DfT Queries 27/10/16

Q1 Speeds within Lincoln

The tables below provide an understanding of speeds and movements through Lincoln in the PM peak period, which represents a period of interest to DfT. Tow paths are selected, the A158/A15 through the city and the LEB routing. DM and DS results are reported for each scenario including core, revised (alternative) core,

Table 1 Core VDM

Route	Direction	Distance	DM 2033 PM		DS 2033 PM		Time saving
			Time (minutes)	Speed (km/h)	Time (minutes)	Speed (km/h)	
A158_A15	NB	9.21	31.3	17.7	21.8	25.4	9.5
A158_A15	SB	9.20	29.7	18.6	24.8	22.3	4.9
LEB	NB	7.17	-	-	11.1	38.7	-11.1
LEB	SB	7.19	-	-	11.5	37.7	-11.5

Table 2 Revised Core VDM

Route	Direction	Distance	DM 2033 PM		DS 2033 PM		Time saving
			Time (minutes)	Speed (km/h)	Time (minutes)	Speed (km/h)	
A158_A15	NB	9.21	29.3	18.9	19.9	27.8	9.4
A158_A15	SB	9.20	27.3	20.2	21.8	25.3	5.5
LEB	NB	7.17	-	-	9.8	43.9	-9.8
LEB	SB	7.19	-	-	10.5	41.2	-10.5

Table 3 High Growth (p-=2.5) VDM

Route	Direction	Distance	DM 2033 PM		DS 2033 PM		Time saving
			Time (minutes)	Speed (km/h)	Time (minutes)	Speed (km/h)	
A158_A15	NB	9.21	32.6	16.9	23.5	23.5	9.2
A158_A15	SB	9.20	30.8	17.9	25.8	21.4	5.0
LEB	NB	7.17	-	-	12.8	33.5	-12.8
LEB	SB	7.19	-	-	11.5	37.4	-11.5

Table 4 High Growth (p=2) VDM

Route	Direction	Distance	DM 2033 PM		DS 2033 PM		Time saving
			Time (minutes)	Speed (km/h)	Time (minutes)	Speed (km/h)	
A158_A15	NB	9.21	32.6	16.9	23.3	23.8	9.4
A158_A15	SB	9.20	30.0	18.4	25.8	21.4	4.3
LEB	NB	7.17	-	-	12.3	34.8	-12.3
LEB	SB	7.19	-	-	11.5	37.6	-11.5

Table 5 Low Growth VDM

Route	Direction	Distance	DM 2033 PM		DS 2033 PM		Time saving
			Time (minutes)	Speed (km/h)	Time (minutes)	Speed (km/h)	
A158_A15	NB	9.21	28.4	19.5	19.9	27.7	8.5
A158_A15	SB	9.20	27.8	19.9	22.7	24.3	5.1
LEB	NB	7.17	-	-	9.8	43.8	-9.8
LEB	SB	7.19	-	-	10.4	41.4	-10.4

Figure 1 Route: A158_A15

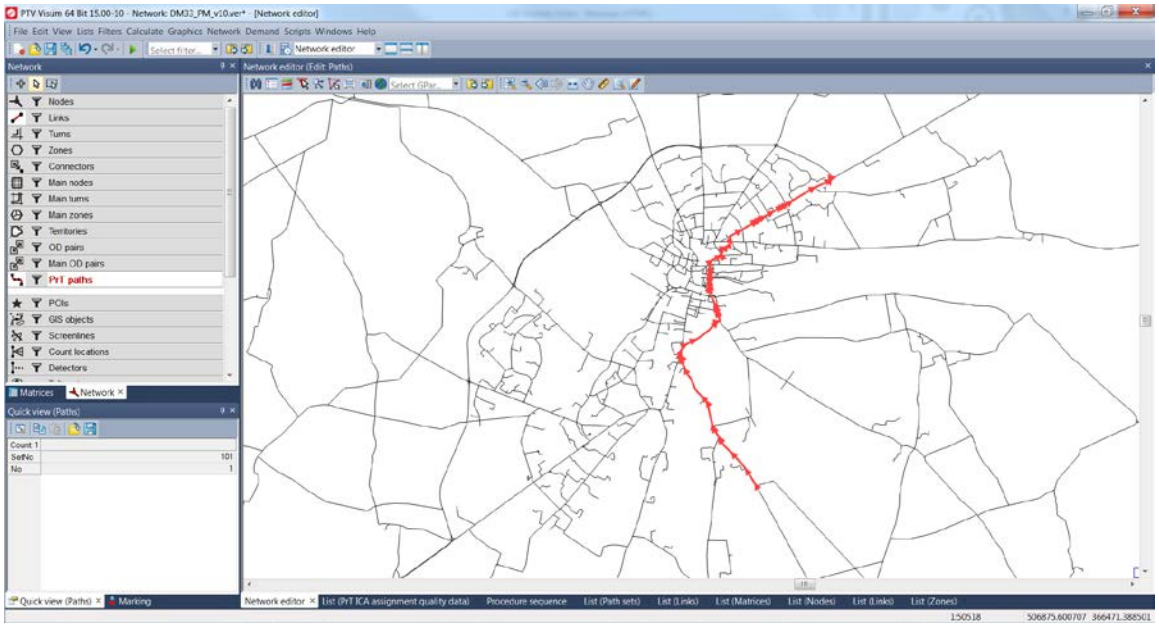
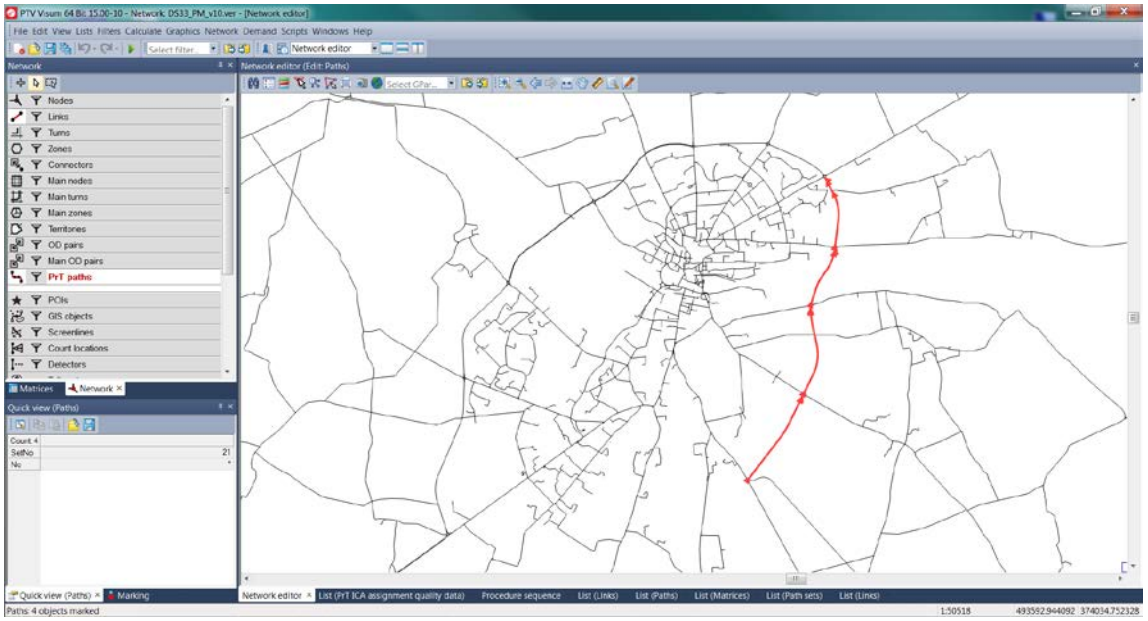


Figure 2 Route: LEB

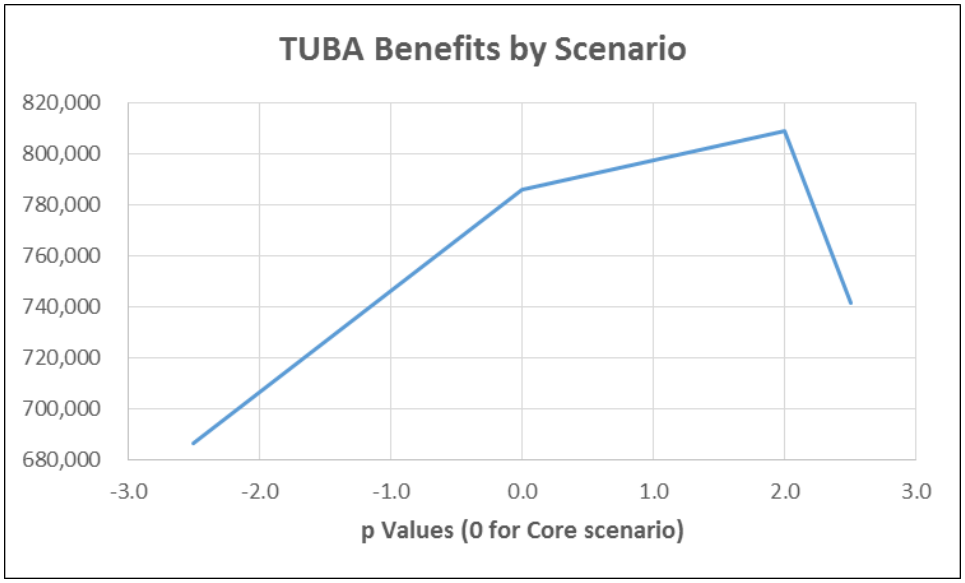


Travel times and speeds are indicative of the levels of congestion in advance of the opening of LEB and the relief afforded by LEB. The relative travel times between tests accord to the anticipated levels of congestion. Progression in the core DM indicates relatively low speeds through the city. High growth worsens this position. Low growth slightly ameliorates the position.

Q2 Benefits by time period

Mouchel previously presented the attached figure demonstrating overall PVB by p-test, with the p value on the x axis and p=0 being the core, + and – p=2.5 being high and low and +p=2 being the alternative high.

Figure 1 TUBA Benefits by Scenario



DfT have requested the time period specific analyses. These are presented below.

Figure 2 AM Peak Benefits by Scenario

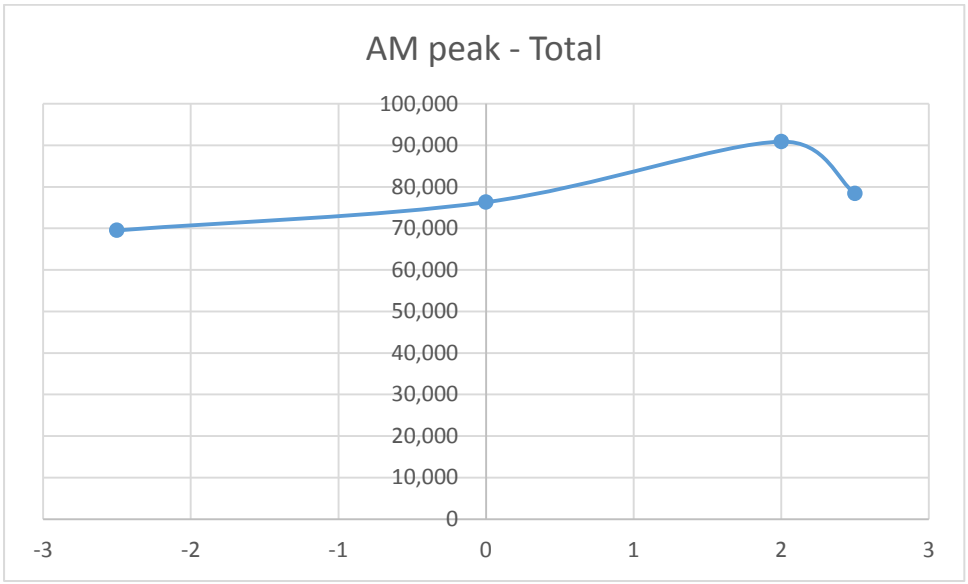


Figure 3 *PM Peak Benefits by Scenario*

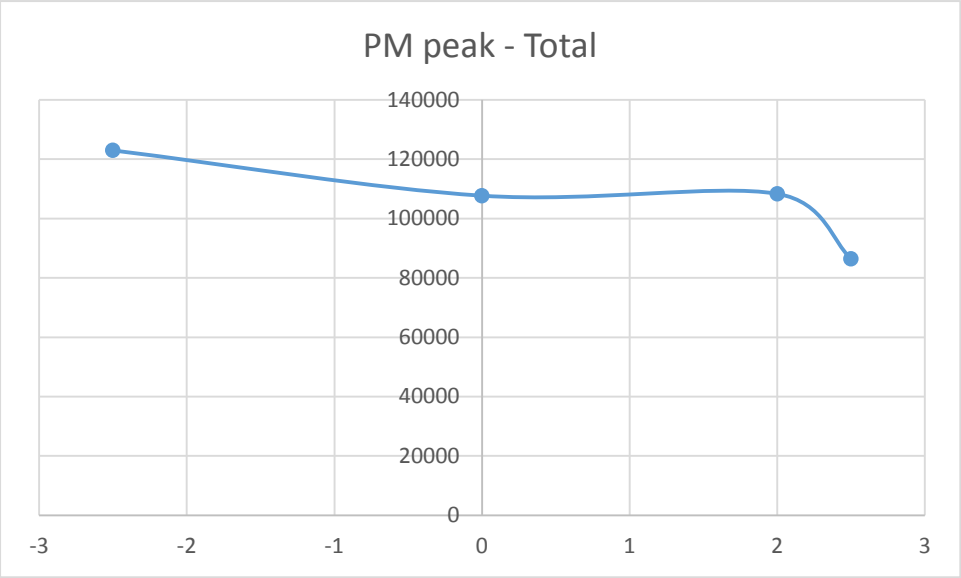


Figure 4 *Inter Peak Benefits by Scenario*

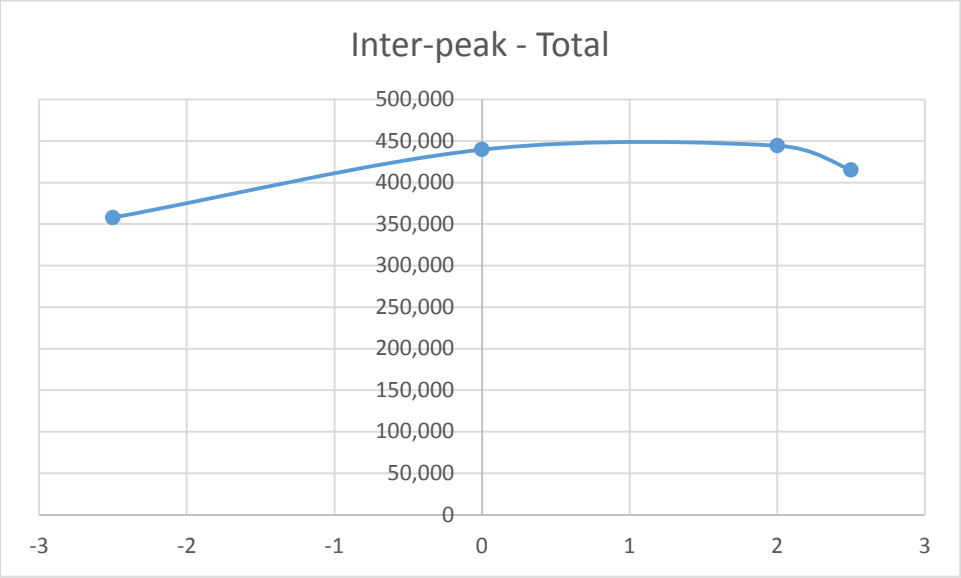


Figure 5 Off Peak Benefits by Scenario

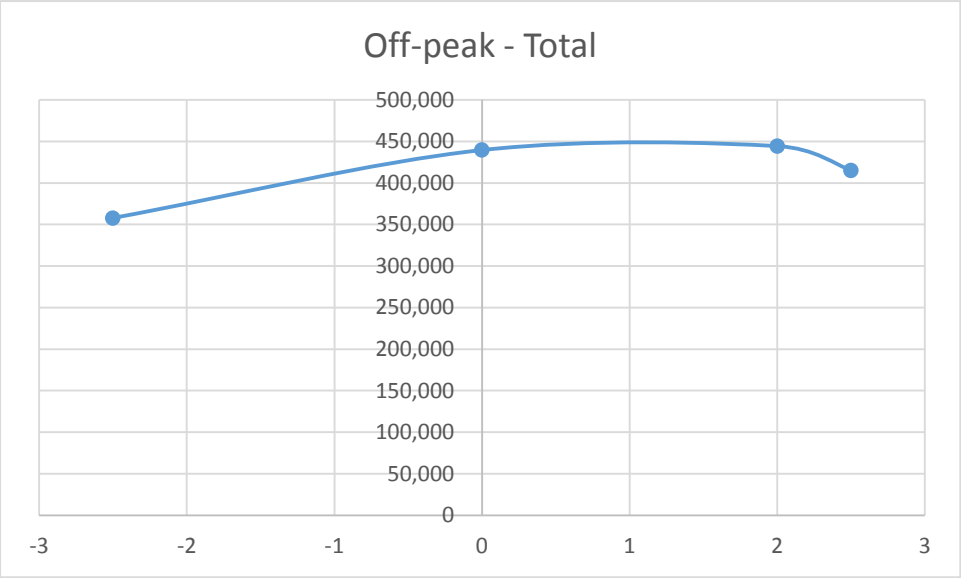
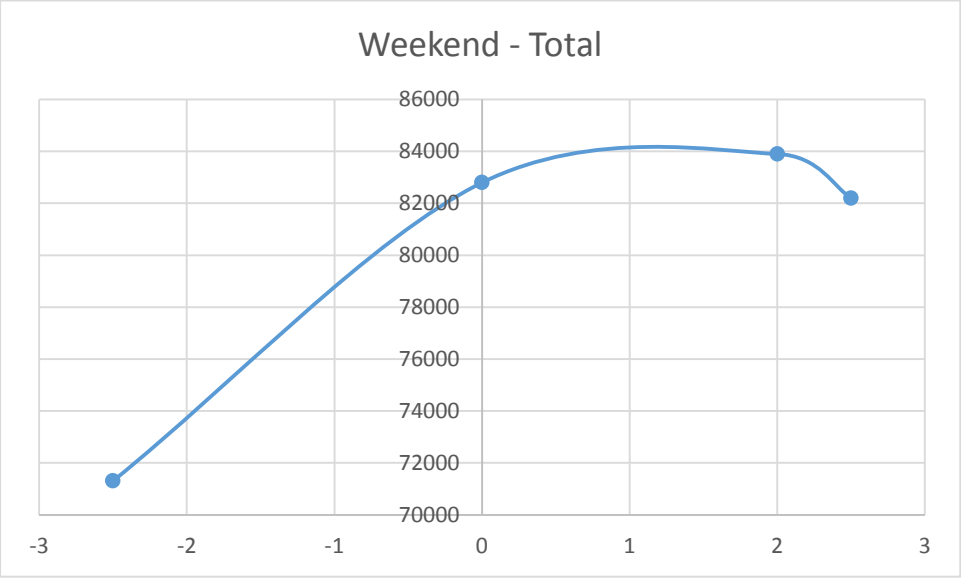


Figure 6 Weekend Benefits by Scenario



The AM and PM peaks demonstrate a relatively flat profile compared to the other time period. This is largely because high congestion constrains benefits and VDM serves to limit the impacts of any decongestion which ensues.

However the PM peak demonstrates an atypical pattern in this respect, whereby the low growth benefits are actually higher than the core benefits by around 14%. This appears to be out of step and requires explanation..

A review of matrix inputs is included below. This demonstrates that the reduction from core to is in the order expected, from 4% to 10%. Input matrices are verified.

Table 1 Core and Low, Ref, DM and DS Matrices

		Core			Low			Difference					
2018	**Purpose**	**Ref.Dem**	**DM.Dem**	**DS.Dem**	**Ref.Dem**	**DM.Dem**	**DS.Dem**	**Ref Dem**	**Diff**	**DM Dem**	**Diff**	**DS Dem**	**Diff**
AM Peak	Business	5,770	5,775	5,798	5,529	5,561	5,587	-241	-4.18%	-214	-3.71%	-211	-3.65%
	Commute	28,116	28,187	28,306	26,958	27,179	27,270	-1,158	-4.12%	-1,008	-3.58%	-1,036	-3.66%
	Other	19,788	19,809	20,106	18,970	19,090	19,365	-817	-4.13%	-719	-3.63%	-740	-3.68%
	Car	**53,674**	**53,771**	**54,210**	**51,458**	**51,830**	**52,222**	-2,216	-4.13%	-1,941	-3.61%	-1,988	-3.67%
	LGV	9,818	9,818	9,818	9,393	9,393	9,393	-425	-4.33%	-425	-4.33%	-425	-4.33%
	HGV	2,611	2,611	2,611	2,498	2,498	2,498	-113	-4.33%	-113	-4.33%	-113	-4.33%
Inter-Peak	Business	5,022	5,029	5,086	4,811	4,842	4,894	-211	-4.20%	-187	-3.72%	-192	-3.77%
	Commute	6,762	6,769	6,822	6,481	6,499	6,551	-280	-4.15%	-269	-3.98%	-271	-3.97%
	Other	37,668	37,739	38,014	36,175	36,379	36,630	-1,494	-3.97%	-1,360	-3.60%	-1,384	-3.64%
	Car	**49,452**	**49,537**	**49,922**	**47,467**	**47,720**	**48,075**	-1,985	-4.01%	-1,816	-3.67%	-1,846	-3.70%
	LGV	9,163	9,163	9,163	8,766	8,766	8,766	-397	-4.33%	-397	-4.33%	-397	-4.33%
	HGV	3,736	3,736	3,736	3,574	3,574	3,574	-162	-4.33%	-162	-4.33%	-162	-4.33%
PM Peak	Business	5,606	5,610	5,621	5,372	5,414	5,437	-233	-4.16%	-196	-3.49%	-184	-3.28%
	Commute	22,987	23,196	23,382	22,061	22,390	22,567	-925	-4.02%	-806	-3.48%	-815	-3.49%
	Other	24,491	24,732	25,122	23,560	23,931	24,339	-931	-3.80%	-800	-3.24%	-782	-3.11%
	Car	**53,083**	**53,538**	**54,125**	**50,994**	**51,735**	**52,343**	-2,089	-3.94%	-1,802	-3.37%	-1,782	-3.29%
	LGV	9,410	9,410	9,410	9,002	9,002	9,002	-407	-4.33%	-407	-4.33%	-407	-4.33%
	HGV	1,894	1,894	1,894	1,812	1,812	1,812	-82	-4.33%	-82	-4.33%	-82	-4.33%
24-Hours	Business	66,651	66,727	67,202	63,865	64,287	64,773	-2,787	-4.18%	-2,440	-3.66%	-2,430	-3.62%
	Commute	194,827	195,705	196,960	186,853	188,596	189,732	-7,973	-4.09%	-7,109	-3.63%	-7,228	-3.67%
	Other	379,413	380,661	384,503	364,392	367,201	370,877	-15,021	-3.96%	-13,459	-3.54%	-13,626	-3.54%
	Car	**640,892**	**643,092**	**648,665**	**615,111**	**620,084**	**625,382**	-25,781	-4.02%	-23,009	-3.58%	-23,283	-3.59%
	LGV	117,107	117,107	117,107	112,037	112,037	112,037	-5,070	-4.33%	-5,070	-4.33%	-5,070	-4.33%
	HGV	37,905	37,905	37,905	36,264	36,264	36,264	-1,641	-4.33%	-1,641	-4.33%	-1,641	-4.33%

2033	Purpose	Ref.Dem	DM.Dem	DS.Dem	Ref.Dem	DM.Dem	DS.Dem	Ref Dem	Diff	DM Dem	Diff	DS Dem	Diff
AM Peak	Business	6,075	6,011	6,030	5,467	5,488	5,511	-608	-10.01%	-523	-8.70%	-519	-8.60%
	Commute	29,674	29,597	29,711	26,685	26,930	27,073	-2,989	-10.07%	-2,667	-9.01%	-2,637	-8.88%
	Other	22,592	22,023	22,358	20,530	20,433	20,769	-2,061	-9.12%	-1,590	-7.22%	-1,588	-7.10%
	Car	**58,340**	**57,632**	**58,099**	**52,682**	**52,852**	**53,354**	-5,658	-9.70%	-4,780	-8.29%	-4,745	-8.17%
	LGV	13,662	13,662	13,662	12,213	12,213	12,213	-1,449	-10.61%	-1,449	-10.61%	-1,449	-10.61%
	HGV	2,874	2,874	2,874	2,569	2,569	2,569	-305	-10.60%	-305	-10.60%	-305	-10.60%
Inter-Peak	Business	5,289	5,239	5,308	4,760	4,791	4,850	-529	-10.00%	-448	-8.55%	-458	-8.63%
	Commute	7,080	7,052	7,122	6,385	6,418	6,473	-695	-9.81%	-634	-9.00%	-649	-9.12%
	Other	43,203	42,977	43,380	38,833	39,109	39,432	-4,370	-10.11%	-3,868	-9.00%	-3,948	-9.10%
	Car	**55,572**	**55,268**	**55,810**	**49,979**	**50,318**	**50,755**	-5,593	-10.06%	-4,950	-8.96%	-5,055	-9.06%
	LGV	12,751	12,751	12,751	11,399	11,399	11,399	-1,352	-10.61%	-1,352	-10.61%	-1,352	-10.61%
	HGV	4,118	4,118	4,118	3,681	3,681	3,681	-437	-10.60%	-437	-10.60%	-437	-10.60%
PM Peak	Business	5,932	5,873	5,867	5,338	5,390	5,394	-594	-10.01%	-484	-8.23%	-473	-8.07%
	Commute	24,432	24,540	24,663	22,010	22,416	22,594	-2,422	-9.91%	-2,124	-8.66%	-2,068	-8.39%
	Other	27,510	27,392	27,674	24,964	25,332	25,716	-2,545	-9.25%	-2,060	-7.52%	-1,957	-7.07%
	Car	**57,874**	**57,805**	**58,203**	**52,313**	**53,137**	**53,705**	-5,561	-9.61%	-4,668	-8.07%	-4,498	-7.73%
	LGV	13,094	13,094	13,094	11,705	11,705	11,705	-1,389	-10.61%	-1,389	-10.61%	-1,389	-10.61%
	HGV	2,083	2,083	2,083	1,862	1,862	1,862	-221	-10.60%	-221	-10.60%	-221	-10.60%
24-Hours	Business	70,276	69,585	70,075	63,245	63,666	64,131	-7,031	-10.00%	-5,920	-8.51%	-5,944	-8.48%
	Commute	205,763	205,681	206,841	185,274	187,413	188,730	-20,489	-9.96%	-18,268	-8.88%	-18,111	-8.76%
	Other	433,125	429,636	434,108	390,675	393,316	397,574	-42,450	-9.80%	-36,320	-8.45%	-36,534	-8.42%
	Car	**709,164**	**704,901**	**711,024**	**639,194**	**644,394**	**650,435**	-69,970	-9.87%	-60,507	-8.58%	-60,589	-8.52%
	LGV	162,961	162,961	162,961	145,679	145,679	145,679	-17,282	-10.61%	-17,282	-10.61%	-17,282	-10.61%
	HGV	41,752	41,752	41,752	37,326	37,326	37,326	-4,426	-10.60%	-4,426	-10.60%	-4,426	-10.60%

A review of sector benefits for the PM peak is included in the tables below. The major difference is that in the low scenario, benefits from Sector 1 are considerably higher at 27 million compared to 7 million in the Core. All other areas are similar. Large changes occur between low and core for sectors 1, 2 and 4. These are for trips between the City and suburbs to the south and the north (See Figure 7).

Table 2 Core PM Benefits

Sec	1	2	3	4	5	6	7	8	9	10	Orig
1	26.7	-14.9	0.4	0.2	-1.3	-5.6	1.5	1.1	-1.2	-0.4	**6.6**
2	1.3	-0.2	6.4	5.9	-0.1	0.2	1.7	2.5	0.2	4.0	**21.8**
3	4.2	4.6	-0.1	-0.0	1.1	0.0	-0.1	-0.1	0.2	0.4	**10.2**
4	8.6	2.1	-0.5	2.4	1.0	0.1	0.2	0.1	0.3	1.1	**15.3**
5	3.1	-0.2	0.5	1.9	-0.0	0.0	0.1	0.1	0.1	0.5	**6.1**
6	-0.3	0.1	0.0	-0.4	0.0	0.1	0.0	-0.0	0.2	0.7	**0.5**
7	0.8	2.4	-0.3	-0.6	0.1	0.0	-0.0	-0.1	0.0	0.3	**2.7**
8	-0.8	3.2	-0.7	-1.4	0.4	-0.2	-0.4	0.8	0.5	1.6	**3.2**
9	3.2	0.3	-0.4	0.8	0.0	0.0	0.0	-0.1	0.0	0.4	**4.3**
10	6.7	16.5	1.4	0.8	4.7	0.3	0.2	2.2	0.3	3.8	**37.0**
Dest	**53.5**	**13.9**	**6.9**	**9.7**	**5.9**	**-5.1**	**3.3**	**6.6**	**0.6**	**12.4**	**107.7**

Table 3 Low PM Benefits

Sec	1	2	3	4	5	6	7	8	9	10	Orig
1	29.7	-9.9	2.0	5.3	0.2	-4.7	2.6	1.1	0.7	0.5	**27.6**
2	3.0	-0.2	6.2	5.1	0.0	0.1	1.7	2.4	0.1	0.1	**18.5**
3	4.6	3.5	-0.0	0.2	0.9	0.0	-0.1	-0.1	0.3	0.2	**9.6**
4	8.8	2.4	0.2	4.2	1.3	0.3	1.1	0.3	0.1	0.4	**19.0**
5	2.3	-0.2	0.6	1.8	-0.0	0.0	0.1	0.1	0.0	0.2	**4.8**
6	-0.0	0.1	0.0	-0.6	0.0	0.0	-0.0	-0.0	-0.0	0.1	**-0.5**
7	1.1	2.3	-0.3	-0.6	0.1	-0.0	-0.0	-0.1	0.0	0.1	**2.6**
8	0.0	2.8	-0.4	-1.0	0.3	-0.1	-0.3	0.4	0.2	-2.8	**-0.8**
9	4.0	0.4	-0.0	0.6	0.0	0.0	0.0	0.0	-0.0	-1.0	**4.0**
10	6.2	17.2	2.5	0.9	5.8	0.0	-0.1	2.1	0.4	2.9	**38.0**
Dest	**59.7**	**18.4**	**10.8**	**15.9**	**8.7**	**-4.3**	**5.0**	**6.4**	**1.8**	**0.7**	**123.0**

This can be demonstrated on a matrix wide level in Table 4 and Figure 8. In this the net difference between induction and suppression becomes apparent in 2033 PM.

Figure 7 Benefit Sectors

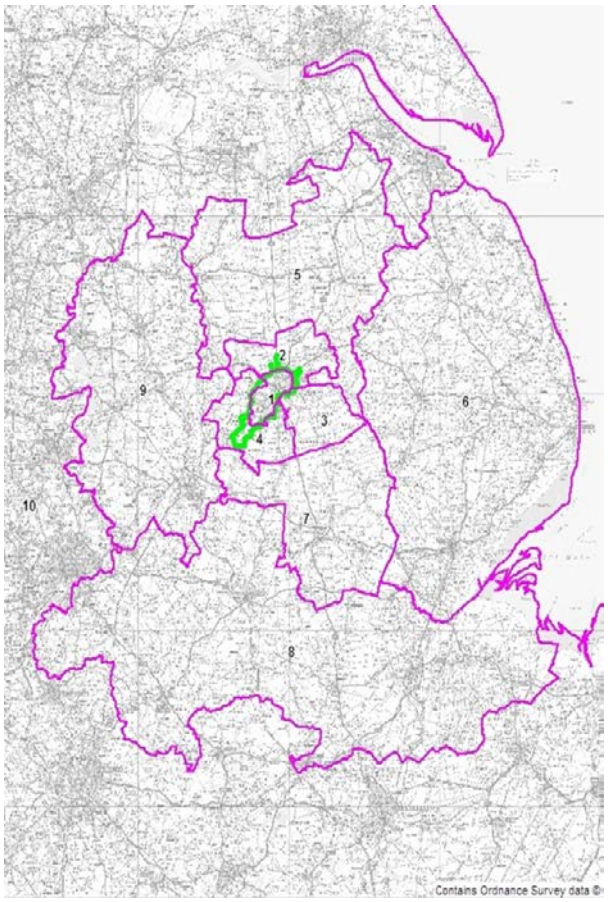


Table 4 Percentage Changes in PM Matrices from Reference

Ref	PM	Scenario	DM	DS
1	2018	low	1.5	2.6
2		core	0.9	2.0
3		high p2	0.3	1.4
4		high p2.5	0.2	1.2
5	2033	low	0.8	1.8
6		core	-0.1	0.6
7		high p2	-1.7	-1.2
8		high p2.5	-2.0	-1.6

Figure 8 Percentage Changes in Matrices from Reference

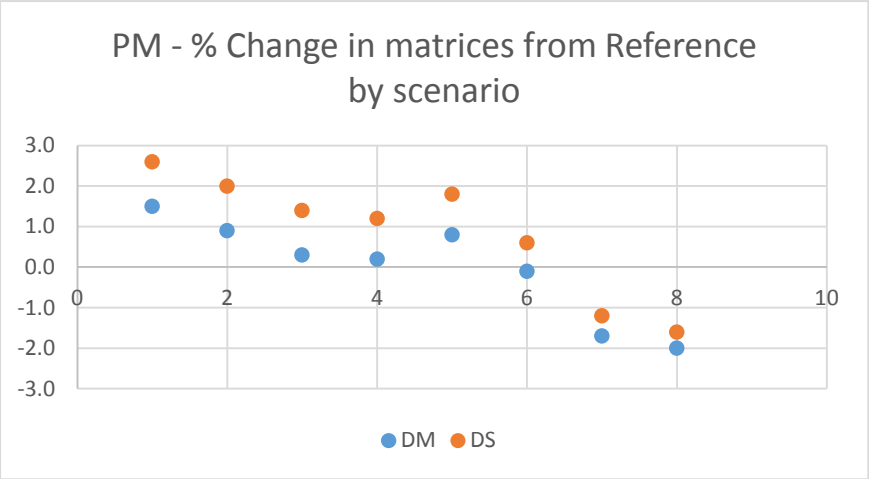


Table 5 Core PM Car – Ref to DM Changes by Sector

Car	1	2	3	4	5	6	7	8	9	10	Total
1	-18	-3	74	-277	0	88	59	-35	-27	-68	**-208**
2	-14	8	4	-32	25	8	19	-7	-2	9	**18**
3	28	-3	-7	-5	-1	7	10	-5	0	4	**27**
4	-93	-25	5	-15	6	12	42	39	15	5	**-8**
5	-11	26	4	5	0	0	1	0	0	1	**26**
6	5	9	11	11	0	0	-2	0	0	0	**34**
7	1	2	12	7	1	0	-3	-19	0	11	**13**
8	-23	-1	2	-2	1	0	-19	0	0	0	**-42**
9	35	-4	-17	31	0	0	-1	0	0	0	**43**
10	-65	14	23	1	52	0	5	0	0	0	**29**
Total	**-155**	**23**	**110**	**-275**	**83**	**115**	**111**	**-28**	**-15**	**-39**	**-69**

Table 6 Core PM Car – DM to DS Changes by Sector

Car	1	2	3	4	5	6	7	8	9	10	Total
1	122	-272	26	72	-22	-70	29	17	-30	-9	**-136**
2	-7	-30	186	112	-10	-2	15	29	0	2	**296**
3	17	83	-47	-19	14	0	-5	-5	2	-2	**37**
4	60	39	-28	-34	15	2	-7	-24	0	4	**27**
5	21	-13	13	30	0	0	0	0	0	0	**52**
6	-9	1	-1	-6	1	0	0	0	0	0	**-14**
7	15	47	-9	-14	1	1	-5	-4	0	-3	**28**
8	-1	32	-6	-15	0	0	-2	0	0	0	**8**
9	27	1	2	-7	0	0	-1	0	0	0	**21**
10	-10	89	14	-11	0	0	-3	0	0	0	**80**
Total	**235**	**-23**	**149**	**108**	**0**	**-69**	**21**	**13**	**-28**	**-8**	**398**

Table 7 Low PM Car – Ref to DM Changes by Sector

Car	1	2	3	4	5	6	7	8	9	10	Total
1	-140	89	113	-127	41	83	79	0	28	64	**231**
2	-34	-32	14	6	22	6	16	1	5	42	**47**
3	51	3	-25	-6	1	4	4	2	2	3	**40**
4	-43	-2	3	-73	13	11	45	51	35	22	**62**
5	6	13	3	10	0	0	1	0	0	1	**33**
6	23	4	8	23	0	0	-2	0	0	0	**56**
7	15	7	10	15	1	0	-23	-5	0	32	**52**
8	9	3	3	18	0	0	-6	0	0	0	**27**
9	48	2	-10	30	0	0	-2	0	0	0	**69**
10	44	59	31	18	46	0	10	0	0	0	**208**
Total	**-21**	**146**	**149**	**-85**	**124**	**106**	**123**	**49**	**71**	**164**	**825**

Table 8 Low PM Car – DM to DS Changes by Sector

Car	1	2	3	4	5	6	7	8	9	10	Total
1	97	-237	51	82	-16	-62	60	23	-5	-5	**-13**
2	11	-36	172	103	-14	-2	22	27	-1	31	**313**
3	22	57	-44	-4	10	1	-4	-4	2	-1	**34**
4	57	35	-12	-20	19	2	-6	-24	-2	3	**52**
5	12	-12	12	25	0	0	0	0	0	0	**38**
6	-7	1	-1	-9	0	0	0	0	0	0	**-15**
7	27	47	-11	-14	1	0	-5	-3	0	-8	**33**
8	7	27	-6	-13	1	0	-3	0	0	0	**13**
9	27	3	-5	-3	0	0	-1	0	0	0	**22**
10	-15	88	12	-5	13	0	-2	0	0	0	**90**
Total	**237**	**-25**	**168**	**141**	**13**	**-61**	**62**	**18**	**-6**	**19**	**567**

At a localised VDM level in the core 2033 Sector 1 DM is supressed heavily by 208 trips. Under the low scenario traffic is induced by 231 The induction in the low scenario (which is not significantly adjusted in the DS) leads to additional benefits. In the core DS there is further suppression in this period for this sector, although the net impact across the network as a whole remains positive.

Hence the relatively large positive changes in the low growth demand relative to core cause the effect of improved benefits.