# 3.0 Travel Forecasts

## 3.0 Travel Forecasts

This section provides a brief overview of the model used to generate ridership forecasts and user benefits for the Transport 2020 rail project. Summit reports and maps, and the Travel Forecasts Template are also provided.

## 3.1 Travel Forecasting Methodology

The Transport 2020 ridership forecasts and user benefit estimates are based on the Madison MPO model that is applied to the T2020 corridor. The properties of the Madison MPO model were discussed with the FTA and the model was updated and is in accordance with FTA requirements. These requirements are included in the most recent documentation available by the FTA and have been disseminated in FTA courses on New Starts. The model incorporates the following elements:

- A household survey conducted as part of the NHTS add-on sample in 2001/2002 was used to develop the trip generation model and the trip distribution model in the Madison area.
- The 2000 on-board survey and APC and farebox data collected in 2005 were used to assess total bus ridership, bus utilization by route and route grouping, and the extent of transferring.
- Bus transit schedules were reviewed and documented to provide a benchmark for comparing against the bus transit skims that are generated by the Madison model.

The properties of the Madison model for the Transport 2020 corridor were presented and subsequent updates and model validation efforts were discussed with FTA staff during technical meetings and presentations.

A technical methodology meeting was held at FTA's offices on April 4, 2006. The key points of discussion among FTA and project team members are summarized as follows:

- It was agreed that a new mode choice model does not need to be estimated since FTA
  agreed with the approach of using and adjusting coefficients from similar models.
  Additional information on model structure and modal constants was requested.
- The FTA discussed with the team the value of collecting a reliable and up-to-date **on-board survey** for the Madison area. Such a survey can be used to confirm patterns suggested by the model and will complement the National Household Travel Survey.
- It was agreed to focus on nonmotorized trips and suggested to account for these trips
  by using the existing mode choice model and modifying it to account for the walk and
  bike modes and their disutility.

- The FTA also suggested to split out the existing Home-based School trip purpose to
  distinguish more clearly between University travel and other school-related travel.
  This is consistent with the more explicit treatment of walk and bike trips which are
  more prevalent in the vicinity of the corridor and among University students and staff.
- It was agreed to distinguish between **peak** and **off-peak periods** to the extent that such an approach would help better reflect the congestion on the highway network and especially in the vicinity of the corridor.
- The FTA stressed that according to the current guidance on **modal constant values**, the same constant should be used for bus and for rail alternatives. Different values for the rail constant will depend on the proposed fixed guideway alternative and may be used only at a later stage as part of a sensitivity analysis.

A second meeting was held at FTA offices on May 31, 2007. During this meeting the following items were presented and discussed:

- The project team presented a summary of the **Market Analysis** that highlighted the key drivers of travel flows and transit demand in the Madison area for the current and future year horizons.
- Early results from the **Aggregate Rail Ridership Forecasting** modules were presented and discussed with FTA staff. Both the "light rail" and "commuter rail" modules were used to help bound the sketch estimates of travel demand.
- Preliminary estimates of ridership using the **Madison model** were also presented. Boardings by station group were discussed to highlight the impacts of the overlapping rail service. Estimates of drive and walk access were also discussed.
- The magnitude of the **modal constant** values that should be used for the proposed rail service were discussed with FTA. The "discount" on perceived in-vehicle travel time for rail and the adjusted wait times for longer headways were also implemented as part of this round.

A third meeting was held at FTA offices on October 4, 2007. During this meeting the following five documents were disseminated and discussed with FTA staff:

- The final version of the **Market Analysis** that summarized key travel patterns in the corridor based on the analysis of the 2000 Census Journey to Work data.
- The **Transport 2020 DRAFT Report** that summarized the properties of the Madison Area model for trip generation, distribution, mode choice, and assignment. This report also documented the coefficients used in the mode choice model and discussed how the Home-based University trips were modeled.
- A full set of Quality Analysis / Quality Control Tables that were compiled to summarize the base-year and future-year socioeconomic characteristics, observed and modeled travel patterns by purpose, and the share of transit under the TSM and LPA alternatives. A total of nine key districts in the Transport 2020 corridor were used to compare the Madison model with other available data sources.

- The application of the **Aggregate Rail Ridership Forecast** approach to the Transport 2020 corridor was summarized in another technical memo. This application used both a "Light Rail" and a "Commuter Rail" approach to estimate ridership to reflect the relatively high level of service frequency that is envisioned in the corridor.
- A full set of Summit Benefits Reports that show the patterns of estimated benefits by purpose and by market segment. Two separate sets of tables were produced showing district-to-district benefits using nine and twenty-five districts in the Madison area. Accompanying maps showed the distribution of benefits in the Madison area at the zonal level.

A fourth follow-up meeting was held via teleconference on November 19, 2007. During this call, we discussed questions posed by the FTA during the October meeting. We also presented and discussed in detail the level of service characteristics for the various Build and No Build options.

- A memo summarizing all key **level of service assumptions** for the Baseline and Build alternatives was prepared. Hours of service, service frequency, location of Park and Ride lots, and the reconfiguration of the existing bus service was detailed.
- Updated **Benefit tables and maps** were produced following the new guidance by the FTA that focuses only on "travel time savings". The impact of constants was accounted for separately using different assumptions for drive access and walk access rail trips.

## ■ 3.2 Summit Reports and Maps

Summit reports and maps for the T2020 rail project are provided electronically on a CD contained in the front pocket of this submittal; hard copies of Summit reports are also provided. Key results of this user benefit analysis include the following:

The **total benefits** reflecting the difference in transportation system user daily benefits between the proposed Rail and Baseline alternatives is 69,200 minutes. This estimate is derived <u>exclusively from the model</u> and does not reflect any other benefits:

- No alternative-specific effects are included since both the Rail and Baseline alternatives use the local bus constants from the Madison model.
- No benefits due to special events are included despite the proximity of various key activity centers within the Transport 2020 corridor (Randall Camp, Kohl Center, and Monona Terrace.)
- The perceived rail in-vehicle travel time is treated as identical to the perceived weight of bus in-vehicle travel time without applying a smaller weight on the coefficient.
- All post-model estimates of benefits are calculated independently according to recent FTA guidance.

An annualization factor of 260 has been used, which represents the number of work days in a year. This is a conservative annualization factor, given that the proposed rail service will operate regularly-scheduled service six days a week<sup>1</sup>. Metro data suggest that total ridership during a typical weekend is equal to one half of the ridership during a typical weekday.

The **distribution of user benefits** also follows reasonable patterns across purposes and across travel market segments (**Tables 3.1** to **3.6**). Overall, work travel accounts for 72 percent of total daily user benefits. Approximately half of the total benefits are attributed to work-related trips that access the transit system by walking. About a quarter of all benefits correspond to work travel that relies on drive access to reach the proposed transit system.

Table 3.1 focuses on walk access work travel and suggests the following patterns:

- The majority of the benefits (75 percent) accrue to the Can Walk market. This pattern suggests that most of the benefits will accrue to Madison residents who can currently walk to transit. This is generally consistent with the existing development patterns along the Transport 2020 corridor, the existing bus service, and the proposed transit alternatives.
- A smaller percentage of benefits (24 percent) correspond to the Must Drive Market. This pattern may reflect the existing low drive access market share in Madison in the absence of an organized and visible Park and Ride system. Furthermore, the market share of drive access to bus needs to be updated by the new survey.
- There are very few negative benefits that appear in four cells of the benefits matrix.

To examine the distribution of benefits in the study area we use the nine district system shown in **Figure 3.1**. Each of these districts is drawn to correspond to different parts of the Transport 2020 corridor. These districts differentiate between the CBD and the other closer-in areas of the corridor versus the outlying areas that include East Towne at the eastern end of the corridor and Middleton at the western end of the alignment.

We should note that the district labels are used to roughly describe the collection of Traffic Analysis zones along the Transport 2020 corridor. There are two districts whose coverage is broader than what their title suggests.

- In particular, District 4 which is titled Middleton includes the Middleton zones but also includes the Far West Madison and West Towne parts of Madison.
- Similarly, District 7 is referred to as West Towne. This district could also be referred to as either Mid West or the Midvale Blvd. Corridor since it includes Shorewood Hills, Hilldale Mall, and the Sheboygan Avenue area, which is a big transit generator.

The benefits are summarized at the district-to-district level for each trip purpose in **Tables 3.1** to **3.6** and in **Figures 3.2** to **3.8**. These patterns by purpose suggest the following:

<sup>&</sup>lt;sup>1</sup> Initially, Sunday service and other special event service will be offered as demand warrants.

- For home-based work travel with walk access to transit benefits are summarized in **Table 3.1** and **Figure 3.2**:
  - o In the western part of the corridor, most of the benefits are produced in the Middleton and West Towne districts (specifically west Madison and the Sheboygan Avenue area).
  - o In the eastern part of the corridor, benefits are concentrated in the Near East and East Towne districts. These patterns are consistent with the proposed transit service improvements and benefits to the corridor's outlying areas.
  - O Areas that attract most of the benefits include the Madison CBD, the UW Campus area, and the Middleton district consistent with the transit service and stop patterns. We should note that District 8 UW Campus also includes the UW Hospital & Clinics and Veteran's Hospital which account for a lot of the benefits attracted to this district.
- For home-based work travel with drive access to the four Park and Ride lots, the benefits are summarized in **Table 3.2** and **Figure 3.3**:
  - o Most of the benefits are produced in the Rest of Dane County (especially in western Sun Prairie just east of the boundaries of District 6) and in remote western sections of the Middleton district reflecting the longer trips that are expected to benefit from drive access to the proposed Transport 2020 service.
  - o Areas that attract the majority of the benefits for this trip purpose include the Madison CBD and the UW Campus area, two key employment concentrations in the corridor.
- For home-based other travel shown in Table 3.3 and Figure 3.3,
  - Most benefits are produced in the UW Campus area and the Near West districts. At the attraction end of travel, system user benefits are concentrated in the Middleton and West Towne districts.
  - We should also note some negative benefits that appear to be produced in Middleton, Mendota/Airport and Rest of Dane County districts. The alignment of the Baseline alternative a little north of the rail line accounts for some of these disbenefits.
- The non-home-based trip purpose accounts for few benefits that are produced mostly in the West Towne and the UW Campus districts and are attracted primarily to the Campus area (**Table 3.4** and **Figure 3.5**).
- The home-based University trip purpose produces a small amount of negative benefits. This suggests that the nature of the short, local trips taken within or close to the University area by UW students will be served equally well or marginally better by the Baseline option (**Table 3.5** and **Figure 3.6**).

- In summary, the total district-to-district benefits summarized in **Table 3.6** and presented in **Figures 3.7** and **3.8** show the distribution of total transportation system user benefits both at the production end of the trips (**Figure 3.7**) and at the attraction end of the trips (**Figure 3.8**):
  - o Outlying areas such as Rest of Dane County, Middleton and East Towne account for almost 40 percent of the benefits produced.
  - o Closer-in districts that include the UW Campus area, West Towne and Near East account for an additional 47 percent of benefits produced.
  - o The distribution of benefits that are attracted by different districts point to the dominance of the Madison CBD as the most important concentration of attracted benefits due to the improved accessibility of that area.
  - Other areas in Madison that attract a significant share of benefits include the UW Campus area, Middleton, and West Towne underscoring the role that the proposed rail service will play in serving these districts.

**Figures 3.2** through **3.8** show the distribution of benefits at the Traffic Analysis zone level of detail along the proposed Transport 2020 corridor. These patterns are consistent with the summary findings discussed in this section. Some of the reductions in benefits are due to the slightly different alignment o the Baseline and the Rail alternative primarily east of the Madison downtown area.

#### ■ 3.3 Post-model Benefits

The recent guidance from the FTA differentiates between the travel time savings attributable to a proposed New Starts project and the alternative specific effects that are associated with improved new transit service such as fixed guideway rail and bus systems. The Final Guidance on New Starts/Small Starts Policies allows project sponsors that seek to introduce a new transit mode to an area to claim credits (implemented through what is commonly called a mode specific constant or effect) for the user benefits caused by attributes of that mode beyond the travel time and cost measures currently available in the local travel model.

The approach gives credit and additional user benefits based on the specific attributes of the proposed transit alternative as they are perceived by travelers. FTA will consider credits for characteristics in three categories of transit service:

**Guideway-like** characteristics can result to assigning to a new transit mode the equivalent of up to eight minutes of travel time savings. Operating reliability may account for up to four minutes, visibility and branding up to two minutes, and schedule-free service up to two minutes of travel time savings.

The second category reflects the **span of good service** and the travel time benefits can account for up to the equivalent of three minutes of travel time savings.

**Passenger amenities** is the last category of additional benefits and can account for up to four minutes of equivalent travel time savings. Upgraded and visible stations and stops account for up to 3 minutes and dynamic schedule information amounts up to 1 minute of travel time savings.

Furthermore, a discount of up to 20 percent on the weight applied to time spent on the transit vehicle (the **in-vehicle travel time** component of travel) can be used to reflect the perceived advantages of a proposed transit service that operates on its own right of way.

The difference with the prior methodology used in New Starts is that the alternative specific effect credits and the discount on travel time are applied to the calculation of user benefits only while the ridership forecasts are not affected. Furthermore, there is a distinction between the larger benefits that are expected for riders who drive to transit and the benefits that are expected for those who walk to transit.

In the Transport 2020 project we used conservative estimates of seven minutes of additional travel time savings for those who drive to transit and three minutes of additional travel time savings for those who walk to transit. These assumptions were used to calculate the total benefits for Transport 2020.

The estimated travel time benefits were originally 69,200 minutes of daily benefits (**Table 3.6**). An additional 121,600 minutes of daily benefits reflect the seven and three minutes of additional travel time savings that were assumed. This brings the transportation system user benefits to a total of 190,800 minutes of daily benefits.

These benefits are annualized resulting in an estimate of total benefits of 826,800 hours which is used in calculating the cost-effectiveness index used for this submittal.

## ■ 3.4 Travel Forecast Template

Ridership results for the T2020 rail project are presented in the Travel Forecast Template provided at the end of this section.

#### ■ 3.5 Annualization Factor

An annualization factor of 260 has been used, which represents the number of work days in a year. This is a conservative annualization factor, given that the proposed rail service

will operate regularly-scheduled service six days a week<sup>2</sup>. Metro data suggest that total ridership during a typical weekend is equal to one half of the ridership during a typical weekday.

## 3.6 Screening Process for Bus Alternatives

As documented in the alternatives analysis undertaken for the Transport 2020 corridor, a range of alternatives was identified and examined to determine which alternative best addresses the purpose and need for improvements in the corridor. These alternatives were all designed to provide comparable levels of service aimed at meeting the needs and serving the travel markets in the corridor, and included both bus and rail alternatives; bus alternatives examined included a Bus Rapid Transit (BRT) system as well as enhancements to Madison's existing highly utilized bus system operated by Metro Transit. The latter alternative was subsequently identified as the Baseline Alternative (see Section 1.0 for a definition of this alternative) which, in accordance with FTA New Starts guidelines, is used as the point of comparison for calculating the cost effectiveness of the LPA.

The BRT Alternative, which was evaluated and screened out early in the alternatives analysis process, would need to provide the same level of service as the rail alternatives via a dedicated transit lane. That dedicated lane would need to extend for the entire length of the east-west transit corridor, and buses would need priority operations at intersections of other streets. To achieve these operating characteristics, new right-of-way would be required, as opposed to conversion of existing lanes to bus-only lanes, due to the severely limited traffic capacity that now exists throughout the isthmus and east-west travel corridor. These right-of-way needs proved to be a fatal flaw for the BRT alternative, given the constrained roadway network (particularly on the Isthmus). In contrast, the LPA (as well as the other rail alternatives) provides a dedicated transit lane for the entire length within the existing railroad right-of-way and does not delay the trains at intersections (i.e., trains have priority at street intersections).

As noted above and described in more detail in Section 1.0, the Baseline Alternative represents the best that can be done to address needs in the corridor absent a major capital investment. As such, the Baseline would operate at a similar service frequency and serve the same travel markets as the LPA. On the east side, the Baseline provides a dedicated bus travel lane between the Capitol Square and Milwaukee Street (by removing existing on-street parking). However, throughout the remainder of corridor, buses would operate in mixed traffic since the conversion of travel lanes to bus-only lanes has been rejected by the community.

<sup>&</sup>lt;sup>2</sup> Initially, Sunday service and other special event service will be offered as demand warrants.

In comparison to the Baseline Alternative, the commuter rail LPA offers superior point-to-point travel times and reliability. This will become most evident over time, as development along east-west travel corridor and traffic congestion grows into the future. The rail alternative would provide attractive service not just in the plan forecast year (2030), but especially in later years – in 40, 50, 75 years from now. Travel conditions in those "out-years" will see rail corridor travel times remaining constant, while auto and bus travel times become unacceptable (as has been the experience in countless growing U.S. cities). In addition, over the course of many years, this very high level of commuter rail service and reliability will help to create an urban form and magnitude of new development along the east-west travel corridor that is unmatched by any of the other alternatives.

The estimated capital costs for the various transit options are as follows:

- Baseline Bus: \$44 million
- Bus Rapid Transit (BRT) w/dedicated bus lanes: \$192 million
- Transport 2020 Commuter Rail: \$252 million

A proper evaluation of these options should consider the true costs and benefits of each, especially viewed in light of the long term health of the community.

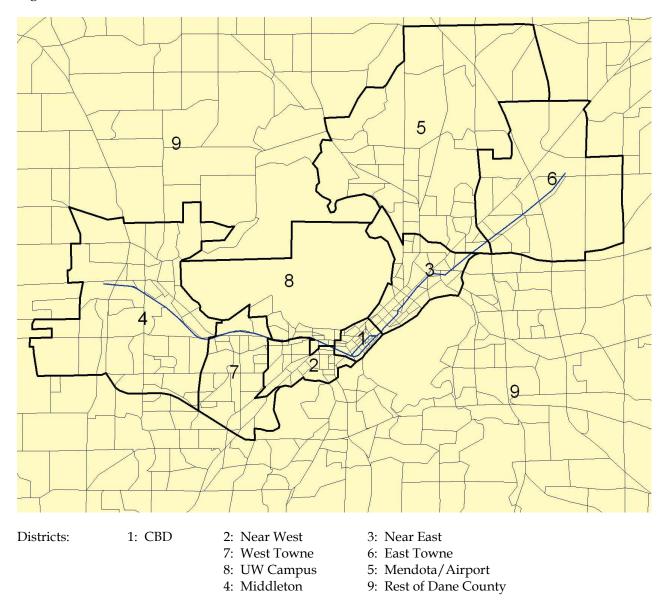


Figure 3.1. Districts in the Madison Area for Summaries of Travel Benefits

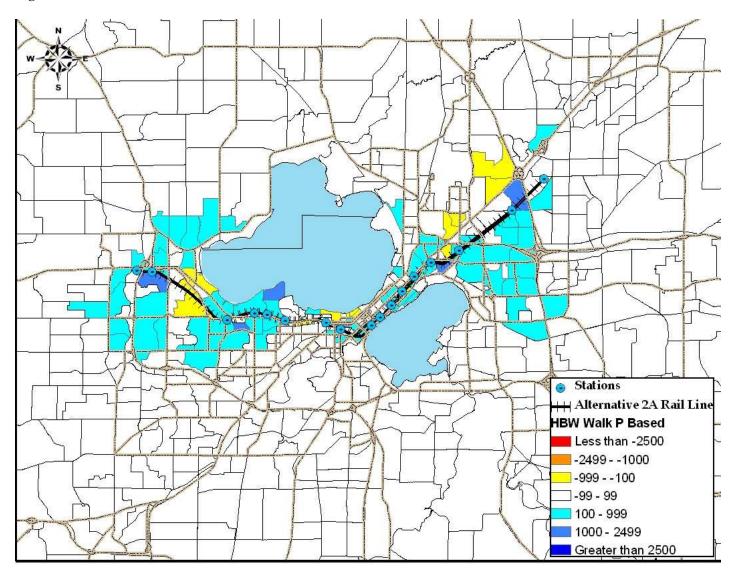


Figure 3.2. Benefits for Home Based Work Travel with Walk Access at the Production End

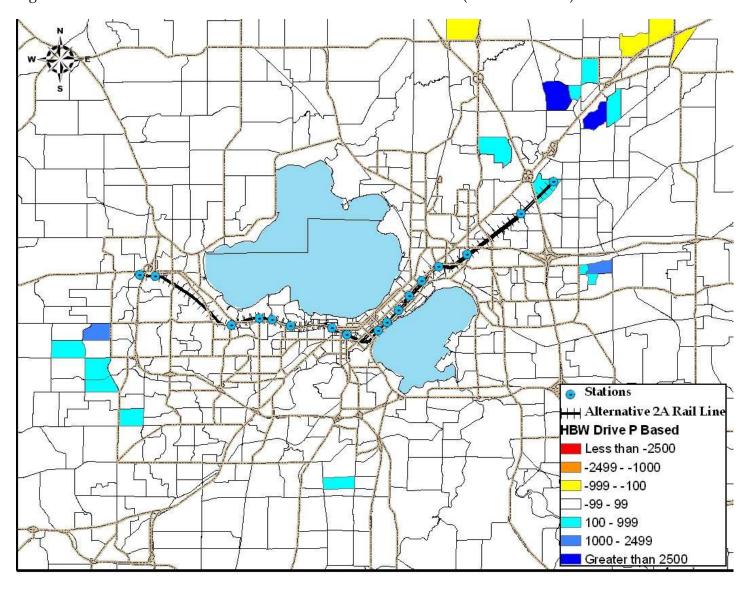


Figure 3.3. Benefits for Home Based Work Travel with Drive Access (Production End)

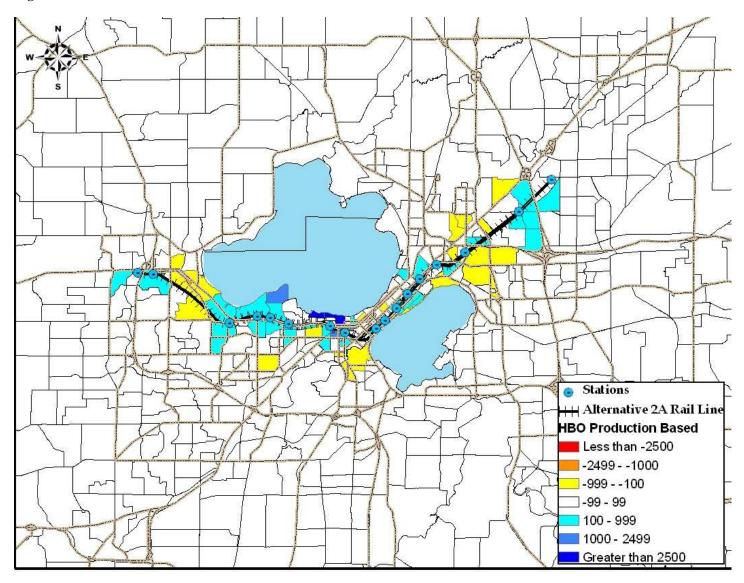


Figure 3.4. Benefits for Home Based Other Travel with Walk Access at the Production End

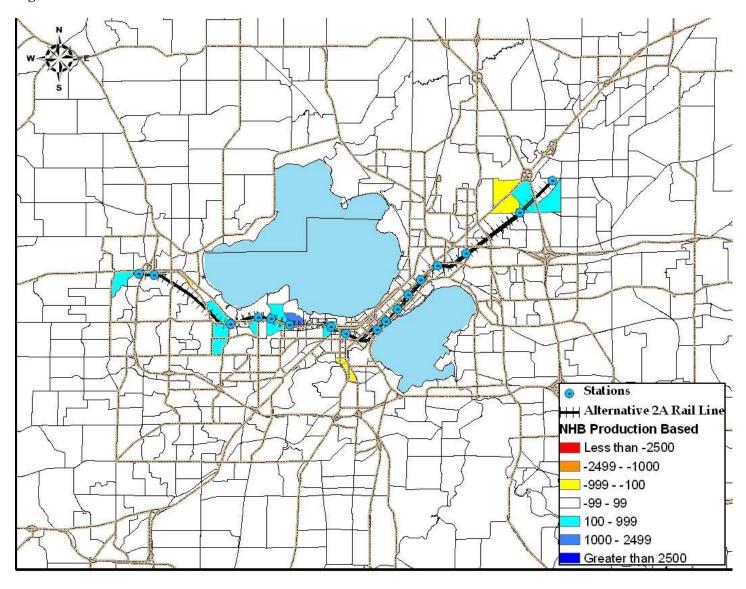


Figure 3.5. Benefits for Non Home Based Travel with Walk Access at the Production End

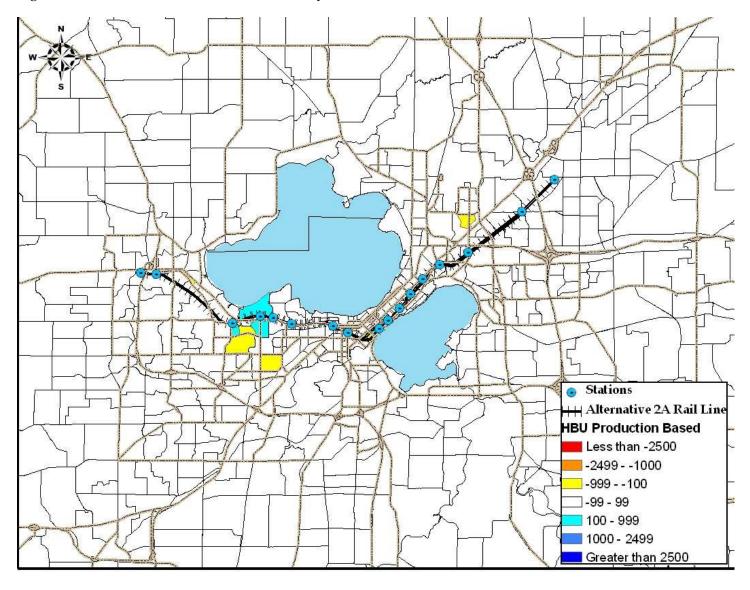


Figure 3.6. Benefits for Home Based University with Walk Access at the Production End

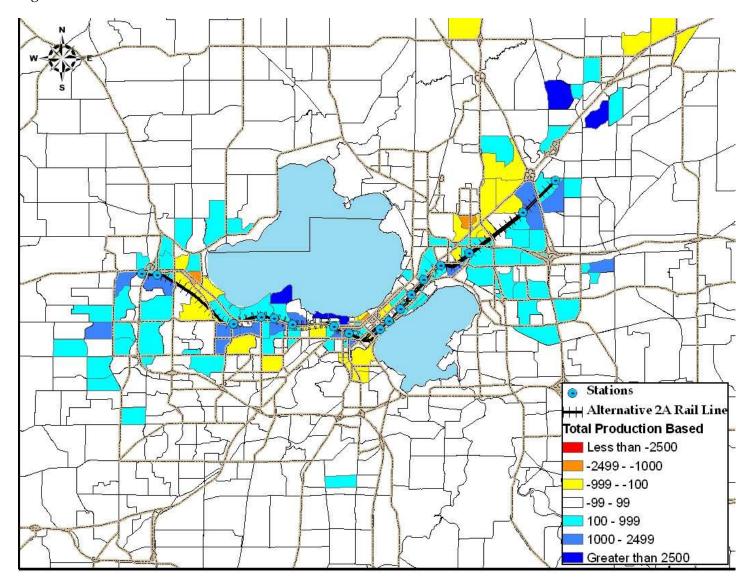


Figure 3.7. Total Benefits at the Production End of Travel

Figure 3.8. Total Benefits at the Attraction End of Travel

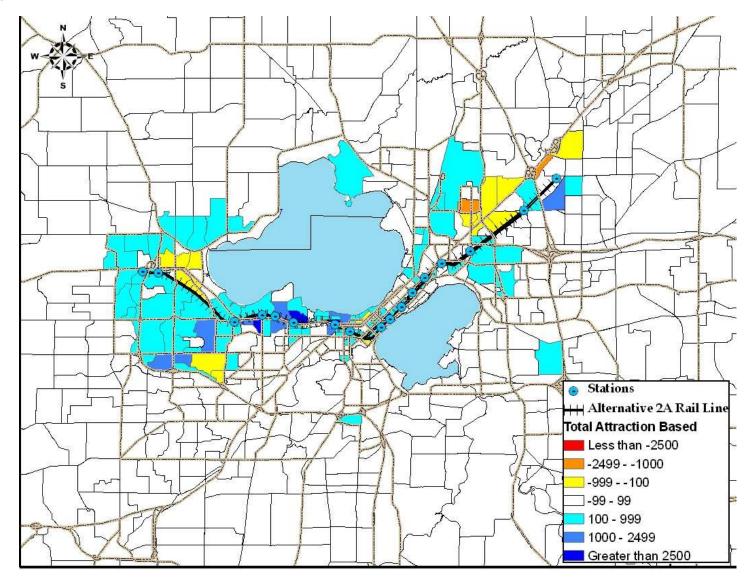


Table 3.1. Home-based Work Walk Access Benefits: Production to Attraction District

HBW Walk Access	1 - CBD	2 - Near West	3 - Near East	4 - Middleton	5 - Mendota/ Airport	6 - East Towne	7 - West Towne	8 - Campus	9 - Rest of Dane Co.	Total
1 - CBD	-364	-21	493	1,733	627	-92	739	-298	42	2,859
2 - Near West	-973	-16	-60	582	101	-75	452	276	-5	282
3 - Near East	3,617	44	287	1,472	179	-189	1,072	1,787	-200	8,069
4 - Middleton	4,746	183	182	-115	30	36	95	1,756	161	7,074
5 - Mendota/Airport	311	18	163	105	-11	-54	14	71	-245	372
6 - East Towne	2,133	173	279	260	-3	-34	255	1,008	301	4,372
7 - West Towne	2,250	187	210	90	63	33	4	1,765	160	4,762
8 - Campus	601	-13	237	188	177	-27	41	-63	69	1,210
9 - Rest of Dane Co.	2,505	186	113	465	-205	-144	342	986	148	4,396
Total	14,826	741	1,904	4,780	958	-546	3,014	7,288	431	33,396

Table 3.2. Home-based Work Drive Access Benefits: Production to Attraction District

HBW Drive Access	1 - CBD	2 - Near West	3 - Near East	4 - Middleton	5 - Mendota/ Airport	6 - East Towne	7 - West Towne	8 - Campus	9 - Rest of Dane Co.	Total
1 - CBD	0	0	0	0	0	0	0	0	0	0
2 - Near West	0	0	0	0	0	0	0	0	0	0
3 - Near East	41	1	2	3	0	0	3	4	0	54
4 - Middleton	1,442	113	114	-102	21	32	140	950	189	2,899
5 - Mendota/Airport	372	40	100	35	-41	-17	43	185	15	732
6 - East Towne	104	5	6	5	-9	-10	6	36	5	148
7 - West Towne	0	0	0	0	0	0	0	0	0	0
8 - Campus	0	0	0	0	0	0	0	0	0	0
9 - Rest of Dane Co.	6,974	855	913	736	-968	-504	734	3,400	934	13,074
Total	8,933	1,014	1,135	677	-997	-499	926	4,575	1,143	16,907

Table 3.3. Home-based Other Benefits: Production to Attraction District

НВО	1 - CBD	2 - Near West	3 - Near East	4 - Middleton	5 - Mendota/ Airport	6 - East Towne	7 - West Towne	8 - Campus	9 - Rest of Dane Co.	Total
1 - CBD	-616	-9	-178	1,380	21	207	1,079	92	86	2,062
2 - Near West	-930	158	277	3,401	-47	77	2,009	667	258	5,870
3 - Near East	7	221	272	899	28	-526	681	532	407	2,521
4 - Middleton	-374	-183	-23	-1,945	-1	6	-414	-195	-67	-3,196
5 - Mendota/Airport	-179	-7	22	-45	-36	-248	-29	-15	-523	-1,060
6 - East Towne	103	22	89	17	18	437	12	29	8	735
7 - West Towne	666	138	283	330	11	32	-578	136	138	1,156
8 - Campus	-4	-185	913	3,544	74	286	2,863	10	1,203	8,704
9 - Rest of Dane Co.	-618	-84	-682	-14	-130	-547	-54	-160	-43	-2,332
Total	-1,945	71	973	7,567	-62	-276	5,569	1,096	1,467	14,460

Table 3.4. Non Home-based Benefits: Production to Attraction District

NHB	1 - CBD	2 - Near West	3 - Near East	4 - Middleton	5 - Mendota/ Airport	6 - East Towne	7 - West Towne	8 - Campus	9 - Rest of Dane Co.	Total
1 - CBD	-915	-5	65	212	4	39	183	435	47	65
2 - Near West	-574	-7	28	116	-8	6	77	166	13	-183
3 - Near East	306	23	26	119	3	-21	97	318	26	897
4 - Middleton	126	4	22	-68	5	9	-1	95	28	220
5 - Mendota/Airport	22	2	6	2	-2	-8	1	15	-25	13
6 - East Towne	65	8	-15	10	-10	-37	7	36	-17	47
7 - West Towne	1,098	76	104	111	10	16	-31	424	49	1,857
8 - Campus	925	5	192	459	11	29	160	215	122	2,118
9 - Rest of Dane Co.	-240	-1	-35	9	-9	-30	0	-45	-2	-353
Total	813	105	393	970	4	3	493	1,659	241	4,681

Table 3.5. Home-based University Benefits: Production to Attraction District

нви	1 - CBD	2 - Near West	3 - Near East	4 - Middleton	5 - Mendota/ Airport	6 - East Towne	7 - West Towne	8 - Campus	9 - Rest of Dane Co.	Total
1 - CBD	-13	-7	-1	0	-20	0	0	-675	0	-716
2 - Near West	-8	-1	0	0	-3	0	0	-73	0	-85
3 - Near East	-6	4	0	0	2	0	0	432	0	432
4 - Middleton	-9	-17	0	0	0	0	0	-239	0	-265
5 - Mendota/Airport	2	1	0	0	0	0	0	-97	0	-94
6 - East Towne	5	5	0	0	7	0	0	117	0	134
7 - West Towne	16	41	0	0	0	0	0	525	0	582
8 - Campus	21	-12	-1	0	2	0	0	-3	0	7
9 - Rest of Dane Co.	-27	1	0	0	0	0	0	-211	0	-237
Total	-19	15	-2	0	-12	0	0	-224	0	-242

Table 3.6. Benefits Across All Travel Purposes: Production to Attraction District

TOTAL	1 - CBD	2 - Near West	3 - Near East	4 - Middleton	5 - Mendota/ Airport	6 - East Towne	7 - West Towne	8 - Campus	9 - Rest of Dane Co.	Total
1 - CBD	-1,908	-42	379	3,325	632	154	2,001	-446	175	4,270
2 - Near West	-2,485	134	245	4,099	43	8	2,538	1,036	266	5,884
3 - Near East	3,965	293	587	2,493	212	-736	1,853	3,073	233	11,973
4 - Middleton	5,931	100	295	-2,230	55	83	-180	2,367	311	6,732
5 - Mendota/Airport	528	54	291	97	-90	-327	29	159	-778	-37
6 - East Towne	2,410	213	359	292	3	356	280	1,226	297	5,436
7 - West Towne	4,030	442	597	531	84	81	-605	2,850	347	8,357
8 - Campus	1,543	-205	1,341	4,191	264	288	3,064	159	1,394	12,039
9 - Rest of Dane Co.	8,594	957	309	1,196	-1,312	-1,225	1,022	3,970	1,037	14,548
Total	22,608	1,946	4,403	13,994	-109	-1,318	10,002	14,394	3,282	69,202