf of Marriott International, Inc., a Delaware corporation, et al., Case No. 8:05-CV-00787-PJM, October 23, 2007. pdf (1140kb)

Before the Public Utility Commission of Oregon, Trial Testimony on behalf of Pacificorp. Docket No. UM 1002, August 8, 2007.

Before the Public Utility Commission of Oregon, Supplemental Reply Testimony on behalf of Pacificorp. Docket No. UM 1002, July 30, 2007. pdf (620kb)

Before the Eighth Judicial District Court, Clark County, Nevada, Trial Testimony on behalf of Advanced Medical Products, Inc. Case No. A449091, January 17, 2006.

Before the Eighth Judicial District Court, Clark County, Nevada, Deposition Testimony on behalf of Advanced Medical Products, Inc. Case No. A449091, January 15, 2006. pdf (254kb)

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mb)

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Before the Washington Utilities and Transportation Commission, Trial Testimony on behalf of Puget Sound Energy Inc., Docket No. UE-060266, Docket No. UG-060267, September 20, 2006. pdf (51.8kb)

Before the Washington Utilities and Transportation Commission, Prefiled Rebuttal Testimony on behalf of Puget Sound Energy Inc., Docket No. UE-060266, Docket No. UG-060267, August 26, 2006. pdf (95.1kb)

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Before the Washington Utilities and Transportation Commission, Trial Testimony on behalf of Puget Sound Energy, Inc., Docket No. UG-040640, Docket No. UE-040641, December 14, 2004. pdf (164kb)

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Before the United States Bankruptcy Court, Southern District of New York, Trial Testimony on behalf of At Home General Unsecured Creditors Trust, Case No. 04-10156 (BRL), July 19, 2004. pdf (606 kb)

Before the United States Bankruptcy Court, Southern District of New York, Deposition Testimony on behalf of At Home General Unsecured Creditors Trust Case No. 04-10156 (BRL), June 15, 2004. pdf (1.14mb)

Before the Washington Utilities and Transportation Commission, Prefiled Direct Testimony on behalf of Puget Sound Energy, Inc., Docket No. UG-040640, Docket No. UE-040641, April 5, 2004. pdf (232 kb)

Before the Superior Court of the State of California, Sacramento County, Trial Testimony on behalf of the Oakland Raiders in City of Oakland, et al. v. Oakland Raiders, May 21–22, 2003. pdf (547kb)

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Before the Superior Court of Alaska, Third Judicial District, Trial Testimony on behalf of the State of Alaska of Alaska Inter-Tribal Council v. State of Alaska, April 11, 2002.

Before the United States District Court, Northern District of California, San Francisco Division, Deposition Testimony on behalf of the City and County of San Francisco, Case No. C-99-0020 WHA and C-99-0193 WHA, March 13, 2002.

Before the United States District Court, District of Puerto Rico, Deposition Testimony on behalf of Puerto Rico Telephone Company, Inc., Civil Action No. 01-1832, February 6, 2002. pdf (706kb)

Before the Superior Court for the State of Alaska, Third Judicial District at Dillingham, Deposition Testimony on behalf of the State of Alaska, Case No. 3DI-99-113 Civil, February 9, 2001. pdf (578 kb)

Before the Alameda County Superior Court, Trial Testimony on behalf of Oliver, Case No. 784492-6, May 8, 9, 10, 11, and 18, 2000.

Before the United States District Court, District of New Jersey, Deposition Testimony on behalf of Baker Norton Pharmaceuticals, Inc., Civil Action No. 98 CV 1412 (WHW), February 11, 2000. pdf (2.4mb)

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Before the United States District Court, Southern District of New York, Deposition Testimony on behalf of Mabuchi Motor America Corp., CIV. 73(JES), June 8, 1999. pdf (1.37mb)

Before the United States District Court, Central District of Illinois, Peoria Division, Deposition Testimony on behalf of Archer Daniels Midland et al., March 11,1999. pdf (1.20mb)

Before the Surface Transportation Board, Applicants' Rebuttal (Volume 1B of 2) on behalf of Canadian National Railway Company, et. al., Finance Document No. 33556. December 16, 1998. pdf (394 kb)

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Before the Federal Energy Regulatory Commission, Trial Testimony on behalf of Koch Gateway Pipeline Company, Docket No. RP95-362-000, October 6 and 7, 1996. pdf (7.01mb)

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Before the U.S. Tax Court, Trial Testimony on behalf of Nestlé Holding, Inc., Tax Court Docket No. 21562-90, April 25, 1994. pdf (355kb)

Comments before the Department of Interior, July 22, 1993, Advance Notice of Proposed Rulemaking (43 CFR Part II) Natural Resource Damage Assessment Regulations Type B Rule, with C. Cicchetti, September 22, 1993. pdf (115kb)

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EXPERT REPORTS

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Declaration on behalf of Dr. Michael Howard Roth, v. California State University, Los Angeles, California, August 18, 2006. pdf (59.4kb)

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Before the United States Bankruptcy Court, Southern District of New York, Expert Report on behalf of At Home General Unsecured Creditors Trust Case No. 04-10156 (BRL), June 15, 2004. pdf (606kb)

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Before the United States District Court, Central District of Illinois, Peoria Division, Expert Report, "A Review of Professor Williams Ed. Whitelaw's 'A Study of Prices of High Fructose Corn Syrup-42 and Glucose Corn Syrup'" on behalf of Archer Daniels Midland et al., February 3, 1999. pdf (2.2mb)

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"Criminal Investigation Enforcement Activities and Taxpayer Noncompliance," submitted to Internal Revenue Service Criminal Investigation, February 10, 2004. pdf (1.13mb)

"Stratified Random Sample for Non-Categorical Use of Force Reports," with C. Cicchetti and E. Cotton, prepared for the Los Angeles Police Department, September 10, 2001. pdf (633kb)

Statistical Analysis of Errors and Lost Charges for TENET Home Care Facilities, January 12, 1996. pdf (337kb)

"Financial Analysis of Addressed Admail," May 1996. pdf (2.08mb)

"Bears and Bulls Synergy Model Source Code," Dubin/Rivers Research, March 7, 1996. pdf (954kb)

"The Economic Consequence of Independent Film Making," with Cicchetti, Peale, Boedeker, Truitt, prepared for the American Film Marketing Association, January 1995. pdf (622kb)

"Statistical Analysis of Errors and Lost Charges for TENET Home Care Facilities," June 7, 1995. pdf (481kb)

"Competition and Regulation in the Natural Gas Transportation Industry," with C. Cicchetti and C. Long, circa 1995. pdf (885kb)

"National Medical Enterprises, Inc., Psychiatric Division Review," September 14, 1994. pdf (370kb)

"An Introduction to Discrete Choice Modeling and its Applications to Load Forecasting," prepared for Canadian Electrical Association Conference, Nova Scotia, Canada, May 18, 1993. pdf (4.7mb)

"Preliminary Analysis of the Potential Natural Resource Damage to Commercial Fishing," prepared for the Los Angeles Harbor Counsel, July 12, 1991. pdf (1.15mb)

"Analysis of Market Expansion and Business Diversion in Instant Photography Attributable to the Entry of Eastman Kodak from 1976-1985," with T. Bresnahan, April 20, 1989. pdf (885kb)

"Detecting Cartel Behavior from Price Data," Architectural Hinges, with R. Preston McAfee, circa 1988. pdf (642kb)

"A Report on Freshmen Admissions at Caltech: Who's Admitted, Who Comes, and Why," with R. Noll, circa 1983. pdf (450kb)

PROFESSIONAL ACTIVITIES

1996–present	Co-Founding Partner, Pacific Economics Group
1993–1996	Director of Statistics and Econometric Analysis, Arthur Andersen Economic Consulting
1992–1993	Senior Economist, Arthur Andersen Economic Consulting
1989–1992	Senior Advisor, Putnam, Hayes & Bartlett, Inc.

ACADEMIC APPOINTMENTS

2005–present	Visiting Professor of Economics, University of California, Santa Barbara

2005–2007	Professor of Economics, California Institute of Technology
2005	Visiting Professor of Economics, Occidental College
1988–2005	Associate Professor of Economics, California Institute of Technology
1982–1988	Assistant Professor of Economics, California Institute of Technology

EDITORIAL BOARDS

1986–1991	*The Energy Journal*

ADVISORY POSITIONS

2004	Technical Advisor under Rule 706 of the Federal Rule of Civil Procedure to advise a Los Angeles Federal District Court in matters of statistics.
2001	Member, California State Auditors, Bureau of State Audits
1991	Advisory Panel on Biotechnology Opportunities, National Science Foundation, Member
1990	Lawrence Berkeley Laboratory Manufacturer Input Model for Department of Energy
1988–1995	University of California, University-Wide Energy Research Group
1987	California Energy Commission
1985	National Research Council, Committee on Behavior and Social Aspects of Energy Consumption and Production
1985	Lawrence Berkeley Laboratory, Energy Analysis Program
1984	Oakridge National Laboratory, Energy Policy Division
1984	Southern California Air Quality Management Board

PUBLICATIONS

Books

The California Electricity Crisis: What, Why, and What's Next , with Charles J. Cicchetti and Colin M. Long, Massachusetts: Springer Publishing Company, 2004. pdf (1,453 kb)
Chapter 1: Introduction
Chapter 2: Power Production Economics
Chapter 3: Principles of Traditional Regulation

Chapter 4: Reconciling Marginal Cost and Revenue Requirements
Chapter 5: Competitive Wholesale Markets for Electricity
Chapter 6: California's Market Design: an Initial Success Followed by a "Perfect Storm"
Chapter 7: Design Flaws and a Worsening Crisis
Chapter 8: Testable Hypothesis
Chapter 9: Survey of Electricity Models for California
Chapter 10:An Economic Analysis of Natural Gas Price Movements During the Crisis
Chapter 11:An Economic Analysis of Electricity Prices in California
Chapter 12:Market Manipulation
Chapter 13:Gaming and Cheating
Chapter 14:Market Monitoring and Initial Regulatory Response
Chapter 15:Refunds and Mitigation
Chapter 16:California Responds
Chapter 17:Handicapping Winners
Chapter 18:Conclusion: Wrapping Up and Lessons Learned

Empirical Studies in Applied Economics, Boston, Massachusetts: Springer Publishing Company, 2001. pdf (1,040 kb)
Chapter 1: The Revealed Market Power of a Natural Gas Pipeline
Chapter 2: The Demand For NFL Football
Chapter 3: Detecting and Measuring Shifts in the Demand for Direct Mail
Chapter 4: Valuation of a Technology Patent–Scope, Duration, and Royalty
Chapter 5: Statistical Analysis of the Additive and Multiplicative Hypotheses of Multiple Exposure Synergy for Cohort and Case-Control Studies
Chapter 6: Tests of the Additive and Multiplicative Hypotheses of Multiple Exposure
Chapter 7: Concentration and Competition in the Chemotherapy Drug Market
Chapter 8: The Allocation of Police Services in Rural Alaska
Chapter 9: Financial Market Reaction to the Fast Food Hamburger Health Scare of 1993

Studies in Consumer Demand—Econometric Methods Applied to Market Data. Boston, Massachusetts: Springer Publishing Company, 1998. pdf (2,792 kb)
Chapter 1: The Demand for Addressed Admail and Complementary Products in Canada
Chapter 2: The World Demand for Fractional Horsepower Direct-Current Motors
Chapter 3: Estimation and Identification of the Worldwide Demand for Acetic Acid
Chapter 4: The Demand for Branded and Unbranded Products—An Econometric Method for Valuing Intangible Assets
Chapter 5: The Demand for Recreational Fishing in Montana
Chapter 6: The Demand for Commercial Fishing in California
Chapter 7: The Demand for Cameras by Consumers—A Model of Purchase Type Choice, and Brand Choice
Chapter 8: The Demand for Transportation Services in Natural Gas Markets—The Market Power of a Natural Gas Pipeline

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Chapter 1: Consumer Durable Choice and Utilization
Chapter 2: A Heating and Cooling Load Model for Single-Family Detached Dwellings
Chapter 3: Estimation of Nested Logit Model for Appliance Holdings
Chapter 4: Rate Structure and Price Specification in the Demand for Electricity
Chapter 5: Two-Stage Estimation Methods for the Switching Regime Model with Known

Regimes
Chapter 6:Estimation of the Demand for Electricity and Natural Gas from Billing Data
Appendix A
Appendix B

Articles

"Mid-range, Average, and Hourly Estimates of Heating Degree Days: Implications for Weather Normalization of Energy Demand," with Villamor Gamponia, April 2007 pdf (185kb)

"An Integrated Engineering-Econometric Analysis of Residential Balance Point Temperatures," forthcoming *Energy Economics*, 2007. pdf (419 kb)

"Valuing Intangible Assets with a Nested Logit Market Share Model," *Journal of Econometrics*, Vol. 139, No. 2, August 2007: 285-302. pdf (323 kb)

"Criminal Investigation Enforcement Activities and Taxpayer Noncompliance," *Public Finance Review*, Vol. 35, No. 4, July 2007: 500-529 pdf (417 kb)

"A Quasi-Comparable Approach to Reasonable Royalty Determination," in *Economic Damages in Intellectual Property,* Daniel Slottje, editor, John Wiley & Sons, New York: New York, 2006. pdf (235 kb)

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"Comparing Absentee and Precinct Voters: Voting on Direct Legislation," with Gretchen A. Kalsow, *Political Behavior,* Vol. 18, No. 2, June 1996: 393–411. pdf (1,762 kb)

"Comparing Absentee and Precinct Voters: A View Over Time," with Gretchen A. Kalsow, *Political Behavior,* Vol. 18, No. 2, June 1996: 369–392. pdf (2,148 kb)

"Testing Minority Preferences in Broadcasting," with Matthew Spitzer, *California Law Journal,* Vol. 68, No. 4, May 1995: 841–884 pdf (1,402 kb)

"A Microeconometric Analysis of Risk Aversion and the Decision to Self-Insure," with Charles J. Cicchetti, *Journal of Political Economy*, 102 (1994): 169–186. pdf (526 kb)

"Experimental Estimates of the Impact of Wage Subsidies," with R. Douglas Rivers, *Journal of Econometrics* 56 (1993): 219–242. pdf (752 kb)

"Voting on Growth Control Measures: Preferences and Strategies," with D. Roderick Kiewiet and Charles Noussair, *Economics and Politics* 4 (1992): 191–213. pdf (509 kb)

"State Income Tax Amnesties: Causes," with Michael J. Graetz and Louis L. Wilde, *Quarterly Journal of Economics* 107 (August 1992): 1057–1070. pdf (474 kb)

"The Demand for Tax Return Preparation Services," with Michael J. Graetz, Michael A. Udell, and Louis L. Wilde, *The Review of Economics and Statistics* 74 (1992): 75–82. pdf (356 kb)

"The Changing Face of Tax Enforcement, 1978–1988," with Michael J. Graetz and Louis L. Wilde, *The Tax Lawyer* 43 (1990): 893–914. Reprinted in R. Westin, R. Hishon, and B. Green, eds. *Criminal Tax Prosecutions*. Anderson Publishing Company (1991). pdf (678 kb)

"The Effect of Audit Rates on the Federal Individual Income Tax, 1977–1986," with Michael J. Graetz and Louis L. Wilde, *National Tax Journal* 43 (1990): 395-409. pdf (3,284 kb)

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"Risk and Reactor Safety Systems Adoption," with Geoffrey S. Rothwell, *Journal of Econometrics* 42 (1989): 202–17. pdf (249 kb)

"The Report of the United States to the International Fiscal Association 43 Congress: Administrative and Compliance Costs of Taxation," with Michael J. Graetz and Louis L. Wilde, *Cahiers de Droit Fiscal International (Studies on*

International Fiscal Law) Kluwer, The Netherlands 74b (1989): 310-47. pdf (1,240 kb)

"The Distributional Effects of the Federal Energy Tax Act," with Steven E. Henson, *Resources and Energy* 10 (1988): 192–211. pdf (661 kb)

"How Markets for Impure Public Goods Organize: The Case of Household Refuse Collection," with Peter Navarro, *Journal of Law, Economics and Organization* 4 (1988): 217–41. pdf (832 kb)

"An Empirical Analysis of Federal Income Tax Auditing and Compliance," with Louis L. Wilde, *National Tax Journal* 16 (1988): 61–74. pdf (584 kb)

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"Regulatory Climate and the Cost of Capital," with Peter Navarro, in *Regulatory Reform and Public Utilities*. M. Crew, ed. Lexington, Massachusetts: Lexington Books (1982): 141–66. pdf (551 kb)

May 12, 2008

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SST—Statistical Software Tools Version 3.0, ©1985–2007 with R. Douglas Rivers, "Statistical Software Tools Reference Manual and User's Guide," with R. Douglas Rivers, (1990). pdf(7,051kb). Online at http://www.hss.caltech.edu/~jad/sst/html/main.help.sst.html.

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"Participation in Direct Legislation: Evidence from the Voting Booth," with Gretchen A. Kalsow, California Institute of Technology, Social Science Working Paper No. 997, January 1997. pdf (917 kb)

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EDUCATION

1982	Ph.D., Economics, Massachusetts Institute of Technology
1978	A.B., Economics, University of California, Berkeley, with Highest Honors and Great Distinction in General Scholarship

HONORS AND AWARDS

Econometric Society Frisch Medal, 1986.

Departmental Citation, U.C. Berkeley, Department of Economics, awarded to the author of the best undergraduate honors thesis in Economics, 1978.

CURRENT RESEARCH

Discrete-choice econometrics, energy economics, ballot proposition voting, tax compliance.