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**Title:** Danetree: ITP Technical Note 14 (Rev A)  
Danetree Public Transport Demands

**Date:** 21 July 2009

**Author:** AN/JW

**Project Code:** 1007

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## 1 INTRODUCTION

1.1 This technical note has been prepared by Integrated Transport Planning (ITP) Ltd to inform Northamptonshire County Council as to the public transport strategy and predicted demands associated with the proposed Danetree development. The note goes on to discuss potential operating costs, phasing of services and predicted subsidies that will be necessary.

## 2 DANETREE PROPOSED BUS SERVICE PLAN

2.1 Further details of the proposed Danetree public transport strategy are set out in the Interim Statement of Common Ground (SOCG) dated January 2009. The proposed service plan, as set out in the SOCG, is included as follows:

2.2 Negotiations are ongoing with the County Council and bus operators which could include the following within a service level agreement:

2.3 Two bus services are proposed. The first, a new service that effectively connects Danetree with destinations within the wider Daventry area. The second, recognising the importance of Northampton as a destination, is an improvement of an existing service.

2.4 The first service will provide a new 'figure of eight' town centre that connects key residential, employment and commercial areas of the town, as well as connecting the three neighbourhood centres within Daventry. An important feature of this service is it provides direct connections within Daventry without the need to interchange.

2.5 The second service sees the diversion of existing service D2, between the rest of Daventry and Northampton, through Danetree, along with an increase in the frequency of the D2 from hourly to half hourly (Monday to Saturday daytime). This diversion would mean a loss of one service per hour from the Admirals Way section of the existing route. To mitigate it is proposed that service D1 should increase its frequency from one to two buses per hour. This service, once again, provides a direct connection between Danetree and Northampton, including Northampton rail station, without the need for interchange at Daventry bus station or elsewhere.

- 2.6 Therefore, not only will this result in two direct services from the Danetree spine road to Northampton, the overall frequency over both services will increase from two to four buses per hour, which will be of substantial benefit to all users along the entire route.
- 2.7 Recognising that the nature of demand from and to Danetree will change as the new community develops, phased implementation of bus services is proposed. The service frequency is entirely consistent with NCC's Strategy for Growth Appendix 8, which specifies (for settlement of over 4501 dwellings that is not within 400m of an existing hourly service):

*"10 min day-time service, and half hourly Evening and Sunday bus service to town centre."*

- 2.8 During development of Danetree, service provision is cognisant of the size of the development and the service level requirement stated within Appendix 8, building to a 10 minute daily service to Daventry town centre when the 4501 house threshold is met. The service frequency proposed for full development is summarised below:

**Table 1: Proposed Danetree Bus Service Frequency**

	Monday-Saturday Operating Hours	Monday – Saturday Daytime Peak Frequency	Weekday Evening Frequency	Sunday and Bank Holidays
Danetree – rest of Daventry New Service (NS)	16	15mins (13 hours per day)	30 mins (3 hours per day)	30 minutes (10 hours per day)
Rest of Daventry – Danetree – Northampton Diverted Service D2	16	30mins(13 hours per day)	60mins (3 hours per day)	120 minutes (12 hours per day)

- 2.9 Based upon the above full service, the table below demonstrates the daytime service frequency occurring on the Danetree Spine Road.

**Table 2: Danetree Spine Road Service Frequency**

	To Daventry	To Northampton	TOTAL
Northbound	4	0	4
Southbound	2	2	4
TOTAL	6	2	8

- 2.10 Within the above table the service going to Daventry northbound are made up of 2 new services and 2 of the diverted services en route to Daventry from Northampton passing

through Daventry. The 2 services going to Daventry southbound are the new service only. The table shows that Danetree residents will benefit from 6 bus services per hour, or every 10 minutes travelling along the spine road to Daventry town centre. The total number of buses serving Danetree is 8, ensuring that a bus is present upon the spine road, on average, every 7.5 minutes.

### 3 DERIVATION OF PREDICTED MODE SHARE AND PATRONAGE

- 3.1 As part of the Supplementary Transport Assessment (STA) issued by ITP in October 2008, a comprehensive trip generation exercise was undertaken for the proposed Danetree development. The number of person trips to and from the proposed development was predicted for the highway network peak hours of 8:00-9:00 and 17:00-18:00. Further details of the trip generation exercise are provided within the STA.

#### *Predicted Bus Mode Share*

- 3.2 To predict the proportion of person trips that will arrive by bus with the proposed bus strategy in place, the following methodology was employed:
- 3.3 Bus modal share for approximately 100 origin-destination pairs (at Census Ward level) within the County was investigated to determine the key factors influencing modal shares. The following parameters were tested for significance:
- Car ownership levels in origin Ward
  - Bus service frequency
  - The requirement to make an interchange to complete the journey
  - Relative journey time on bus compared to car (both absolute and proportionate)
  - Whether the destination is a town centre (to account for parking charges etc)
- 3.4 Regression analysis was carried out to determine the extent to which the above factors played a role in determining the modal share of bus for a given journey. The findings of this analysis are presented below:

**Table 3: Modal Split from Hill, Flore and Badby Ward Census Journey to Work Data**

Parameter	Coefficient
Car ownership (% households without car) (C)	0.306
Frequency (bph) (F)	0.019
Number of Interchanges (N)	- 0.024*
Relative JT differential (J)	- 0.001*

Town Centre (T)	0.017*
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- 3.5 The coefficients provide a means of predicting likely modal share based on service levels and characteristics of the origin area. The car ownership coefficient shows that a ward in which 30% of households have no access to a car is likely to exhibit a public transport mode share around 3% higher than a ward with 20% no-car households.  $((30\% - 20\%) * 0.306 = 3.06\%)$ .
- 3.6 More importantly, for public transport service planning, the analysis shows that an increase in frequency of 1 bus per hour increases public transport mode share by nearly 2% (0.019). Hence, moving from a half hourly service to a 10 minutely service suggest an increase in modal share of 5.7%.
- 3.7 The impact of an interchange, while not provable at the 95% confidence level, is negative as one would expect. The value of 0.024 suggests that having to make an interchange to reach the chosen destination reduces the modal share of public transport by 2.4%.
- 3.8 Journey time differentials between public transport and car are shown by the low coefficient to be fairly unimportant in mode choice. Again, whilst not provable at the 95% confidence level, the coefficient value suggests that given a 10 minute journey time differential in favour of the car, the modal share of PT would be 1% lower than if they exhibited equivalent journey times.
- 3.9 A resulting formula for deriving the expected level of PT modal share was then derived as follows, where the terms of the equations relate to the parameters detailed in Table 3:

$$\text{Predicted PT Modal Share (\%)} = 2.68 + 0.306 C + 0.019 F - 0.024 N - 0.001 J + 0.017 T$$

- 3.10 The surrounding areas were divided into zones, which included the four wards that comprise the Daventry urban area, and areas such as Northampton, Rugby etc and rural parts of the Daventry District. The parameters described in Table 3 were derived for bus journeys from the site to each area with the proposed bus improvements in place and the resulting modal share was applied to the overall number of people expected to make that journey. Using this analysis it is predicted that with the improved bus services in place, 11.7% of all trips made by residents and 12.2% of all trips made by employees would be made by bus.

#### *Associated Daily Patronage*

- 3.11 The analysis described above provided the number of bus passengers that can be expected to travel between the site and surrounding areas for peak hour trips. In order to derive the daily number of trips, factors were derived from TRICS. The daily profile of public transport trips from all privately owned housing sites in the TRICS database was used to convert peak hour trips to daily trips. This leads to the following peak hour and associated daily patronage to Daventry and Northampton:

**Table 4: Predicted Peak and Daily Bus Patronage for New Services from / to Danetree**

Destination	Predicted Patronage					
	AM Peak		PM Peak		Daily	
	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
Daventry (Abbey North Ward)	23	60	44	43	352	316
Daventry (Abbey South Ward) (Includes Town Centre)	23	125	90	70	600	603
Daventry (Drayton Ward)	25	84	62	54	454	428
Daventry (Hill Ward)	25	63	46	45	373	335
Northampton Town Centre	13	54	39	33	277	268

#### 4 REVENUE FORECAST

- 4.1 Forecasts of revenue (derived from the Danetree development ONLY) for the two services were estimated based on the forecast daily demand, an average fare, and an annualisation factor.
- 4.2 The forecast daily demand to/from the Danetree development on the “Figure of Eight” service to Daventry is shown in Table 4 as 3,461 journeys. The existing fares for longer distance journeys within Daventry on the Dart services are as follows:
- Single: £1.45
  - Return: £2.65
  - Daily: £9
  - Weekly: £22
  - Monthly: £80
  - Quarterly: £220
  - Annual: £780
- 4.3 As the return fare offers the best value, it is assumed that the existing average fare per journey is equivalent to half of the return fare, i.e. £1.33. As the journey to/from Danetree would be longer than most existing internal Daventry trips, it is reasonable to assume that a slightly higher fare would be charged, and a fare of £1.50 has been assumed.
- 4.4 An annualisation factor of 300 was used to convert the estimated daily revenue to annual revenue. This is a commonly used factor in the industry.
- 4.5 The estimated annual revenue for the Daventry service arising from trips to/from the full development is therefore  $3,461 \times £1.50 \times 300 = £1.56$  million.
- 4.6 From Table 4, the daily demand on the Northampton service is 545 journeys. The existing fares between Daventry and Northampton are as follows:
- Single: £3.10

- Return: £5.20
  - Daily: £9
  - Weekly: £22
  - Monthly: £80
  - Quarterly: £220
  - Annual: £780
- 4.7 In order to estimate an average fare for journeys to Northampton, it was assumed that one third of passengers purchase return tickets, one third purchase weekly tickets, and one third purchase monthly tickets. This equates to an average fare per journey of £2.21. The estimated annual revenue for the Northampton service arising from trips to/from the full development is therefore  $545 \times £2.21 \times 300 = £361,000$
- 4.8 To reflect the phasing of development, these annual revenues were pro-rated according to the total number of dwellings completed in each year, to provide a revenue profile over the development period, as shown in Table 5.

**Table 5: Predicted Annual Bus Revenue for Journeys from / to Danetree**

Year	Dwellings Built	Cumulative Dwellings	Daventry Service Revenue	Northampton Service Revenue
2011/12	125	125	£37,802	£8,755
2012/13	225	350	£10,584	£24,513
2013/14	325	675	£204,132	£47,275
2014/15	375	1050	£317,538	£73,539
2015/16	375	1425	£430,945	£99,803
2016/17	375	1800	£544,351	£126,067
2017/18	375	2175	£657,758	£152,330
2018/19	400	2575	£778,725	£180,345
2019/20	400	2975	£899,692	£208,360
2020/21	400	3375	£1,020,659	£236,375
2021/22	375	3750	£1,134,066	£262,639
2022/23	375	4125	£1,247,472	£288,903
2023/24	375	4500	£1,360,879	£315,166
2024/25	350	4850	£1,466,725	£339,679

2025/26	300	5150	£1,557,450	£360,691
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## 5 OPERATING COST ESTIMATES

5.1 ITP's operating cost model has been developed and tested in a number of different towns and cities in the UK, and is based on latest cost information. It reflects the distance, operating speed, frequency and operational hours of each route and includes the following cost elements:

- Drivers
- Inspectors
- Fuel
- Tyres
- Maintenance
- Insurance
- Other staff
- Administration

### *Daventry Service*

5.2 For the Daventry service, the following service frequencies were assumed:

	Initial Service (2011/12)	Interim 1 Service (2012/13 to 2013/14)	Interim 2 Service (2014/15 – 2015/16)	Full service (2016/17 onwards) <sup>1</sup>
Mon-Sat daytime headway	60 mins	30 mins	20 mins	15 mins
Mon-Sat daytime duration	13 hours	13 hours	13 hours	13 hours
Mon-Sat Evening headway	60 mins	60 mins	60 mins	30 mins
Mon-Sat Evening duration	3 hours	3 hours	3 hours	3 hours
Sun headway	60 mins	60 mins	60 mins	30 mins
Sun duration	10 hours	10 hours	10 hours	10 hours

Note 1. 10 minute frequency to Daventry is achieved as Northampton – Danetree – Daventry service will also provide 2 services per hour, therefore providing a combined 10 minute frequency to Daventry.

5.3 The annual operating costs for this service are shown in Table 6, as well as allowances for overhead and profit.

**Table 6: Forecast Annual Operating Costs for Daventry Service**

	Annual Operating Cost	Overhead @ 8%	Profit @ 16%	Total
Initial Service	£264,200	£21,136	£45,654	£330,990
Interim 1 Service	£398,400	£31,872	£68,844	£499,116
Interim 2 Service	£532,600	£42,608	£92,033	£667,241
Full Service	£691,100	£55,288	£119,422	£865,810

*Northampton Service*

- 5.4 For the Northampton service, the proposal is to divert existing route D2 through the development and increase it's frequency to half hourly, and to increase the frequency on the existing D1 service to maintain a half hourly service to Northampton from Admirals Way. The marginal change in operating costs for these two services therefore needs to be calculated, using the following frequencies (which apply throughout the development period):

	Revised D2	Revised D1
Mon-Sat daytime headway	30 mins	30 mins
Mon-Sat daytime duration	13 hours	9 hours
Mon-Sat evening headway	60 minutes	60 mins
Mon-Sat evening duration	3 hours	3 hours
Sun headway	120 minutes	120 minutes
Sun duration	12 hours	12 hours

- 5.5 The marginal change in annual operating costs for these two services is estimated as:
- Revised D2 through Danetree and increased frequency - £335,797
  - Increased frequency on D1 - £196,239
  - Total increase in annual operating cost - £532,036

## 6 ADDITIONAL EXTERNAL REVENUE RESULTING FROM INCREASED SERVICE PROVISION

- 6.1 It is proposed to increase the Monday-Saturday service provision over the D1 and D2 services from two buses per hour to four buses per hour between Daventry and Northampton. This will have a significant impact on patronage. The bus mode share

regression model used by ITP throughout the analysis indicates that increasing service provision to Northampton would increase patronage by in excess of 30%.

- 6.2 To confirm this assumption, cross-checks were undertaken using industry accepted research. These cross-checks, as set out below, demonstrate that the responsiveness of the mode choice model for Danetree (regression model) with respect to service frequency is fully in line with the wider body of research. Patronage increases in the order of 30% in response to a doubling of the service frequency can be considered realistic and robust.
- 6.3 'The Demand for Transport: A practical Guide' (also known as the 'Black Book' / TRL Note 593) is a recognised industry source of evidence on public transport demand and its determinants. The document presents a review of research and evidence on passenger response to service and fare changes.

#### *The Effect of Increasing Vehicle Kilometers of the Service*

- 6.4 Chapter 7 relates to the impact of service levels on patronage. Service provision can be measured in a number of ways, so evidence of the two main measures is presented below. These are presented as elasticities which measure the responsiveness of demand to a proportional change in the determining factor. A positive elasticity relates to a positive proportional change in determining factor.
- 6.5 Service elasticity is set out in relation to bus vehicle kilometres operated in Table 7.5. This shows elasticities in the short run (within the first year) of 0.38, and in the long run (within 3-5 years) of 0.66.
- 6.6 By increasing the service frequency from 2 buses per hour to 4 buses per hour, a 100% increase, we would expect service kms to broadly increase by 100% also. This means that in the short run (within the first year), the enhanced D1 and D2 services would see an increase in patronage of 38% ( $0.38 \times 1$ ). In the long run (3-5 years) the overall patronage increase would be expected to reach 66%.

#### *The Effect of Reducing Wait Time*

- 6.7 Wait time can also be used as a measure of service offer. Bus elasticity with respect to wait time is set out in Table 7.9 of TRL593. This quotes elasticities of -0.64 for all trips or -0.65 for peak hour town centre trips.
- 6.8 By increasing frequency from 2 buses per hour to 4 buses per hour, average wait time is reduced from 15 minutes to 7.5 minutes ie a reduction of 50%. Using an elasticity of -0.65, this would imply an increase in patronage of 32.5% ( $-0.65 \times 0.5$ ).
- 6.9 Therefore whether considering evidence in either in terms of increase in vehicle kilometres, or decrease in wait time resulting from the proposed enhancement of the D1 and D2 services, an increase in patronage of at least 30% is considered achievable.

6.10 The annual operating costs of the existing D1 and D2 services were derived in the same way as for the proposed services. It is assumed that Stagecoach operate these services at a typical profit margin of 10%. Therefore the annual operating costs and revenue of these two services are assumed as follows:

	Operating Costs	Assumed Revenue
D1 Service	£316,121	£347,733
D2 Service	£316,121	£347,733
Overall	£632,242	£695,246

6.11 Therefore it is reasonable to assume that the existing D1 and D2 services collect revenue in the order of £695,246 per annum.

6.12 Assuming that patronage along these two routes were to increase by 15% in the first year and 30% in subsequent years as a result of increased service provision, then the revenue of these services would increase in the same proportions, i.e. by £104,320 in the first year and by £208,620 in subsequent years.

## 7 DIFFERENCE BETWEEN REVENUE AND OPERATING COST

7.1 Comparing the revenue and operating cost forecasts allows an initial estimate to be made of the subsidy requirements, as shown in Table 7. For the Daventry service, the only revenue included in this Table is that arising from journeys to/from Danetree. For the Northampton Services, the increased revenue arising from increased patronage discussed in Section 6 is also taken into account.

**Table 7: Difference between Annual Operating Cost and Revenue arising from Danetree Journeys**

Year	Daventry Service			Northampton Service				
	Danetree Revenue	Operating Cost	Difference	Danetree Revenue	External Increase in Revenue	Overall Revenue	Operating Cost	Difference
2011/12	£37,802	£330,990	£293,188	£8,755	£104,320	£113,075	£532,036	£418,962
2012/13	£10,584	£499,116	£393,269	£24,513	£208,640	£233,153	£532,036	£298,884
2013/14	£204,132	£499,116	£294,984	£47,275	£208,640	£255,915	£532,036	£276,122
2014/15	£317,538	£667,241	£349,703	£73,539	£208,640	£282,179	£532,036	£249,858
2015/16	£430,945	£667,241	£236,296	£99,803	£208,640	£308,443	£532,036	£223,594
2016/17	£544,351	£865,810	£321,459	£126,067	£208,640	£334,706	£532,036	£197,330
2017/18	£657,758	£865,810	£308,052	£152,330	£208,640	£360,970	£532,036	£171,066
2018/19	£778,725	£865,810	£87,085	£180,345	£208,640	£388,985	£532,036	£143,051
2019/20	£899,692	£865,810	-£33,882	£208,360	£208,640	£417,000	£532,036	£115,037
2020/21	£1,020,659	£865,810	-£154,849	£236,375	£208,640	£445,015	£532,036	£87,022
2021/22	£1,134,066	£865,810	-£268,255	£262,639	£208,640	£471,279	£532,036	£60,758
2022/23	£1,247,472	£865,810	-£381,662	£288,903	£208,640	£497,542	£532,036	£34,494
2023/24	£1,360,879	£865,810	-£495,069	£315,166	£208,640	£523,806	£532,036	£8,230
2024/25	£1,466,725	£865,810	-£600,915	£339,679	£208,640	£548,319	£532,036	-£16,283
2025/26	£1,557,450	£865,810	-£691,640	£360,691	£208,640	£569,330	£532,036	-£37,294

7.2 It can be seen that for the Daventry service, revenue from Danetree journeys begins to exceed operating cost (and overhead and profit) in 2019/20, by which time a deficit of £2.2840 million has accumulated. Revenue exceeds the change in operating cost on the Northampton service in 2024/25, by which time the deficit of £2.2844 million has accumulated. The cumulative deficit is therefore £4,568,444 million.

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Daventry (Abbey North Ward)	23	60	44	43	352	316
Daventry (Abbey South Ward) (Includes Town Centre)	23	125	90	70	600	603
Daventry (Drayton Ward)	25	84	62	54	454	428
Daventry (Hill Ward)	25	63	46	45	373	335
Northampton Town Centre	13	54	39	33	277	268

#### 4 REVENUE FORECAST

- 4.1 Forecasts of revenue (derived from the Danetree development ONLY) for the two services were estimated based on the forecast daily demand, an average fare, and an annualisation factor.
- 4.2 The forecast daily demand to/from the Danetree development on the “Figure of Eight” service to Daventry is shown in Table 4 as 3,461 journeys. The existing fares for longer distance journeys within Daventry on the Dart services are as follows:
- Single: £1.45
  - Return: £2.65
  - Daily: £9
  - Weekly: £22
  - Monthly: £80
  - Quarterly: £220
  - Annual: £780
- 4.3 As the return fare offers the best value, it is assumed that the existing average fare per journey is equivalent to half of the return fare, i.e. £1.33. As the journey to/from Danetree would be longer than most existing internal Daventry trips, it is reasonable to assume that a slightly higher fare would be charged, and a fare of £1.50 has been assumed.
- 4.4 An annualisation factor of 300 was used to convert the estimated daily revenue to annual revenue. This is a commonly used factor in the industry.
- 4.5 The estimated annual revenue for the Daventry service arising from trips to/from the full development is therefore  $3,461 \times £1.50 \times 300 = £1.56$  million.
- 4.6 From Table 4, the daily demand on the Northampton service is 545 journeys. The existing fares between Daventry and Northampton are as follows:
- Single: £3.10

- Return: £5.20
  - Daily: £9
  - Weekly: £22
  - Monthly: £80
  - Quarterly: £220
  - Annual: £780
- 4.7 In order to estimate an average fare for journeys to Northampton, it was assumed that one third of passengers purchase return tickets, one third purchase weekly tickets, and one third purchase monthly tickets. This equates to an average fare per journey of £2.21. The estimated annual revenue for the Northampton service arising from trips to/from the full development is therefore  $545 \times £2.21 \times 300 = £361,000$
- 4.8 To reflect the phasing of development, these annual revenues were pro-rated according to the total number of dwellings completed in each year, to provide a revenue profile over the development period, as shown in Table 5.

**Table 5: Predicted Annual Bus Revenue for Journeys from / to Danetree**

Year	Dwellings Built	Cumulative Dwellings	Daventry Service Revenue	Northampton Service Revenue
2011/12	125	125	£37,802	£8,755
2012/13	225	350	£10,584	£24,513
2013/14	325	675	£204,132	£47,275
2014/15	375	1050	£317,538	£73,539
2015/16	375	1425	£430,945	£99,803
2016/17	375	1800	£544,351	£126,067
2017/18	375	2175	£657,758	£152,330
2018/19	400	2575	£778,725	£180,345
2019/20	400	2975	£899,692	£208,360
2020/21	400	3375	£1,020,659	£236,375
2021/22	375	3750	£1,134,066	£262,639
2022/23	375	4125	£1,247,472	£288,903
2023/24	375	4500	£1,360,879	£315,166
2024/25	350	4850	£1,466,725	£339,679

2025/26	300	5150	£1,557,450	£360,691
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## 5 OPERATING COST ESTIMATES

5.1 ITP's operating cost model has been developed and tested in a number of different towns and cities in the UK, and is based on latest cost information. It reflects the distance, operating speed, frequency and operational hours of each route and includes the following cost elements:

- Drivers
- Inspectors
- Fuel
- Tyres
- Maintenance
- Insurance
- Other staff
- Administration

### *Daventry Service*

5.2 For the Daventry service, the following service frequencies were assumed:

	Initial Service (2011/12)	Interim 1 Service (2012/13 to 2013/14)	Interim 2 Service (2014/15 – 2015/16)	Full service (2016/17 onwards) <sup>1</sup>
Mon-Sat daytime headway	60 mins	30 mins	20 mins	15 mins
Mon-Sat daytime duration	13 hours	13 hours	13 hours	13 hours
Mon-Sat Evening headway	60 mins	60 mins	60 mins	30 mins
Mon-Sat Evening duration	3 hours	3 hours	3 hours	3 hours
Sun headway	60 mins	60 mins	60 mins	30 mins
Sun duration	10 hours	10 hours	10 hours	10 hours

Note 1. 10 minute frequency to Daventry is achieved as Northampton – Danetree – Daventry service will also provide 2 services per hour, therefore providing a combined 10 minute frequency to Daventry.

5.3 The annual operating costs for this service are shown in Table 6, as well as allowances for overhead and profit.

**Table 6: Forecast Annual Operating Costs for Daventry Service**

	Annual Operating Cost	Overhead @ 8%	Profit @ 16%	Total
Initial Service	£264,200	£21,136	£45,654	£330,990
Interim 1 Service	£398,400	£31,872	£68,844	£499,116
Interim 2 Service	£532,600	£42,608	£92,033	£667,241
Full Service	£691,100	£55,288	£119,422	£865,810

*Northampton Service*

- 5.4 For the Northampton service, the proposal is to divert existing route D2 through the development and increase it's frequency to half hourly, and to increase the frequency on the existing D1 service to maintain a half hourly service to Northampton from Admirals Way. The marginal change in operating costs for these two services therefore needs to be calculated, using the following frequencies (which apply throughout the development period):

	Revised D2	Revised D1
Mon-Sat daytime headway	30 mins	30 mins
Mon-Sat daytime duration	13 hours	9 hours
Mon-Sat evening headway	60 minutes	60 mins
Mon-Sat evening duration	3 hours	3 hours
Sun headway	120 minutes	120 minutes
Sun duration	12 hours	12 hours

- 5.5 The marginal change in annual operating costs for these two services is estimated as:
- Revised D2 through Danetree and increased frequency - £335,797
  - Increased frequency on D1 - £196,239
  - Total increase in annual operating cost - £532,036

## 6 ADDITIONAL EXTERNAL REVENUE RESULTING FROM INCREASED SERVICE PROVISION

- 6.1 It is proposed to increase the Monday-Saturday service provision over the D1 and D2 services from two buses per hour to four buses per hour between Daventry and Northampton. This will have a significant impact on patronage. The bus mode share

regression model used by ITP throughout the analysis indicates that increasing service provision to Northampton would increase patronage by in excess of 30%.

- 6.2 To confirm this assumption, cross-checks were undertaken using industry accepted research. These cross-checks, as set out below, demonstrate that the responsiveness of the mode choice model for Danetree (regression model) with respect to service frequency is fully in line with the wider body of research. Patronage increases in the order of 30% in response to a doubling of the service frequency can be considered realistic and robust.
- 6.3 'The Demand for Transport: A practical Guide' (also known as the 'Black Book' / TRL Note 593) is a recognised industry source of evidence on public transport demand and its determinants. The document presents a review of research and evidence on passenger response to service and fare changes.

#### *The Effect of Increasing Vehicle Kilometers of the Service*

- 6.4 Chapter 7 relates to the impact of service levels on patronage. Service provision can be measured in a number of ways, so evidence of the two main measures is presented below. These are presented as elasticities which measure the responsiveness of demand to a proportional change in the determining factor. A positive elasticity relates to a positive proportional change in determining factor.
- 6.5 Service elasticity is set out in relation to bus vehicle kilometres operated in Table 7.5. This shows elasticities in the short run (within the first year) of 0.38, and in the long run (within 3-5 years) of 0.66.
- 6.6 By increasing the service frequency from 2 buses per hour to 4 buses per hour, a 100% increase, we would expect service kms to broadly increase by 100% also. This means that in the short run (within the first year), the enhanced D1 and D2 services would see an increase in patronage of 38% ( $0.38 \times 1$ ). In the long run (3-5 years) the overall patronage increase would be expected to reach 66%.

#### *The Effect of Reducing Wait Time*

- 6.7 Wait time can also be used as a measure of service offer. Bus elasticity with respect to wait time is set out in Table 7.9 of TRL593. This quotes elasticities of -0.64 for all trips or -0.65 for peak hour town centre trips.
- 6.8 By increasing frequency from 2 buses per hour to 4 buses per hour, average wait time is reduced from 15 minutes to 7.5 minutes ie a reduction of 50%. Using an elasticity of -0.65, this would imply an increase in patronage of 32.5% ( $-0.65 \times 0.5$ ).
- 6.9 Therefore whether considering evidence in either in terms of increase in vehicle kilometres, or decrease in wait time resulting from the proposed enhancement of the D1 and D2 services, an increase in patronage of at least 30% is considered achievable.

6.10 The annual operating costs of the existing D1 and D2 services were derived in the same way as for the proposed services. It is assumed that Stagecoach operate these services at a typical profit margin of 10%. Therefore the annual operating costs and revenue of these two services are assumed as follows:

	Operating Costs	Assumed Revenue
D1 Service	£316,121	£347,733
D2 Service	£316,121	£347,733
Overall	£632,242	£695,246

6.11 Therefore it is reasonable to assume that the existing D1 and D2 services collect revenue in the order of £695,246 per annum.

6.12 Assuming that patronage along these two routes were to increase by 15% in the first year and 30% in subsequent years as a result of increased service provision, then the revenue of these services would increase in the same proportions, i.e. by £104,320 in the first year and by £208,620 in subsequent years.

## 7 DIFFERENCE BETWEEN REVENUE AND OPERATING COST

7.1 Comparing the revenue and operating cost forecasts allows an initial estimate to be made of the subsidy requirements, as shown in Table 7. For the Daventry service, the only revenue included in this Table is that arising from journeys to/from Danetree. For the Northampton Services, the increased revenue arising from increased patronage discussed in Section 6 is also taken into account.

**Table 7: Difference between Annual Operating Cost and Revenue arising from Danetree Journeys**

Year	Daventry Service			Northampton Service				
	Danetree Revenue	Operating Cost	Difference	Danetree Revenue	External Increase in Revenue	Overall Revenue	Operating Cost	Difference
2011/12	£37,802	£330,990	£293,188	£8,755	£104,320	£113,075	£532,036	£418,962
2012/13	£10,584	£499,116	£393,269	£24,513	£208,640	£233,153	£532,036	£298,884
2013/14	£204,132	£499,116	£294,984	£47,275	£208,640	£255,915	£532,036	£276,122
2014/15	£317,538	£667,241	£349,703	£73,539	£208,640	£282,179	£532,036	£249,858
2015/16	£430,945	£667,241	£236,296	£99,803	£208,640	£308,443	£532,036	£223,594
2016/17	£544,351	£865,810	£321,459	£126,067	£208,640	£334,706	£532,036	£197,330
2017/18	£657,758	£865,810	£308,052	£152,330	£208,640	£360,970	£532,036	£171,066
2018/19	£778,725	£865,810	£87,085	£180,345	£208,640	£388,985	£532,036	£143,051
2019/20	£899,692	£865,810	-£33,882	£208,360	£208,640	£417,000	£532,036	£115,037
2020/21	£1,020,659	£865,810	-£154,849	£236,375	£208,640	£445,015	£532,036	£87,022
2021/22	£1,134,066	£865,810	-£268,255	£262,639	£208,640	£471,279	£532,036	£60,758
2022/23	£1,247,472	£865,810	-£381,662	£288,903	£208,640	£497,542	£532,036	£34,494
2023/24	£1,360,879	£865,810	-£495,069	£315,166	£208,640	£523,806	£532,036	£8,230
2024/25	£1,466,725	£865,810	-£600,915	£339,679	£208,640	£548,319	£532,036	-£16,283
2025/26	£1,557,450	£865,810	-£691,640	£360,691	£208,640	£569,330	£532,036	-£37,294

7.2 It can be seen that for the Daventry service, revenue from Danetree journeys begins to exceed operating cost (and overhead and profit) in 2019/20, by which time a deficit of £2.2840 million has accumulated. Revenue exceeds the change in operating cost on the Northampton service in 2024/25, by which time the deficit of £2.2844 million has accumulated. The cumulative deficit is therefore £4,568,444 million.