APPENDIX F-D

Ridership Forecast Review

Desert Xpress Ridership Forecast Review

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Cambridge Systematics, Inc. conducted a review of the demand forecasts that have been developed for the proposed Desert Xpress high speed rail service between Victorville, CA and Las Vegas, NV. The forecasts were developed, and documented, by URS Corporation in 2005.[1] In addition to the forecasting report, Desert Xpress also provided a number of other data files and memoranda to describe the forecasting process. Among the documents provided was a summary of another review of the forecasts conducted by Steer Davies Gleave earlier this year.[2]

To evaluate the previous forecasting efforts, we reviewed the provided documents and used available at-hand information to validate the analyses. It should be noted here, first, that the general forecasting methods that have been used appear to us to be quite reasonable and represent very good demand forecasting practices as we understand them.

However, all demand forecasting efforts must contend to some extent with imperfect data, and all require analysts to make assumptions that others might find inaccurate or might question. Thus, it should not be surprising that our analysis (like the previous forecast review) raises a number of issues with the details of the forecasting effort that could affect the ridership forecasts in both material and minor ways.

The forecast review is summarized in the sections below. We begin with a short review of the overall mode choice forecasting approach that was used. We then discuss the development of the overall travel market estimates. We continue with a discussion of the mode choice model development effort and the input assumptions used in the forecasts. Finally, we discuss the induced demand analysis that was conducted in the forecasting process.

In each section, for the sake of context, we provide a very brief description of the URS forecasting methodology. Then we provide our review of the forecasting process as we understand it. This memo does not provide an updated forecast based on our suggested revisions, but where possible we identify the likely effect of changing the forecasting approach in the recommended way.

Mode Choice Modeling Approach

URS Methods

Desert Xpress ridership estimates were developed by determining the overall air, auto, and bus travel markets between Southern California and Las Vegas, and then by separately modeling the diversion of ridership from each mode to the

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[1] URS Corporation, *Desert Xpress Updated Ridership and Revenue Study: Draft Final Report* (December 22, 2005). Attached as Appendix B.

[2] Steer Davies Gleave, *Desert Xpress Ridership and Revenue Audit: Technical Memorandum – FRA Summary* (September 2007). Attached as Appendix C.

Desert Xpress with binary mode choice models. Finally, additional analyses were conducted to assess induced demand for the Desert Xpress service.

Our Review

We have used the binary modeling approach previously for forecasting high speed rail ridership, and have found it to be a reasonable approach for forecasting the demand for a new service and for accounting for the forecasts.

However, in these previous efforts with this approach, several valid issues with the method have been raised:

- The binary diversion approach can increase the difficulty of evaluating level-of-service changes to existing modes, because it will not capture shifts between the existing options. This could materially affect (positively or negatively) the rail forecasts when the rail mode is forecast to compete with the existing modes to different degrees.
- The binary mode choice models rely solely on stated preference modeling methods. Revealed preference data on actual travel choices are used only in total market estimation and perhaps for model validation. Revealed preference data are freer of survey response biases than stated preference data, so having the revealed preference data in model estimation can improve the validity of the resulting models.
- The binary diversion approach makes it more difficult to develop analytic estimates of induced demand based on the mode choice models, because the different binary models are not necessarily consistent with each other.

These limitations do not invalidate the modeling approach, but should be considered when evaluating the model-generated forecasts. The alternative approach to the binary modeling technique is the development of a multinomial model (or preferably a nested model) that includes both the full set of existing modes and the new mode.

It is difficult to assess the validity of the forecasts in aggregate by comparing them to other similar efforts, because new high speed rail systems (outside of Amtrak improvements) have not been implemented in the U.S. and because intercity corridors tend to be unique. Certainly, there are no corridors that are comparable to the Las Vegas-Southern California corridor, in terms of the reasons people travel and the geography of Las Vegas. However, it may be useful to compare the predicted mode shares of Desert Xpress with demand predictions for other intercity corridors.

URS forecast that Desert Xpress will capture 22 percent of the Southern California – Las Vegas travel market (or 24 percent of the market with the higher speed EMU alternative), and that the shares diverted from auto, bus, and air would be very similar. These shares are based on the input assumptions about the relative times and costs of the mode options, so they would vary with different assumptions, as would forecasts for other travel corridors. However, for the Desert Xpress analysis, as well as other HSR corridor studies, the analyses sought to find the best operating strategies, so there may be some validity, at least in a very simplistic way, to compare the mode share estimates of other corridors to those of Desert Xpress.

The table below shows the mode share estimates reported from some recent high speed rail market estimation efforts. The initial set of forecasts shown are taken from the FRA Commercial Feasibility Study analyses. For these forecasts and the specific studies that follow them, the mode shares shown represent the shares of all longer distance trips within the corridors shown. Thus, auto trips between intermediate locations that could conceivably be captured by the rail services are included in the mode share denominators even though there is very little likelihood that rail would be considered for these shorter trips. Since Desert Xpress will be designed to serve two large trip ends and will capture intermediate trips only if it appears commercially feasible, the comparison with the systemwide reported shares is probably somewhat biased for the auto market shares.

Forecast High Speed Rail Mode Shares From Some Recent Studies

Corridor (with HSR Top Speed; and Study Year)	Forecast Mode Share
FRA CFS Corridors	
North-South California (150; 1998)	8.6% from air; 4.3% from auto
Los Angeles-San Diego (150; 1998)	19.8% from air; 0.7% auto
Chicago Hub (150: 1998)	18.6% from air; 4.3% auto
Chicago-Detroit (150; 1998)	17.6% from air; 2.8% auto
Chicago-St. Louis (150; 1998)	22.2% from air; 5.2% auto
Florida (150; 1998)	8.5% from air; 2.3% from auto
Pacific Northwest (150; 1998)	32.0% from air; 3.5% auto
Texas Triangle (150; 1998)	17.9% from air; 5.0% auto
Specific Corridor Studies	
California Statewide (250; 2007)	33% air; 6% auto; 27% rail
Cleveland-Columbus-Cincinnati (150; 2001)	2.0% air; 1.7% auto; 16.2% bus
Boston-Montreal (110; 2005)	18% from air; 0.2% auto
Baltimore-Washington (300; 2003)	13% from air; 0.1% auto
Tampa-Orlando (150; 2003)	12% from auto; minimal air service
New York- Buffalo (150; 1995)	67% air; 6% auto; 29% rail
New York – Boston (200; 1996)	50% air; 7% auto; 15% rail

As noted above, the direct comparison of corridor forecasts is probably not completely reasonable. The wide range in forecasts are related to differing assumptions about times and costs of the HSR service and the competing modes, as well as specifics of the travel corridors themselves. The URS forecasts of air and bus diversion (about 24 percent with the base EMU service) are well within the range of the other forecasts.

The URS forecast diversions from auto of more than 20 percent for the base EMU service and DMU service are higher than forecast for the other corridors, but it should be noted that there are some peculiarities of the Las Vegas – Southern California market and the Desert Xpress service that may support the finding that Desert Xpress competes with autos to a greater degree than systems planned for the other corridors. In particular, the location of the Victorville terminal would be passed by virtually every auto traveler going between Southern California and Las Vegas. The vast majority of trip makers from Southern California to Las Vegas drive on I-15, which has two lanes in each direction for much of the route and which does not (and likely will not in the foreseeable future) have any credible parallel alternative highways across the Mojave Desert.

In addition, the need for an automobile at the Las Vegas destination is lower than for other destinations in other corridors. A significant proportion of Las Vegas visitors travel only within walking distance of their hotels. A recent survey of Las Vegas visitors performed for the Regional Transportation Commission of Southern Nevada asked respondents to report all of their travel in Las Vegas over the previous 24 hours. Of the visitors staying at hotels in the Strip area, 22 percent had not left the property where they were staying and 68 percent traveled only within the Strip area (n=1008). The same percentages for visitors from Southern California were 17 percent and 78 percent (n=214).

The initial forecasts developed by URS were based on operating assumptions for a DMU technology service with a run time of 116 minutes, a $55 fare (2005$), and 30 minute train headways. The forecasting model has since been used to analyze an EMU technology service with a run time of 100 minutes, a $50 fare (2005$), and 20 minute train headways. The EMU service is now considered to be the baseline service. The proposed high levels-of-service, especially for the EMU service, contribute to the higher forecasts of ridership when compared to other potential intercity rail corridors.

Total Travel Market

As noted above, the first step in the forecasting process is the development of forecasts of the potential ridership of the existing travel options. This was accomplished by developing base year estimates of the market size and then by applying growth rates to these market estimates to obtain future year projections.

Auto Trips

URS Methods

Due to significant inconsistencies in available data on auto travel, URS conducted additional fieldwork to better establish estimates of the overall highway travel market for the Southern California – Las Vegas travel market. The traffic count data from the State Departments of Transportation indicated significantly more vehicles entering Nevada on I-15 than the Las Vegas Convention & Visitors Authority (LVCVA) estimates of Las Vegas visitors from Southern California. To better understand the differences and estimate the percentage of I-15 vehicles that had Las Vegas and Southern California trip ends, URS conducted additional field data collection along I-15 in Baker, California. URS collected three types of data in Baker on November 10, 11, and 12th of 2005:

- Mainline classification counts;
- Ramp license plate counts; and
- Interviews at parking lots of service stations and restaurants (N=948).

Based on these Baker origin-destination data and traffic count data, URS developed estimates of the relevant auto market. The URS analysis concluded that:

- 89.2% of I-15 traffic was comprised of autos (estimated through manual classification counts);
- 80.8% of the auto traffic was comprised of California vehicles going to Las Vegas (estimated through license plate/auto occupancy observation and origin-destination surveys);
- The average auto occupancy was 2.46 persons per vehicle (estimated through license plate/auto occupancy observation);
- 12.7% of the trip makers were making day trips (estimated from data collected for a subset of the origin-destination surveys);
- 21.8% of the trip makers did not stay in public accommodations (estimated from data collected for a subset of the origin-destination surveys).

The last two of these data items were used to reconcile the I-15 traffic data based market estimates with LVCVA visitor estimates. The URS analysis concluded that there were 5,389,500 auto visitor vehicle trips and 13,258,169 auto visitor person trips that used I-15 in 2004. The LVCVA estimated that there were 7,346,595 auto visitor trips in 2004. However, the LVCVA estimates include much lower shares of day trippers and visitors not staying in public accommodations than URS measured in their surveys. So, for comparison purposes, URS showed the effect of removing the day trips and non-public accommodation trips. The result of this comparison was 8,678,074 for the URS estimate and 7,346,595 for the LVCVA estimate. The 13,258,169 person trip estimate was used for the total Southern California auto market estimate.

Table 17 of the URS Forecasting Report shows the distribution of the I-15 Las Vegas travelers. The 13,258,169 annual auto visitor person trips consist of 78.7%

Los Angeles Metro trip ends and 3.1% Victorville area trip ends, as well as an additional 7.0% of the trip ends from the San Diego area. It is reasonable that the proposed rail service would compete for these trips. Another 2.9% come from the Barstow area, which could presumably also be served by the rail system as long as a Barstow station were present. The remaining 8.4 percent of trips have trip ends north of the Southern California catchment area. These areas include Red Bluff/Anderson, Bay Area, Sacramento/Folsom, Fresno, Bishop, and Bakersfield. These trips technically might be able to be served by a Barstow Station, but the likelihood that these long distance auto travelers, who have chosen to travel by auto for a very long time rather than by traveling by air, would decide to leave their vehicles behind in Barstow, rather than to bring their auto all the way to Las Vegas, is very small.

If the 2004 auto trip estimates derived from the I-15 analyses are reduced to account for the non-Southern California travel, the comparison of the URS I-15 derived estimates with the LVCVA estimates are quite similar to each other: 8,678,074 - 1,109624 = 7,568,360 for the URS estimate and 7,346,595 for the LVCVA estimate (within 3 percent).

<u>Our Review</u>

SDG endorsed the URS overall auto estimates, but in their revised forecasting effort they reduced the base demand levels to reflect the number of trips that take place during times-of-day that the proposed rail service would not be available. This reduction is quite reasonable, in our view. The total divertable auto market should reflect the proposed DXE operating plan.[3] The Desert Xpress Enterprises operating plan is only at the preliminary draft stage, and could be adjusted to extend the operating hours, so the service could compete for the bulk of the trips in question.

In our view, and based on our understanding of the analyses conducted, we believe there are some reasons that make the total auto market forecasts based on the Baker origin-destination analyses somewhat uncertain.

First, we note that we were unable to reproduce the survey analyses reported by URS using the origin-destination survey data file provided (datafile3.xls). This may be due simply to our potential misunderstanding of the data, or our performing different data summaries than the forecasters. However, our calculated percentages of Las Vegas-Southern California trips, day trips, and non-public accommodation trips all vary by significant amounts from the results reported by URS.

Second, an important potential problem with the use of the Baker origin-destination survey data is that the surveys do not necessarily represent I-15 travelers overall. As we understand it, the surveys were performed among

[3] SDG Summary, pg. 4.

travelers who had stopped in Baker for fuel and/or food, so the implicit assumption is that the characteristics of those that stopped in Baker are the same as those that did not stop there. We believe it is more likely that short trips are underrepresented in the survey, because people traveling shorter distances will have less need to stop along the way. It is difficult to say how the mix of Las Vegas travel and through trip travel could be affected by the survey limitation. Through-trip makers may stop in the Las Vegas area, because of the large number of food and fuel options, and then be less likely to stop in Baker, but on the other hand, Las Vegas visitors may be less inclined to make a stop in Baker than those traveling longer distances. However these tendencies play out, they could have a significant effect on the estimates derived from the survey, and the assumption that the travelers that stopped are similar to those that did not is somewhat speculative. It is possible that this question could be resolved through additional survey work using an alternative data collection approach as the Applicant takes the analysis to the Investment Grade level.

Another potential problem is that the origin-destination work was performed on a Thursday, Friday, and Saturday, and expanded to Sunday and the other weekdays. The expansion to include Sunday has not been detailed for us, but the percentage of traffic that is made up of Las Vegas visitors was estimated to be the highest on Sunday. The Thursday survey data were used to expand Monday through Thursday. The I-15 traffic counts indicate that the average daily traffic volumes at the state border for Mondays through Thursdays are similar to each other. However, there is evidence that Monday through Wednesday travel to Las Vegas is much lower than Thursday or the weekend days. More than four-fifths of respondents to the RSG stated preference survey that was used for the mode choice modeling indicated that they traveled between Thursday and Sunday.[4] For that sample, more of the respondents traveled on a Thursday than on Mondays, Tuesdays, and Wednesdays, combined. LVCVA estimates that Southern California residents are 25 percent more likely to arrive on Thursday than on Monday and 67 percent more likely to arrive on Thursday than on Tuesday. LVCVA estimates the number arriving on Wednesday to be roughly the same as on Thursday.[5] By expanding the Thursday data to be representative of the four weekdays, visitor trips can be overestimated.

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[4] CS analysis of data provided in DesertExpress_SPSurvey.dbf.

[5] LVCVA, *Las Vegas Visitor Profile Calendar Year 2004 Southern California and International Visitors Version: January 1, 2004 to December 31, 2004.*

Air Trips

<u>URS Methods</u>

For the development of base year air passenger volumes, URS appears to have relied on a combination of sources, including McCarran Airport (LAS) enplanement data and the U.S. Department of Transportation Origin & Destination database (referred to as the FAA travel survey in the URS report). The U.S. DOT origin-destination ten-percent sample database includes actual ticket information for 10 percent of the tickets processed by large air carriers (airlines operating flights with more than 60 seats). Commuter and regional airlines are not required to provide the Department with ticket sample data, but sometimes do so because of integrated operations with large air carriers.

URS chose not to rely solely on the U.S. DOT data because they found that "not all airports had a ten percent sample."[6] Instead, they used the ticket sample data to "establish the percentage of trips headed to LAS from each airport, and then multiplied this percentage by the annual air traffic activity reported for each airport for 2004".

<u>Our Review</u>

The discrepancy identified by URS was most likely primarily the result of missing commuter and regional airline data and of sampling error, rather than the result of unknown problems with the database. Therefore, the ten percent sample estimates for specific origin-destination pairs from the database are likely to be minimum numbers of passengers (within normal sampling boundaries). These passenger numbers are all higher than the URS estimates for Long Beach, Burbank, Ontario, and Orange County.

One way to account for the missing commuter and regional airline passengers in the ten percent sample data is to examine another U.S. Department of Transportation database, the T-100 database. The T-100 Domestic Segment Database provides monthly supply and demand information on all direct flights between U.S. airports, and the T-100 Domestic Market Database provides demand summaries for passengers boarding and de-boarding aircraft. The T-100 data are actual counts, as opposed to sample data, and include all scheduled airline services. However, the market definition used in the T-100 database does not allow one to capture true origin-destination travel, because individual segments for connecting traffic are included. By comparing the origin-destination data and ten percent sample by airline, one can identify significant undercounts within the origin-destination data due to missing commuter/regional data. For the Las Vegas-Southern California airport pairs,

[6] URS Report, Page 19.

we did not find any major sources of missing commuter/regional data. Therefore, we maintain that the best publicly available estimate of the air passenger demand in this market is the U.S. DOT 10 percent sample data, balanced by direction.

The differences between the URS air travel estimates and our recommended estimates is shown in the following table.

Table 1. Year 2004 Air Passenger Estimates

Airport Pair	URS Estimate (2004)	Estimate Based on U.S. DOT Data	Difference
LAX – LAS	745,569	672,740	-10%
LGB – LAS	82,605	90,575	+10%
BUR – LAS	326,145	377,900	+16%
ONT – LAS	205,426	216,775	+6%
SNA - LAS	213,571	242,295	+13%
TOTAL	1,573,315	1,600,285	+2%

Sources: URS Report (page 19); Cambridge Systematics, Inc analysis of U.S. DOT Aviation statistics, obtained from the Bureau of Transportation Statistics website, November 2007.

The overall estimates are similar, but the distribution between Southern California airports vary measurably and will affect the assumed distribution of air passenger trip ends and therefore the high speed rail forecasts. Since the proposed Victorville rail service is likely to be more competitive in attracting passengers who would otherwise use airports that are more accessible to points in Southern California than LAX, it is reasonable that changing the distribution as the U.S. DOT data suggest would lead to higher ridership estimates for the rail service. A more detailed analysis would be required to confirm this supposition though.

Bus Trips

To analyze the potential diversion of passengers from charter bus services to the proposed high speed rail service, URS used past survey data and proprietary data from past URS analyses of the charter bus market. The surveys were used to size the overall market, and the past charter bus analysis allowed them to make conjectures about mode choice behavior. While the approach used was less analytical than for the air or auto diversion estimation, it is certainly understandable because of the difficulty of obtaining market data for these bus services. These data are typically almost impossible to get, and the fact that URS had access to some of these data probably indicates that their analysis was superior to similar estimates for other U.S. intercity rail corridor passenger demand efforts.

SDG notes that for their new ridership forecasts, they have taken a more conservative view on the amount of traffic that might be captured from bus, but they do not seem to have had any issues with the overall travel market size.

Las Vegas Forecasts

URS Methods

Long term forecasts were related to projections of Clark County population through 2040. URS forecasts growth of 4.0 percent for the 2015 to 2019 period; 2.3 percent for the 2020 to 2029 time period; and 1.2 percent for the 2030 to 2040 time period.

The annual growth projections for the Clark County population cited by URS reduce over time from 4.9 percent in 2006 to 2.7 percent in 2015 to 1.3 percent in 2025 and finally to about 1.1 percent for the longer term. According to URS, the Center for Business and Economic Research expects an annual growth for 2020 of 1.2 percent, declining to 0.9 percent by 2035.

URS forecast short term growth in Las Vegas visitation from Southern California by assuming the growth would be proportional to the increase in projected hotel rooms over time. URS assembled an inventory of hotel and casino development plans, and used these projections to forecast visitation through 2014.

SDG deemed the growth forecasts to be reasonable.

Our Review

The URS long-term growth rate is slightly higher than the sources, but the consistent strong growth rate for Las Vegas development and visitation over the past 30 years probably explains the optimism. We believe that the forecast assumptions fall in a reasonable range.

Southern California Forecasts

URS Methods

URS allocated the Southern California trip ends based on 2000 and 2004 population estimates disaggregated to the ZIP code level that had been developed by the State of California Department of Finance. Population projections by County for 2012 were also obtained from the Department of

Finance. The projections were disaggregated to the ZIP code and "SuperZip" levels using the ZIP level relative growth rates between 2000 and 2004.

Our Review

We believe a better source of small area forecasts for the Southern California region than the disaggregated Department of Finance estimates is available from the Southern California Association of Governments (SCAG). SCAG maintains these projections to support their regional travel demand modeling and other planning efforts. They are informed by the state's county level forecasts, but they also rely on more detailed local data, such as building permit data and zoning regulations. Based on our data summaries of the SCAG demographic databases, the SCAG projections imply different growth rates for the ZIP level and SuperZIP level estimates of population than the URS projections, so it is our belief that the Southern California trip tables could be improved through the application of the SCAG data. The net effect of using these data on the high speed rail forecasts is difficult to say, but they should improve model accuracy.

Assessment of the Potential Effects of the Identified Issues

In summary, our review of the total travel market estimates performed by URS identified several issues that could materially affect the ridership forecasts.

We believe there were potential biases in the auto trip data collection effort that could result in uncertainties in the estimates of base year trips. The issues noted above with the expansion of trips to the different days-of-week could cause auto trips to be overestimated by a few thousand trips per average day.

The overall effects of relying only on stopped traffic in Baker for the auto analyses is potentially larger than the issue related to the survey days. However, the stopped-traffic issue could affect the estimates in either direction. Arguments could be made for either an underestimation or overestimation of Las Vegas travel due to this issue.

Therefore, we would estimate that the combination of these issues means that the high confidence range of trips in the auto travel market probably ranges between about 10 percent more than the URS estimates to 20 percent less than the URS estimates.

Overall air trip estimates were found to be similar to what we would estimate using the U.S. DOT data, but we believe the distribution of trips by Southern California airport will be different than forecast by URS, with fewer LAX trips and more trips from/to the other Southern California airports. Because air service from these other airports is projected to be slightly better than for LAX, the rail mode would be expected to be divert slightly fewer trips from air, all else being equal. This effect is likely to affect the total air travel market by something less than about 5 percent, so a high confidence range would probably be between five percent less than the URS forecasts up to the URS forecasts themselves.

Lacking any data to evaluate the bus trip estimates, we believe the URS estimates are probably reasonable. However, SDG's recommendation to adjust the total travel markets (air, auto, and bus) downward to account only for trips made while the rail service is operating seems quite reasonable to us. The size of these adjustments may not be significant if the Desert Xpress operating service plan is adjusted to match the demand profile of the other modes.

The URS forecasts for Las Vegas growth are higher than the sources they used in developing the forecasts, but we believe the forecasts are in a reasonable range based on the past trends. Because of the difficulty in forecasting growth in general, we believe sensitivity testing of potential growth scenarios as URS seems to have performed already are a good idea. Based on our review of SCAG data, it appears that the distribution of Southern California trip ends in the future could be significantly different than projected by URS. It is not possible to determine the quantitative effects of the different future distributions without re-application of the model, but it would not be surprising for the growth assumptions to affect the forecasts by up to five percent or so.

Mode Choice Model

URS Methods

To estimate the mode diversion from auto and air to the proposed high speed rail system, URS developed stated preference models based on a web-based survey of 400 Southern California participants in an Internet survey panel. The survey work was conducted by Resource Systems Group, using their Survey Café Panel. The survey respondents consisted of people who had actually traveled between Southern California and Las Vegas, so they had direct knowledge of the relevant travel decisions. Based on the survey data, binary logit choice models were developed for the choice between auto and high speed rail and for the choice between air and high speed rail.

The surveys consisted of screening questions to determine whether a potential respondent lived in Southern California and had ever traveled to Las Vegas. Those respondents who had made trips in the past were asked details about their most recent trips. They were then provided a description of the proposed high speed rail service and asked to complete six tradeoff exercises in which they were given hypothetical options to travel by their most recent mode or by the rail mode with varying travel attribute levels. The choice attributes and range of levels for each mode option are shown in the table below.[7]

[7] LVHSR_CBCDesign.xls.

Table 2. Stated Preference Exercise Attribute Levels

Current Mode - Auto	Current Mode - Air	Proposed Rail Service
Access and Wait Time		
N/A	Current Time * 0.9	Time to get to Victorville * 0.9
	Current Time * 1.0	Time to get to Victorville * 1.0
	Current Time * 1.1	Time to get to Victorville * 1.1
	Current Time * 1.2	Time to get to Victorville * 1.2
Access Cost		
N/A	Base Access Cost * 1.00	Cost to get to Victorville * 1.00
	Base Access Cost * 1.05	Cost to get to Victorville * 1.05
	Base Access Cost * 1.10	Cost to get to Victorville * 1.10
	Base Access Cost * 1.15	Cost to get to Victorville * 1.15
Main Mode In-vehicle Time		
Current Time * 0.9	Current Time * 0.9	Estimated Rail Time * 0.9
Current Time * 1.0	Current Time * 1.0	Estimated Rail Time * 1.0
Current Time * 1.1	Current Time * 1.1	Estimated Rail Time * 1.1
Current Time * 1.2	Current Time * 1.2	Estimated Rail Time * 1.2
Main Mode Cost		
Base Cost * 1.00	Base Cost * 1.00	$40
Base Cost * 1.05	Base Cost * 1.05	$50
Base Cost * 1.10	Base Cost * 1.10	$60
Base Cost * 1.15	Base Cost * 1.15	$70
Egress Time		
N/A	30 minutes	10 minutes
	45 minutes	20 minutes
Egress Cost		
N/A	$5	$5
	$10	$10
Service Frequency		
N/A	2 flights every hour	2 trains every hour
	1 flight every hour	1 train every hour
	1 flight every 2 hours	1 train every 2 hours
	1 flight every 4 hours	1 train every 4 hours
Reliability – 1 out of 3 trips late		
Travel time * 1.05	Travel time * 1.05	Travel time * 1.03

Current Mode - Auto	**Current Mode - Air**	**Proposed Rail Service**
Travel time * 1.1	Travel time * 1.1	Travel time * 1.05
Travel time * 1.2	Travel time * 1.2	Travel time * 1.1
Travel time * 1.3	Travel time * 1.3	Travel time * 1.15
Reliability – 1 out of 20 trips late		
Travel time * 1.32	Travel time * 1.32	Travel time * 1.2
Travel time * 1.4	Travel time * 1.4	Travel time * 1.25
Travel time * 1.48	Travel time * 1.48	Travel time * 1.3
Travel time * 1.56	Travel time * 1.56	Travel time * 1.35

The levels for each attribute were varied according to a pre-established experimental design in order to measure how respondents make tradeoffs between the different attributes.

The resulting mode choice models based on these hypothetical choices were summarized in the URS Report in Tables 21 and 22, and seem to have been updated since then for forecasting. The model parameters in the spreadsheet, HSR_MC13_LVTransParty_Alt1.xls are shown below.

Table 3. Stated Preference Model Parameters

Las Vegas High Speed Rail Stated Preference Survey
Draft model for binary choice between AUTO Travel and Las Vegas HSR

Variable	Label	Units	Estimate	Standard Error	T-Ratio	VoT
Travel Time	Time	Minutes	-0.005	0.001	-6.3	$ 8.55
Cost of Travel	Cost	$*	-0.038	0.002	-18.3	
Reliability (Average Minutes Late)	RelAvMins	Minutes	-0.004	0.005	-0.9	
Distance to Victorville	AcDist	Miles	-0.003	0.003	-0.9	
Frequency - 2 per Hour	Freq2pH	(0,1)	0.721	0.138	5.2	
Frequency - 1 per Hour	Freq1pH	(0,1)	0.609	0.137	4.4	
Frequency - 1 per 2 Hours	Freq1p2H	(0,1)	0.349	0.140	2.5	
Frequency - 1 per 4 Hours	Freq1p4H	(0,1)	0.000	0.000	0.0	
Current Mode Constant	cmcon	(0,1)	0.194	0.277	0.7	

Number of Observations	2400
Number of Respondents	300
Log Likelihood	-1299.21

* Cost of travel is total cost of travel divided by party size
The model was NOT improved by transforming cost by household income

Notes
Reliability is specified for just the auto alternative and is in terms of average minutes late. It has the correct sign and a reasonable magnitude (i.e. it
Sensitivity to in vehicle time was found to be statistically similar to access and egress time

Las Vegas High Speed Rail Stated Preference Survey
Draft model for binary choice between Air Travel and Las Vegas HSR

Variable	Label	Units	Estimate	Standard Error	T-Ratio	VoT**
In Vehicle Time	IVTime	Minutes	-0.012	0.005	-2.4	$ 30.44
Access, Wait and Egress Time	AcEgTime	Minutes	-0.025	0.004	-5.6	$ 60.69
Cost of Travel	Cost	$*	-0.104	0.015	-7	
Reliability (Average Minutes Late)	RelAvMins	Minutes	-0.018	0.020	-0.9	
Current Mode Constant	cmcon	(0,1)	-0.243	0.317	-0.8	

Number of Observations	408
Number of Respondents	51
Log Likelihood	-204.21

* Cost of travel is total cost of travel divided by party size and divided by log of household income in thousands
The model was significantly improved by transforming cost by 1/log(income), indicating that cost sensitivity is inversely proportional to the log of income

** VoT is evaluated at $70,000 per annum household income

Notes
Reliability (represented here as average minutes late) has the correct sign and a reasonable magnitude (i.e. it is similar to the other time coefficient in the model), but it is not statistically significant

A specification has not been found that shows frequency to be statistically significant

RSG tested the sensitivity of the model to the coefficients by randomly varying the parameters according to the model estimates and their standard errors.

Our Review

SDG concluded that the surveys provided "useful insights into the potential of capture of the new rail service," but they raised doubts about the robustness of the SP analysis, and pointed out some concerns about the data collection and modeling effort, including:

- High number of choice attributes in the survey added complexity to the choice exercises;
- Representation of reliability in the choice exercises was also particularly complicated;
- Attributes focused on time and cost components of choice, and did not address less quantitative choice attributes;
- The rate of non-trading (respondents that chose the same mode in all exercises) was too high;
- Choice model is not sufficiently sensitive to changes in relative generalized costs.

Because of these concerns, SDG performed additional survey work to modify the mode choice models, but they did not report the resulting changes in the mode choice model parameters that they recommended.

We agree with SDG's overall concern and specific issues regarding the stated preference modeling. In addition to the SDG issues, we have the following concerns about the stated preference modeling.

Regarding survey sample:

The web panel sample approach was likely chosen for ease-of-use, and the particular panel used has a good reputation, but because of the panel's size, the screening for this survey was very limited. Anybody who had ever traveled to Las Vegas was included, regardless of when or how frequently they traveled. About 8 percent of the respondents had traveled to Las Vegas once, and almost a quarter of respondents had not made a Las Vegas trip within the past year. This probably means that the results of questions about trip details are more vulnerable to recall error than in most transportation surveys, and it raises the question of whether many respondents provided relevant choice information.

Even with the liberal definition of Las Vegas traveling respondents, the sample sizes for the stated preference survey analysis are small. The stated preference analysis is based on 300 auto respondents, but only 51 air respondents. Ideally, we would like to see at least 150 to 200 respondents for each mode. This issue could be addressed with additional survey work when the Applicant takes the forecasts to Investment Grade.

Eight choice exercise responses from each respondent were obtained to increase the base number of choices used in modeling, but the choices from a single individual will be correlated with each other. One consequence of this is that the model derived estimates of parameter standard errors are understated. This means that while the parameter estimates are unbiased, the level of uncertainty in their values is higher than is indicated in the URS and RSG documentation. Thus, unless RSG has recalculated the model parameter standard errors, their parameter sensitivity analyses understate the size of the model confidence intervals. The model results are less precise than the reported analysis indicates.

Regarding choice exercise design:

In general, the attribute ranges used in the stated preference choice exercises seem reasonable, except that the auto costs that were tested in the exercises appear to be higher than the costs that are typically assumed to be considered by auto travelers. The stated preference survey documentation provided in the file DX0321 Survey Info.doc indicates that auto operating cost levels for the tradeoff exercises were in a range between $0.25 to $0.29 per mile. Usually, auto travelers will consider their cost of travel to be only their out-of-pocket gas costs. Thus, in most intercity travel models, auto costs are generally in the range of $0.10 to $0.15 per mile. While higher per mile costs are more consistent with the true costs of driving (including operating, maintenance, and ownership costs), they are generally not considered by travelers for specific travel decisions.

As a result of the presentation of the higher range of operating costs, the measured perceived value-of-time was constrained to be in the higher range. Since the resulting models appear to be generally reasonable for most parameters with the perceived auto cost of $0.26 per mile, it is possible that these model results are valid, but because a lower range of auto cost levels were not included in the experimental design, it is not possible to know whether more conventional auto operating cost assumptions would change the modeling results. The auto costs presented in the choice exercises would have looked surprisingly high to respondents, and might have led to higher rejection of the auto option than would occur in reality, and may have led respondents not to consider the other attributes as much as they would if the experiment were more realistic to them.

On the other hand, the survey research was performed at a time when gasoline prices were significantly lower than they are now and when auto operating costs were less in the forefront than they are now. As the analyses of the system are taken further, additional survey work could help to shed light on this issue.

Regarding choice model estimation:

The model parameters are all of the right mathematical sign, and were not constrained in model estimation. In addition, the relative magnitudes of the parameters compared with each other seem reasonable. The reported values-of-time are in line with expectations based on other intercity travel studies.

We did find the reliability model parameter curious as it does not reflect the way in which the concept was presented to respondents in the choice exercises. Respondents made their hypothetical choices after being provided information about the distribution of delays (one in three chance of being some number of minutes late and one in 20 chance of being some other number of minutes late), but in model estimation this information has been transformed into a single average delay time. This transformation may have produced more desirable model specifications than analyzing the parameters as they were presented to respondents, but it is based on implicit assumptions about how people quantify reliability that are not fully supported by the survey data.

The reported sensitivity runs performed by URS and RSG produced results that seem reasonable based on our understanding of intercity travel markets. For instance, a 10 minute increase in the assumed rail time resulted in a 4.7 percent decrease in rail ridership. A 20 minute increase in the assumed rail time resulted in a 11.2 percent decrease. The sensitivity to rail travel time is important because of the proposed use of Regina EMU train sets, a different train technology than URS initially studied that would reduce train travel times to about 100 minutes, rather than the 116 minutes used in the URS initial forecasts. The reasonableness of the model sensitivity runs for train travel times leads us to conclude that the mode choice model can correctly account for the general magnitude of increased ridership that would result from the use of the EMU train sets.

Assessment of the Potential Effects of the Identified Issues

A number of potential mode choice modeling issues were raised by SDG and by ourselves. For most of the identified issues, the bottom line effects of the issues are not obvious. It would require additional data analyses and possibly additional data collected, such as SDG seems to have done, to address these issues. Therefore, unless additional analyses are performed, our review would indicate a wider range of uncertainty in the mode choice model parameters than has been suggested by previous URS and RSG sensitivity analyses.

For the most part, we cannot really determine whether improvements along the lines of the issues identified would have a positive or negative effect on the mode choice forecasts, and probably there would be some cancellation of the effects to some degree. Some improvements may increase potential rail mode shares, while others may dampen them.

To test the sensitivity of the model to individual model parameters, RSG performed Monte Carlo simulation, varying parameter estimates based on assumed distributions of those parameters that were developed by examining the model estimation results. We would recommend that these analyses be performed assuming a much wider range of potential parameter estimates, reflecting the sampling, sample size, and error-measurement issues raised above.

Model Application

URS Methods

To develop forecasts of the mode diversions, URS applied the mode choice models using estimates of the characteristics of the competing modes. For application of the mode choice model, URS made numerous assumptions about the attributes of the rail system and the competing auto and air modes.

The high speed rail attributes used in model application reflected the actual operating plans of the system at the time of the forecasting, while the air and auto assumptions are based on existing service levels, the survey input assumptions, and some other available sources. The treatment of the model input assumptions for each mode in the two choice models are summarized in the URS Report and in the spreadsheet HSR_MC13_LVTransParty_Alt1.xls.

SDG's subsequent analysis of the operating plan and train simulations led them to suggest improvements to the high speed rail assumptions, including significantly improved travel time between Victorville and Las Vegas of 100 minutes, as compared to the initial URS forecasting assumption of 116 minutes. The baseline assumptions for the rail service were updated later to reflect an EMU based service. The revised forecasts are summarized in a January 7, 2008, memorandum from Desert Xpress Enterprises.

SDG did not comment on the input assumptions for the other modes.

Our Review

URS's auto travel time assumptions were developed using highway network data from the Orange County Transportation Authority (OCTA) model with URS improvements to congested network speeds. For our review, we compared the network times with skim times from the SCAG model and to selected MapQuest driving time estimates. The URS auto travel times to Victorville were found to be very reasonable.

URS used real time congestion estimates and studies of specific bottleneck locations to quantify the level of auto delay that could be experienced by those traveling by auto to Las Vegas, Victorville, and the airports. This approach is judgmental, but is probably necessary as current planning tools do not account for non-recurring congestion well. The base delay estimates are probably in a reasonable range, generally, and the delays are all assigned west of Victorville, meaning that they are experienced by modeled high speed rail customers as well as modeled auto travelers. The Desert Xpress modeled ridership does not benefit from assumptions about auto congestion that might occur between Victorville and Las Vegas. Many survey respondents indicated that they experienced congestion on this segment of I-15, and such congestion may become more common as travel volumes increase over time. So, the assumption of no future delays on this segment can be considered conservative.

We also believe that the URS assumptions regarding Las Vegas access to the Desert Xpress system and connectivity with the monorail are reasonable.

On the other hand, we have identified the following issues with the model application input assumptions.

We disagree with the way that URS has defined air delay for the model application. URS develops their definition by combining different components of terminal processing times, including security checkpoint delays, counter, and curbside delays; as well as auto access delays. However, these are not the components that most travelers would designate as delays. In our view, these time components should be considered in the definition of air service levels, but are more appropriately included as part of the access, egress, and wait time of the air journey, rather than as delay time. Because the airlines are operating on schedules, air passengers build the uncertainty in terminal times and potential access time into the amount of time that they arrive early at the airport. Because passengers have reserved this time already, increased variability in these times are only a problem if they are large enough to overcome the amount of time that the passengers have reserved for them (and cause them to miss or almost miss a flight).

A better measure of air delay that more closely corresponds to the unexpected delay concept that was presented in the stated preference exercises is airline on-time performance. The U.S. Department of Transportation records the on-time performance of all domestic airline flights. For this review, we summarized the 2004 airline on-time data for Las Vegas-Southern California flights.

Table 4. Airline On Time Performance, 2004

Origin	Destination	Average Delay in Minutes	Percent Delayed More than 15 Minutes	Percent Delayed More than 30 Minutes
BUR	LAS	9.8	18.1%	10.3%
LAS	BUR	13.6	26.5%	13.9%
LAX	LAS	11.3	21.9%	12.4%
LAS	LAX	11.2	21.2%	12.3%
LGB	LAS	6.4	9.8%	5.5%
LAS	LGB	6.8	10.5%	6.0%
ONT	LAS	10.2	19.4%	11.3%
LAS	ONT	13.7	28.4%	15.4%
LAS	SNA	8.9	19.5%	10.3%
SNA	LAS	9.9	19.2%	11.3%
All Airport Pairs		11.1	21.4%	12.1%

Source: Cambridge Systematics, Inc analysis of U.S. Department of Transportation On-Time Performance Database, obtained from the Bureau of Transportation Statistics website, November 2007.

We believe that air delay should be represented in the model in this way, rather than by the measures employed by URS. If the advance time that travelers build into trips to avoid missing flights is included, it is more appropriately included as a component of the access, egress, and wait time.

At the same time, if the high speed rail system is operated using advanced ticketing, then high speed rail passengers will need to build a similar allowance into their trip time. While this allowance may not need to include any security checkpoint time, the longer access distances to Victorville, as opposed to the airports, will affect the variability in travel times, and therefore the amount of time that people will feel necessary to reserve. The current assumption of 10 minute transfer times in Victorville is reasonable if passengers can board any train when they come to Victorville and if train headways are 20 minutes or less. It is unclear to us how the Desert Xpress reservation system will work, but it is our understanding that headways will only be this frequent on Fridays and Sundays, so many or most travelers would experience longer transfer times. The fare and reservations policies for the proposed system are still under development, and more sophisticated yield management based approaches are under consideation, so it is difficult to judge the reasonableness of the wait time assumptions at this point.

As discussed above, travelers will rarely consider the full range of auto operating costs in their trip decisions. Most regional and intercity models assume auto operating costs that are about one-half of what was used by URS. Given that the model was estimated with the higher auto costs, it would be inappropriate to forecast the auto costs so much lower, but it is important to note that this input assumption could have a significant negative effect on the assumed competitiveness of the auto mode.

Finally, it is our belief that the aggregate manner in which the model is applied introduces bias into the forecasts. The estimated model relies on both household income and travel party size as part of the cost term. This means that even when trips begin and end at the same zones, the probability of selecting the high speed rail mode will be different for travelers with different party sizes and household incomes. In URS's model application, zone average and median values of these characteristics are used, so the estimated variations in choice probabilities are lost. Typically, aggregation bias has a small but measurable overall effect on forecasts, and this bias may diminish the usefulness of the forecasts in understanding specific origin-destination travel markets.

Assessment of the Potential Effects of the Identified Issues

The two forecasting issues that have been identified that we believe cause the estimated mode shares for rail to be overstated to some degree are the use of a very high auto operating cost and the measurement of travel delay for air and rail.

Perceived auto costs are probably significantly lower than modeled. Since the model was developed using the higher costs per mile and the rail mode is affected by auto costs for the significant access portions of the trip, the effect of the higher auto costs in the model are muted to some extent, but the model appears to us to be penalizing auto travelers to a larger extent than other similar models would. Likewise, the way that delays and wait time are modeled does not capture how travelers would actually perceive these times and make choices based (in part) on these times. In our view, the auto cost assumptions and delay/wait time assumptions could affect forecasts of rail trips by more than 10 percent.

The model application zone aggregation issues raised above could affect the ridership estimates in either direction, so it is difficult to know how they could affect the estimates.

Induced Demand

URS Methods

Based on the Baker survey data results, URS determined that a special induced day trip market for the proposed high speed rail service might develop. The analysis of this potential market segment is described in a URS memorandum.[8]

[8] URS Corporation, Frequently asked Questions: Induced Day Trip Forecasting Methodology—Interim Report (October 12, 2006).

For their review, SDG "adjusted downwards the estimated level of induced number of day trips," but they did not elaborate.

Our Review

While it is likely that the introduction of a new high quality service such as that envisioned by Desert Xpress will induce a small number of intercity trips between Southern California and Las Vegas, we are not convinced the day trip analysis conducted by URS is the best means to estimate this induced demand.

In our view, the Baker Survey data do not provide compelling justification for defining a new travel market, because 1) the survey sample size was smaller than we would like to draw market conclusions; and 2) the survey technique used to measure interest levels was necessarily simplified to accommodate the survey data collection procedures. Based on our analysis of the Baker survey data, a total of 115 Las Vegas traveler respondents were asked:

"If there were a high speed train from California to Las Vegas, would you consider a one-day trip on this train?"

Of these only 12 respondents were currently making day trips.

Respondents to this question could not be provided with any additional information about the high speed rail system including any basic information about the routing, cost, or amenities, because the surveys were being personally administered. Because respondents did not receive a full description of the proposed service, it is very difficult to know what characteristics that respondents were assuming for the system. In our view, the survey question serves more as a referendum on high speed trains than a comprehensive measure of market interest.

Furthermore, travelers already have a high-speed public mode option for completing one-day trips to Las Vegas—the air mode. The 2001 LAX airport access survey includes 292 Southern California residents traveling to Las Vegas, of which 20 reported making a day trip. Using the weighted estimates, about 8.5 percent of Las Vegas air trips are day trips. These trips would be included in the overall air passenger demand estimates, and would be subject to the air-HSR mode choice model, so including them as a separate market is not really justified.

Assessment of the Potential Effects of the Identified Issues

We believe it would be prudent to not include the URS induced day trip forecasts until more data on potential induced travel are obtained and analyzed. An alternative approach to estimating induced demand could be included in future analyses as the forecasts are taken to Investment Grade.

Summary

We have identified a number of potential areas of concern with the specific details of the forecasting methods as we understand them. Some of the issues, if addressed, will decrease the ridership forecasts, while others will increase them, but the effects of some will be unknown unless they are implemented. The previous SDG review seems to concur with this overall conclusion. As documented above, in our view, most of the URS analyses are based on sound methods and have been implemented well, but several of the analyses rely on small sample surveys, and for some of these we have raised methodological concerns.

Users of these forecasts should be aware of the potential high level of uncertainty and should exercise reasonable caution in interpreting model results. URS has done an admirable job in testing the sensitivity of the forecasts to different input assumptions already, but these efforts should be expanded with the idea that the uncertainties related to these inputs may be larger than what has been tested.

Without additional analyses, it is impossible for us to accurately bound the potential level of uncertainty in forecasts our concerns raise, but the table below summarizes our rough estimate of how the issues raised could affect the URS forecasts. It is important to note that 1) these quantitative estimates are very rough measures of the potential magnitudes based on our review and professional judgment; and 2) these uncertainty levels are related to the issues we have raised only and do not encompass the full range of uncertainty that accompanies any travel demand forecasting effort. Travel demand forecasts rely on a number of explicit and implicit assumptions, and not all future states can be accounted for with these forecasts.

Rough Estimation of the Quantitative Effects of the Issues Raised

Area of Concern	Potential Effect on Forecast
Recommend not including induced day trip forecasts	Reduces forecasts by 9 percent
Additional uncertainty in total auto trip forecasts	Auto trips between 10 percent higher to 20 percent lower than URS forecasts
Additional uncertainty in total air trip forecasts	Air trips between URS forecasts and 5 percent lower than URS forecasts
Additional uncertainty in Southern California catchment area socioeconomic distributions	+/- five percent of the URS forecasts
Mode choice modeling imprecision	+/- 15 percent of the URS forecasts
Improved auto cost and delay forecasting assumptions	Reduces forecasts by between 0 and 10 percent
Additional uncertainty introduced by aggregate model application	+/- five percent of the URS forecasts
Use of EMU train set technology improving train times to 100 minutes	Increases forecasts by 9 percent

It would not be reasonable to assume that addressing all the issues listed would lead to the most pessimistic potential decreases or to the most optimistic potential increases, but the issues raised would tend to have us conclude that addressing these issues of concern would more likely reduce the URS forecasts. Based on all the issues raised, we believe it would not be unreasonable to assume that the range of reasonable rail mode share forecasts could easily range from one-third less than the URS forecasts to one-fourth more than those forecasts.

Based on this, we feel a reasonable point estimate forecast of about 10 percent lower than the initial URS estimate would be a reasonable estimate of the Desert Xpress ridership for future analyses, at least until better forecasting information is obtained. Based on the issues raised, the forecast reduction should come from auto trip diversion (and induced demand). Based on the reasons that we recommend reducing the forecasts, one approach for applying this simplified adjustment would be to reduce the projected diversion from auto for Southern California zones where auto is most competitive (as measured by the mode choice model utility estimates) by 12 percent and then to reduce the diversion from other zones by a lesser amount (about 5 percent). The table in Appendix A reflect rail passenger forecasts for the DEMU and EMU technologies, adjusted by the factors discussed above.

Additional analyses could enhance the reliability of the forecasts and decrease the level of uncertainty. These additional analyses are often done when transportation projects that are at least partly funded by fares or tolls are subjected to Investment Grade analyses, and Desert Xpress Enterprises has indicated that they expect to do so for this proposed service.

Like all ridership forecasts, the URS forecasts assume that the system is fully operational and that all travelers have knowledge of the system. In reality, it will take a matter of a few years for travelers to know about the system and to evaluate it for their own travel behavior decisions. Often there is an initial few-month test period where interested and motivated travelers try out the new system, but on balance the first few years of the service are likely to be characterized by a "ramp-up" period. For transportation infrastructure projects, a common "ramp-up" period assumption would be to say that the first year of service would achieve 50 to 60 percent of the forecast usage, and the second year would achieve 75 to 85 percent of the forecast usage. By the third year of regular service, we would expect a more steady state usage level to be achieved. The "ramp-up" period will be affected by many factors, including marketing and early successful operations.

Appendix A – Reduced Passenger Forecast Summaries

Table A1 2012 Rail Passenger Forecasts Based On Application of HSR_MC13_LVTransParty_Alt1.xls – DEMU

116 minutes; $55; 30 minute headway				116 minutes; $55; 30 minute headway With recommended reductions			
SuperZip	Diverted from Air	Diverted from Auto	Diverted from Bus	SuperZip	Diverted from Air	Diverted from Auto	Diverted from Bus
L02	175	988	0	L02	166	869	0
L05	32	10	44	L05	30	8	40
L09	0	108	30	L09	0	95	27
L12	591	459	0	L12	561	404	0
L14	0	85	0	L14	0	75	0
L16	60	148	75	L16	57	130	69
L18	44	220	20	L18	42	194	18
L20	0	94	0	L20	0	83	0
L21	131	319	0	L21	124	281	0
L22	0	64	30	L22	0	57	28
L23	96	217	122	L23	91	191	112
L24	0	283	0	L24	0	249	0
L27	13	252	0	L27	13	222	0
L30	18	134	31	L30	17	118	28
L31	51	122	0	L31	49	107	0
L32	24	309	33	L32	23	272	30
L33	14	78	0	L33	13	69	0
L34	21	351	25	L34	20	309	23
L35	25	322	0	L35	24	284	0
L36	24	242	60	L36	23	213	55
L38	430	691	63	L38	409	608	57
L39	13	224	0	L39	12	197	0
L42	87	86	281	L42	83	76	257
L43	32	111	0	L43	30	97	0
L44	94	170	0	L44	90	150	0
L45	46	173	22	L45	44	152	20
L50	72	327	64	L50	68	288	59
L51	60	175	0	L51	57	154	0
O1	63	489	0	O1	60	430	0
O12	0	97	0	O12	0	85	0
O13	11	173	0	O13	11	152	0

116 minutes; $55; 30 minute headway					**116 minutes; $55; 30 minute headway With recommended reductions**			
SuperZip	Diverted from Air	Diverted from Auto	Diverted from Bus		SuperZip	Diverted from Air	Diverted from Auto	Diverted from Bus
O14	38	205	0		O14	36	181	0
O2	69	32	0		O2	66	29	0
O3	24	185	0		O3	22	163	0
O4	0	177	0		O4	0	156	0
O6	0	141	0		O6	0	124	0
O7	25	183	0		O7	24	161	0
O8	11	326	0		O8	10	287	0
O9	0	104	0		O9	0	91	0
R1	75	210	0		R1	71	185	0
R2	76	373	0		R2	72	328	0
R3	40	262	0		R3	38	231	0
SB1	105	153	0		SB1	100	135	0
SB2	0	342	0		SB2	0	301	0
SB3	0	208	0		SB3	0	183	0
SB4	0	127	0		SB4	0	112	0
SB5	0	237	0		SB5	0	209	0
V1	42	267	16		V1	40	235	15
V2	15	139	0		V2	14	122	0
(blank)	0	0	0		(blank)	0	0	0
SD1	0	673	0		SD1	0	592	0
Grand Total	2747	11866	915		Grand Total	2610	10442	837

Notes: 2012 Average Friday Forecasts resulting from the application of the forecasting spreadsheet (without "Ramp-Up" assumptions).

Table A2 2012 Rail Passenger Forecasts Based On Application of HSR_MC13_LVTransParty_Alt1.xls – EMU

100 minutes; $50; 20 minute headway				**100 minutes; $50; 20 minute headway With recommended reductions**			
SuperZip	Diverted from Air	Diverted from Auto	Diverted from Bus	SuperZip	Diverted from Air	Diverted from Auto	Diverted from Bus
L02	224	1227	0	L02	213	1080	0
L05	41	12	55	L05	39	10	51
L09	0	134	37	L09	0	118	34
L12	722	569	0	L12	686	500	0
L14	0	106	0	L14	0	93	0
L16	78	184	96	L16	74	162	88
L18	58	273	26	L18	55	241	23
L20	0	116	0	L20	0	102	0
L21	163	392	0	L21	155	345	0
L22	0	79	38	L22	0	70	35
L23	119	267	151	L23	113	235	138
L24	0	347	0	L24	0	306	0
L27	17	311	0	L27	16	274	0
L30	24	166	39	L30	23	146	36
L31	65	151	0	L31	61	133	0
L32	32	383	42	L32	30	337	39
L33	18	97	0	L33	17	86	0
L34	28	435	32	L34	27	383	29
L35	33	401	0	L35	31	353	0
L36	31	299	75	L36	29	263	69
L38	554	859	79	L38	526	756	73
L39	17	280	0	L39	16	246	0
L42	108	107	349	L42	103	94	319
L43	42	137	0	L43	40	120	0
L44	118	211	0	L44	112	186	0
L45	60	214	28	L45	57	189	25
L50	90	403	80	L50	86	355	73
L51	66	213	0	L51	63	188	0
O1	82	603	0	O1	78	531	0
O12	0	119	0	O12	0	105	0
O13	15	214	0	O13	14	188	0
O14	49	254	0	O14	47	224	0
O2	91	40	0	O2	87	35	0
O3	31	228	0	O3	29	200	0
O4	0	218	0	O4	0	192	0
O6	0	175	0	O6	0	154	0
O7	33	226	0	O7	31	199	0
O8	14	404	0	O8	14	355	0
O9	0	129	0	O9	0	113	0
R1	92	258	0	R1	87	227	0
R2	92	458	0	R2	87	403	0

100 minutes; $50; 20 minute headway				100 minutes; $50; 20 minute headway With recommended reductions			
SuperZip	Diverted from Air	Diverted from Auto	Diverted from Bus	SuperZip	Diverted from Air	Diverted from Auto	Diverted from Bus
R3	49	324	0	R3	47	285	0
SB1	131	188	0	SB1	125	165	0
SB2	0	417	0	SB2	0	367	0
SB3	0	255	0	SB3	0	224	0
SB4	0	154	0	SB4	0	136	0
SB5	0	285	0	SB5	0	251	0
V1	56	333	21	V1	53	293	19
V2	20	174	0	V2	19	153	0
(blank)	0	591	0	(blank)	0	520	0
SD1	0	673	0	SD1	0	592	0
Grand Total	3464	15094	1147	Grand Total	3291	13283	1049

Notes:
2012 Average Friday Forecasts resulting from the application of the forecasting spreadsheet (without "Ramp-Up" assumptions).

Table A3 Rail Passenger Forecasts Based On Application of HSR_MC13_LVTransParty_Alt1.xls - DEMU

	116 minutes; $55; 30 minute headway				**116 minutes; $55; 30 minute headway With recommended reductions**			
	Diverted from Air	Diverted from Auto	Diverted from Bus	Total Rail	Diverted from Air	Diverted from Auto	Diverted from Bus	Total Rail
Average Friday Trips								
2012	1,648	7,120	549	9,317	1,566	6,265	502	8,334
2013	2,286	9,873	761	12,920	2,172	8,688	697	11,556
2014	2,972	12,834	990	16,796	2,823	11,294	906	15,023
2015	3,091	13,348	1,029	17,468	2,936	11,746	942	15,624
2016	3,214	13,882	1,071	18,167	3,053	12,216	980	16,249
2017	3,343	14,437	1,113	18,893	3,176	12,705	1,019	16,899
2018	3,476	15,015	1,158	19,649	3,303	13,213	1,060	17,575
2019	3,615	15,615	1,204	20,435	3,435	13,741	1,102	18,278
2020	3,699	15,974	1,232	20,905	3,514	14,057	1,127	18,698
2021	3,784	16,342	1,260	21,386	3,595	14,381	1,153	19,128
2022	3,871	16,718	1,289	21,878	3,677	14,711	1,180	19,568
2023	3,960	17,102	1,319	22,381	3,762	15,050	1,207	20,018
2024	4,051	17,495	1,349	22,896	3,848	15,396	1,235	20,479
2025	4,144	17,898	1,380	23,422	3,937	15,750	1,263	20,950
2026	4,239	18,309	1,412	23,961	4,027	16,112	1,292	21,432
2027	4,337	18,731	1,445	24,512	4,120	16,483	1,322	21,925
2028	4,437	19,161	1,478	25,076	4,215	16,862	1,352	22,429
2029	4,539	19,602	1,512	25,652	4,312	17,250	1,383	22,945
2030	4,593	19,837	1,530	25,960	4,363	17,457	1,400	23,220
2031	4,648	20,075	1,548	26,272	4,416	17,666	1,417	23,499
2032	4,704	20,316	1,567	26,587	4,469	17,878	1,434	23,781
2033	4,760	20,560	1,586	26,906	4,522	18,093	1,451	24,066
2034	4,818	20,807	1,605	27,229	4,577	18,310	1,468	24,355
2035	4,875	21,056	1,624	27,556	4,632	18,530	1,486	24,647
Annualization - Friday to Annual Trips								
Air	168	days						
Auto	252	days						
Bus	210	days						

Table A4 Rail Passenger Forecasts Based On Application of HSR_MC13_LVTransParty_Alt1.xls - EMU

	100 minutes; $50; 20 minute headway				**100 minutes; $50; 20 minute headway With recommended reductions**			
	Diverted from Air	Diverted from Auto	Diverted from Bus	Total Rail	Diverted from Air	Diverted from Auto	Diverted from Bus	Total Rail
Average Friday Trips								
2012	2,078	9,057	688	11,823	1,974	7,970	630	10,574
2013	2,882	12,558	954	16,395	2,738	11,051	873	14,662
2014	3,747	16,326	1,240	21,313	3,559	14,367	1,135	19,061
2015	3,897	16,979	1,290	22,165	3,702	14,941	1,180	19,824
2016	4,052	17,658	1,342	23,052	3,850	15,539	1,228	20,616
2017	4,215	18,364	1,395	23,974	4,004	16,161	1,277	21,441
2018	4,383	19,099	1,451	24,933	4,164	16,807	1,328	22,299
2019	4,558	19,863	1,509	25,930	4,331	17,479	1,381	23,191
2020	4,663	20,320	1,544	26,527	4,430	17,881	1,413	23,724
2021	4,771	20,787	1,579	27,137	4,532	18,293	1,445	24,270
2022	4,880	21,265	1,616	27,761	4,636	18,713	1,478	24,828
2023	4,992	21,754	1,653	28,400	4,743	19,144	1,512	25,399
2024	5,107	22,255	1,691	29,053	4,852	19,584	1,547	25,983
2025	5,225	22,767	1,730	29,721	4,964	20,035	1,583	26,581
2026	5,345	23,290	1,770	30,405	5,078	20,495	1,619	27,192
2027	5,468	23,826	1,810	31,104	5,195	20,967	1,656	27,818
2028	5,594	24,374	1,852	31,819	5,314	21,449	1,694	28,457
2029	5,722	24,934	1,894	32,551	5,436	21,942	1,733	29,112
2030	5,791	25,234	1,917	32,942	5,501	22,206	1,754	29,461
2031	5,860	25,536	1,940	33,337	5,567	22,472	1,775	29,815
2032	5,931	25,843	1,964	33,737	5,634	22,742	1,797	30,173
2033	6,002	26,153	1,987	34,142	5,702	23,015	1,818	30,535
2034	6,074	26,467	2,011	34,552	5,770	23,291	1,840	30,901
2035	6,147	26,784	2,035	34,966	5,840	23,570	1,862	31,272
Annualization - Friday to Annual Trips								
Air	168	days						
Auto	252	days						
Bus	210	days						

Table A5 Rail Passenger Forecasts Based On Application of HSR_MC13_LVTransParty_Alt1.xls – DEMU Annual Trips

	116 minutes; $55; 30 minute headway				**116 minutes; $55; 30 minute headway With recommended reductions**			
	Diverted from Air	Diverted from Auto	Diverted from Bus	Total Rail	Diverted from Air	Diverted from Auto	Diverted from Bus	Total Rail
Annual Trips								
2012	276,944	1,794,169	115,314	2,186,427	263,097	1,578,869	105,512	1,947,478
2013	384,029	2,487,915	159,902	3,031,846	364,827	2,189,365	146,310	2,700,503
2014	499,237	3,234,289	207,873	3,941,399	474,275	2,846,175	190,204	3,510,654
2015	519,207	3,363,661	216,188	4,099,055	493,246	2,960,022	197,812	3,651,080
2016	539,975	3,498,207	224,835	4,263,018	512,976	3,078,423	205,724	3,797,123
2017	561,574	3,638,136	233,829	4,433,538	533,495	3,201,559	213,953	3,949,008
2018	584,037	3,783,661	243,182	4,610,880	554,835	3,329,622	222,511	4,106,968
2019	607,398	3,935,008	252,909	4,795,315	577,029	3,462,807	231,412	4,271,247
2020	621,369	4,025,513	258,726	4,905,607	590,300	3,542,451	236,734	4,369,486
2021	635,660	4,118,100	264,677	5,018,436	603,877	3,623,928	242,179	4,469,984
2022	650,280	4,212,816	270,764	5,133,860	617,766	3,707,278	247,749	4,572,793
2023	665,237	4,309,711	276,992	5,251,939	631,975	3,792,545	253,447	4,677,968
2024	680,537	4,408,834	283,363	5,372,734	646,510	3,879,774	259,277	4,785,561
2025	696,190	4,510,237	289,880	5,496,307	661,380	3,969,009	265,240	4,895,629
2026	712,202	4,613,973	296,547	5,622,722	676,592	4,060,296	271,341	5,008,228
2027	728,583	4,720,094	303,368	5,752,044	692,153	4,153,683	277,581	5,123,418
2028	745,340	4,828,656	310,345	5,884,341	708,073	4,249,217	283,966	5,241,256
2029	762,483	4,939,715	317,483	6,019,681	724,359	4,346,949	290,497	5,361,805
2030	771,633	4,998,992	321,293	6,091,917	733,051	4,399,113	293,983	5,426,147
2031	780,892	5,058,980	325,148	6,165,020	741,848	4,451,902	297,511	5,491,260
2032	790,263	5,119,687	329,050	6,239,000	750,750	4,505,325	301,081	5,557,156
2033	799,746	5,181,124	332,999	6,313,868	759,759	4,559,389	304,694	5,623,841
2034	809,343	5,243,297	336,995	6,389,635	768,876	4,614,102	308,350	5,691,328
2035	819,055	5,306,217	341,039	6,466,311	778,102	4,669,471	312,050	5,759,623

Notes: Assumes a "ramp-up" period in 2012 and 2013 (60 percent of forecast ridership in 2012; 80 percent of forecast ridership in 2013). Annual growth rates for ridership based on URS projections.

Table A6 Rail Passenger Forecasts Based On Application of HSR_MC13_LVTransParty_Alt1.xls – EMU Annual Trips

	100 minutes; $50; 20 minute headway				100 minutes; $50; 20 minute headway With recommended reductions			
	Diverted from Air	Diverted from Auto	Diverted from Bus	Total Rail	Diverted from Air	Diverted from Auto	Diverted from Bus	Total Rail
Annual Trips								
2012	349,174	2,282,239	144,502	2,775,915	331,716	2,008,370	132,219	2,472,305
2013	484,189	3,164,705	200,376	3,849,269	459,979	2,784,940	183,344	3,428,263
2014	629,445	4,114,116	260,489	5,004,050	597,973	3,620,422	238,348	4,456,742
2015	654,623	4,278,681	270,909	5,204,212	621,892	3,765,239	247,881	4,635,012
2016	680,808	4,449,828	281,745	5,412,381	646,767	3,915,849	257,797	4,820,413
2017	708,040	4,627,821	293,015	5,628,876	672,638	4,072,482	268,109	5,013,229
2018	736,362	4,812,934	304,735	5,854,031	699,544	4,235,382	278,833	5,213,758
2019	765,816	5,005,451	316,925	6,088,192	727,525	4,404,797	289,986	5,422,309
2020	783,430	5,120,577	324,214	6,228,221	744,258	4,506,107	296,656	5,547,022
2021	801,449	5,238,350	331,671	6,371,470	761,376	4,609,748	303,479	5,674,603
2022	819,882	5,358,832	339,299	6,518,014	778,888	4,715,772	310,459	5,805,119
2023	838,739	5,482,085	347,103	6,667,928	796,802	4,824,235	317,600	5,938,637
2024	858,030	5,608,173	355,087	6,821,290	815,129	4,935,192	324,904	6,075,226
2025	877,765	5,737,161	363,254	6,978,180	833,877	5,048,702	332,377	6,214,956
2026	897,954	5,869,116	371,609	7,138,678	853,056	5,164,822	340,022	6,357,900
2027	918,607	6,004,105	380,156	7,302,868	872,676	5,283,613	347,842	6,504,131
2028	939,735	6,142,200	388,899	7,470,834	892,748	5,405,136	355,843	6,653,726
2029	961,349	6,283,470	397,844	7,642,663	913,281	5,529,454	364,027	6,806,762
2030	972,885	6,358,872	402,618	7,734,375	924,240	5,595,807	368,395	6,888,443
2031	984,559	6,435,178	407,449	7,827,187	935,331	5,662,957	372,816	6,971,105
2032	996,374	6,512,401	412,339	7,921,113	946,555	5,730,913	377,290	7,054,758
2033	1,008,331	6,590,549	417,287	8,016,167	957,914	5,799,683	381,817	7,139,415
2034	1,020,430	6,669,636	422,294	8,112,361	969,409	5,869,280	386,399	7,225,088
2035	1,032,676	6,749,672	427,362	8,209,709	981,042	5,939,711	391,036	7,311,789

Notes: Assumes a "ramp-up" period in 2012 and 2013 (60 percent of forecast ridership in 2012; 80 percent of forecast ridership in 2013). Annual growth rates for ridership based on URS projections.

APPENDIX B

Transmax, LLC

Desert Xpress Updated Ridership and Revenue Study

Draft Final Report

December 22, 2005

URS

One Penn Plaza, Suite 610
New York, NY 10119-0698

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Desert Xpress High Speed Rail Ridership, Interim Report

A. Summary of Ridership Forecasts

1. Baseline Forecast

Ridership forecasts were developed for a proposed high-speed rail service between Victorville California to Las Vegas. The estimated diversion of trip makers from driving and flying to Las Vegas was based on a Web based stated preference survey of selected Southern California residents carried out during July 2005. The probability of a trip maker switching to High Speed Rail (HSR) was derived from how these respondents answered questions concerning the attractiveness of HSR service. The model was developed using current information (2004) to describe variables such as security delays at airports, air travel to Las Vegas, and travel costs. In addition, a survey was taken of I-15 vehicles to establish the number of California resident coming to Las Vegas by auto. The ridership shown below is for the year 2012. Future trip levels were based on expected Las Vegas visitation in 2012, and the growth of Southern California population. The baseline forecast assumes a $55 one-way fare.

The best performing single station option was for a High Speed Rail (HSR) station near the Rio, with a monorail spur connection the HSR station to the monorail system. The 2012 ridership forecast for the Rio Station with monorail service is 4.16 million annual round trips on HSR between Victorville and Las Vegas. The projected 2012 total travel market from Southern California to Las Vegas was for 18.2 million trips. Of this market, the HSR service captures 22.8%. The diversion varies by mode. The diversion from auto is 3.4 million trips, 23.6% of the total market. This share includes a 3.3% share of the market for new day trips made possible by the high speed rail service. Diversion share from air travel is 22.2% of the market. The air market is smaller than the auto market so this diversion contributes only 461,000 annual trips. There is also a diversion of 260,000 annual trips from charter bus. Table 1 below shows these results in more detail.

The survey of I-15 users indicated that 11.2% of the vehicles going to Las Vegas come from Barstow, Bakersfield, and other communities north of Bakersfield. A Barstow station would tap this market, so a second station was tested in Southern California. With both the Victorville station and the Barstow station, ridership increased from 4.16 million annual trips to 4.27 million trips. With this station added, the ridership from Victorville decreased slightly, because the additional stop increases travel time from Victorville. However, there was a net gain in ridership of 2.6%. Potential ridership at the Barstow station is <u>not</u> included in the following forecasts.

Table 1

2012 Ridership, Rio HSR Station (Monorail Spur to Monorail Mainline)

116 Min Ave Run Time	Ave Friday HSR Trips	Ratio, Annual To Peak Day	Annual Trips By Mode	Annual HSR Trips	Market Share
From Auto	12,077	252	14,994,213	3,044,727	20.3%
Induced Day Trips	1,566	252		394,748	2.2%
From Air	2,747	168	2,074,520	460,750	22.2%
From Bus	1,240	210	1,180,227	260,187	22.0%
Totals	17,630		18,248,960	**4,160,412**	22.8%

* Based on an average annual Friday. **This ratio is used to expand the Friday ridership to annual ridership.

2. Alternative Stations

Three HSR station locations in Las Vegas were tested. Two of these were the Rio HSR Station located adjacent to Rio Suites on W. Flamingo Rd. and the Mandalay Bay Station located adjacent to Mandalay Bay. The third was a station at Bonneville adjacent to a proposed monorail station for the Downtown extension. Both strip area stations were tested assuming that there will be a monorail spur between the HSR station and a monorail station. The spur for the Rio Station is to the Harrah's monorail station. Monorail service to the airport is also assumed to maintain a fair comparison between HSR and air travel. As a variation, both stations were tested assuming a dedicated shuttle bus for connecting service to the HSR station rather than a direct monorail connection. For all alternatives and variations tested, it is assumed that taxi egress is used for destinations with no monorail service. The Barstow station is not included in the following ridership forecasts. These Tables show HSR trips from Southern California to Las Vegas (trip totals also can be considered as the number of round trips).

The Rio Station was also run with a connection to the Bally's monorail station using a dedicated shuttle bus. With the absence of the more attractive monorail access, ridership decreases to 4.0 million annual trips. Ridership by mode for this variation is shown below. Note that diversion from air is more impacted by this service change than diversion from auto.

Table 2

2012 Ridership, Rio HSR Station (Bus Shuttle to Monorail Station)

116 Min Ave Run Time	Ave Friday HSR Trips	Ratio, Annual To Peak Day	Annual Trips By Mode	Annual HSR Trips	Market Share
From Auto	11,743	252	14,994,213	2,960,285	19.7%
Induced Day Trips	1,522	252		383,648	2.1%
From Air	2,509	168	2,074,520	420,719	20.3%
From Bus	1,205	210	1,180,227	252,911	21.4%
Totals	16,979		18,248,960	**4,017,563**	22.0%

The Mandalay Bay HSR Station was also tested assuming a spur connection to the monorail, in this case connecting at the MGM Grand station. Ridership for this station is slightly lower than the Rio Station with an annual ridership of 4.12 million trips. This station is less competitive in diverting airport trips than the Rio location, but about the same for diversion from auto. Ridership for this Alternative is shown below.

Table 3

2012 Ridership, Mandalay Bay HSR Station (Monorail Spur to Monorail Mainline)

114.5 Min Ave Run Time	Ave Friday HSR Trips	Ratio, Annual To Peak Day	Annual Trips By Mode	Annual HSR Trips	Market Share
From Auto	12,103	252	14,994,213	3,051,276	20.3%
Induced Day Trips	1,569	252		395,441	2.2%
From Air	2,468	168	2,074,520	413,883	20.0%
From Bus	1,242	210	1,180,227	260,751	22.1%
Totals	17,383		18,248,960	**4,121,351**	22.6%

This Alternative was tested assuming that a dedicated shuttle bus would connect the HSR station to the monorail. Ridership declined 2.3% from ridership assuming a monorail spur.

Table 4

2012 Ridership, Mandalay Bay HSR Station (Bus Shuttle to Monorail Station)

114.5 Min Ave Run Time	Ave Friday HSR Trips	Ratio, Annual To Peak Day	Annual Trips By Mode	Annual HSR Trips	Market Share
From Auto	11,817	252	14,994,213	2,979,113	19.9%
Induced Day Trips	1,532	252		386,089	2.1%
From Air	2,413	168	2,074,520	404,722	19.5%
From Bus	1,213	210	1,180,227	254,533	21.6%
Totals	16,975		18,248,960	**4,024,457**	22.1%

Two Alternatives were run to evaluate having two stations for the high speed rail service. The following Table shows ridership with the Rio Station at Flamingo Rd and an HSR Station at Bonneville, near Downtown. While the addition of the Downtown Station adds some ridership, the increase is only a 1 percent gain. This Alternative was evaluated further since intuitively a larger increase was expected. This analysis showed that the share of trips using HSR did increase in the Downtown area by 8%. However the magnitude of the Downtown market is such that this increase is only a small share of total HSR ridership.

Table 5

2012 Ridership, Rio and Bonneville HSR Stations (Monorail Spur to Mainline)

116 Min Ave Run Time	Ave Friday HSR Trips	Ratio, Annual To Peak Day	Annual Trips By Mode	Annual HSR Trips	Market Share
From Auto	12,201	252	14,994,213	3,075,958	20.5%
Induced Day Trips	1,582	252		398,639	2.2%
From Air	2,773	168	2,074,520	465,024	22.4%
From Bus	1,252	210	1,180,227	262,879	22.3%
Totals	17,809		18,248,960	**4,202,500**	23.0%

A run was also made to evaluate two stations with one at Mandalay Bay and the other station at Bonneville. Contrary to expectations, the growth with the additional station is even less than for the Rio Station Alternatives.

Table 6

2012 Ridership, Mandalay Bay and Bonneville HSR Station (Monorail Spur)

114.5 Min Ave Run Time	Ave Friday HSR Trips	Ratio, Annual To Peak Day	Annual Trips By Mode	Annual HSR Trips	Market Share
From Auto	12,286	252	14,994,213	3,097,385	20.7%
Induced Day Trips	1,593	252		401,416	2.2%
From Air	2,565	168	2,074,520	430,129	20.7%
From Bus	1,261	210	1,180,227	264,726	22.4%
Totals	17,705		18,248,960	**4,193,657**	23.0%

In general, variations in station locations in Las Vegas as tested by the above Alternatives do not significantly impact ridership. There are two reasons for this. One is that the Las Vegas egress is only a small part of the total trip between Southern California and Las Vegas. The second reason is that regardless of the location, in this model, destinations in the Strip and Downtown can be reached by taxi. Station location and monorail connections would have a greater impact if the available taxi service were not in the model. However this would mean that some locations could only be reached by local bus connections. This is somewhat unrealistic given the nature of the market. Available taxi service is a necessary assumption for a major transportation facility. (Where taxi was used, taxi fares were included in the model.)

3. Sensitivity Analysis for Fare

There is greater variation in ridership with changes in fare, running time and other variables as explained below. However by far, the most important variable in these ridership models is fare. In the estimation of the model, fare was always the most significant variable regardless of the other variables that were tested with it.

In order to evaluate how the fare variables affected ridership, a series of model runs were made where everything was held constant except the dependent variable being evaluated. The alternative used for this analysis was the Rio HSR station with a monorail connection. All runs used the 2012 trip table. Fare is particularly strong in the auto model where the elasticities are greater than 1, ranging from –1.2 to –2.1. Fare is important but not quite so strong for the air model, with elasticities starting at -0.8 and ranging to –1.3 at the highest level. It should be noted that auto is 83% of the total Southern California market so the auto mode always dominates overall ridership results. Because of this high elasticity, ridership decreases rapidly as fare increases. At a $40 fare, ridership is 6.2 million trips, while with the $70 fare, ridership drops to 2.6 million per year.

Table 7
Fare Sensitivity Analysis

HSR Fare Level	HSR Running Time 116 Min	Ave Friday HSR Trips	Ratio, Annual To Peak Day	Annual Trips By Mode	Annual HSR Trips	Market Share
$40	**From Auto**	18,286	252	14,994,213	4,609,979	30.7%
	Day Trips	2,371	252		597,683	3.3%
	From Air	3,613	168	2,074,520	605,944	29.2%
	From Bus	1,877	210	1,180,227	393,945	33.4%
	Totals	26,147		18,248,960	**6,207,552**	34.0%
$50	**From Auto**	13,966	252	14,994,213	3,520,805	23.5%
	Day Trips	1,811	252		456,472	2.5%
	From Air	3,020	168	2,074,520	506,394	24.4%
	From Bus	1,433	210	1,180,227	300,870	25.5%
	Totals	20,230		18,248,960	**4,784,542**	26.2%
$55	**From Auto**	12,077	252	14,994,213	3,044,727	20.3%
	Day Trips	1,566	252		394,592	2.2%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	1,240	210	1,180,227	260,187	22.0%
	Totals	17,630		18,248,960	**4,160,255**	22.8%
$60	**From Auto**	10,380	252	14,994,213	2,616,791	17.5%
	Day Trips	1,346	252		339,267	1.9%
	From Air	2,492	168	2,074,520	417,987	20.1%
	From Bus	1,065	210	1,180,227	223,618	18.9%
	Totals	15,284		18,248,960	**3,597,663**	19.7%
$70	**From Auto**	7,545	252	14,994,213	1,902,205	12.7%
	Day Trips	978	252		246,621	1.4%
	From Air	2,035	168	2,074,520	341,205	16.4%
	From Bus	774	210	1,180,227	162,553	13.8%
	Totals	11,333		18,248,960	**2,652,584**	14.5%

4. Shuttle Service Between Primm and Las Vegas

A dedicated hourly shuttle between Las Vegas was evaluated in addition to the line haul service. This operation serves a number of relatively small markets. The first market is trips made to Primm from Las Vegas by Las Vegas visitors and residents. This market was estimated to be 11,430 daily round trips in 2005. A second market is for the visitors who stay in Primm but wish to travel to the Strip or other Las Vegas attractions (3,070 daily round trips). The third market is the employees who work in Primm but live in Las Vegas. It was estimated that the employees make 4,460 daily round trips.

Another market is the Las Vegas visitors who will ride the HSR as a form of entertainment. There is a distinct sub market of Las Vegas visitors who go to various attractions during the course of their visit. This market is estimated to make 54,240 trips per day in 2005.This is a sizeable market, so even if a small share is attracted to the HSR shuttle, it could account for a meaningful number of trips. Ridership will depend upon how the service is presented. If the HSR is seen as just another train, then ridership will be limited to “railfan” types who will ride the train just because it is there. If the train is provided as an experience, and marketed that way, the service might attract a share of the attraction-going market.

The following table shows the shuttle ridership forecast for 2012. This assumes that the shuttle service is marketed as an "experience". Otherwise, ridership by attraction goers would be significantly smaller.

Table 8
Daily Primm Shuttle Ridership 2012

Fare Assumptions:	Mode	Visitors from Las Vegas	Trips from Primm to Las Vegas	Employee Trips	Attraction Trips	Total HSR Shuttle Trips
Visitor Round Trp **$12.00** Employee Round Trip **$10.00**	**Auto Trips**	11,287	2,898	3,686		
	Bus Trips	179	0	200		
	HSR Trips	**1,621**	**617**	**1,218**	**1,963**	**5,419**
	Share	12.39%	17.54%	23.86%		
	Total Trips Control	13,086	3,515	5,104		
Visitor Round Trp **$16.00** Employee Round Trip **$10.00**	**Auto Trips**	11,501	2,979	3,686		
	Bus Trips	179	0	200		
	HSR Trips	**1,407**	**536**	**1,218**	**1,181**	**4,341**
	Share of Total	10.75%	15.25%	23.86%		
	Total Trips Control	13,086	3,515	5,104		

Note that ridership, especially attraction ridership, is fairly sensitive to fare. When fares are raised from a $12 round trip fare to a $16 fare, ridership decreases from 5,420 daily trips to 4,340 daily trips. This ridership is for daily travel. However, the attraction trips are calculated as annual, and then presented as daily. This is done because annual attraction trips are discounted to take into account length of stay, and the likelihood that people who may make multiple visits to Las Vegas each year will not repeatedly ride the shuttle. With attraction trips discounted this way, the ridership forecasts can be directly expanded to annual ridership.

There are other variables that could impact this forecast. The first is the nature of future development at Primm. Additional casinos could easily be built in Primm, since it is surrounded by vacant land. For this forecast it was assumed that existing facilities would be expanded, but no new casinos would be built. If there is major development in Primm, ridership would be higher than the above forecast. The second variable has to do with the attraction trips. If the shuttle service does not have a unique entertainment aspect, interest in the service could subside quickly. The prudent assumption is that attraction ridership will diminish over time. Finally, this shuttle analysis does not include service to the Ivanpaw site, and does not take into account future development there.

B. Model Application

1. Results from Testing With 2004 Trips

Research Systems Group (RSG) developed two-mode choice models (described in detail in Section D below) from survey data. URS programmed these models so that they could be applied to each ZIP in the Southern California service area. Input data was prepared for each ZIP, and the models were run to produce the probability of HSR use at the ZIP level. The estimated trip table was multiplied by this percentage to yield a ridership number.

In order to evaluate the suitability of the resulting models, the models were applied using 2004 trip end data. (Note that this analysis is conceptual since it will take some time to implement the high speed rail service.) This application showed that 20.3% of the auto trips would switch to HSR and 22.0% of the air passengers would also switch. The total HSR mode share including Charter Bus is 20.6%. Table 8 below has study service area totals sub-divided into approximations of the Los Angeles airport airsheds. This sub-division by airshed shows that there are geographic differences in mode share. In general, the auto mode shares vary with the distance from Victorville. The Burbank airshed has the lowest share HSR (19.7%) while the Ontario airshed has the highest. The one variation in this relationship is for the cities north of Cajon Pass. Victorville and Apple Valley have a lower share even though they are close to Victorville. Most likely this happens because the shorter distance to Las Vegas from these cities begins to have an influence.

The air passenger model varies differently and more widely. As with the auto model, the Ontario airshed has the highest share in the air passenger model. However in the case of the air passenger model, the HSR share is much higher here than for the other airsheds. This may be due to the shorter distance between the Ontario airport and Victorville. For some trips, particularly in San Bernardino County, the drive to Victorville is not much longer than the drive to the airport. Note the large spread between the highest and lowest share, 31.5% for the Ontario airshed versus 15.3% for the Orange County airshed.

Table 9

2004 HSR Trips to Las Vegas by Location of Origin

116 Min Ave. Run Time Area Name	Airshed	Ave. Friday Total Auto	HSR from Auto	HSR Share	Total Air Psgr	HSR from Air	HSR Share	HSR from Bus
Burbank Trib Area	BUR	12,314	2,426	19.7%	1,943	325	16.7%	221
Orange Co Trib Area	SNA	8,078	1,726	21.4%	1,272	194	15.3%	-
Central LA Trib Area	LAX	12,896	2,503	19.4%	4,704	1,086	23.1%	503
Ontario Trib Area	ONT	8,110	1,968	24.3%	1,439	453	31.5%	217
S Bernardino Mts	All Drive	5,291	840	15.9%	-	-	0.0%	-
Total Southern Calif.		46,689	9,463	20.3%	9,359	2,058	22.0%	940

2. HSR Attraction of Day Trips

During the I-15 interview survey, many respondents were enthusiastic about using the HSR service to make day trips to Las Vegas. Given these responses, it was determined that the ridership estimation model should be modified to include additional day trips that would be generated by the HSR service. To do this, the travel characteristics of survey respondents who reported making day trips were evaluated. This revealed that the market for day trips did not include the entire study area. Essentially, it was limited to the communities in Los Angeles, Orange, and San Bernardino Counties that are closer to Victorville. Ventura and Riverside Counties were not included. The distribution of day trips was 51.0% Los Angeles, 20.5% Orange County, and San Bernardino 28.5%. As explained, not all of Los Angeles was included. However, the share is high because many of the communities included have large populations.

3. Future Las Vegas Visitation and Assumptions

To develop 2012 forecasts, a 2012 trip table was projected. Travel was assumed to grow proportionately to the increase in Las Vegas annual visitation. A 2012 projection of visitation was made based on the Las Vegas Hotel/Casino Development Construction report. Planned projects are listed by date up through 2009. Proposed development expected to start construction after 2009 are listed as tentative proposed projects with undetermined completion dates. Based on that report, total rooms in the Strip and Downtown were estimated for each year between July 2005 and 2014. It was assumed that all the projects listed would be built by 2014. It was further assumed that visitation growth would be proportional to the increase in rooms over time. The intermediate year of 2012 was thus used to project travel.

There have been a number of proposed changes to the Las Vegas Monorail system. These proposals include extending the Monorail to the airport to the south and to Downtown to the north. A West Side line has also been proposed although it has not been clearly defined at this time. The future transit network used in this study assumes that the segment to the airport and to Downtown will be complete by 2012. Since the West Side line may be less likely in this time frame, the accessibility is modeled assuming a spur to the Rio station from the Harrah's monorail station. When Mandalay Bay is tested, it is assumed that a spur will go from the MGM Grand monorail station to Mandalay Bay. The Rio HSR Station alternative was also tested assuming no additions to the existing monorail system. For this case, a dedicated shuttle bus was assumed to move travelers from the HSR station to the Bally's Monorail Station.

For all the Alternatives and variations tested, egress from the Las Vegas HSR station to Strip and Downtown destinations is by two modes. If a destination can be reached using the monorail system then transit is used for this destination. If a destination cannot be reached via the monorail system, then the egress mode is taxi. The taxi time and cost is similar or less than transit because the fare is assumed to be shared by the number of individuals in an average party. The competitiveness of taxi tends to dilute differences between station location and transit services.

The high-speed rail is coded to have a running time from Victorville to the Mandalay Bay Station of 114.5 minutes. From Victorville to the Rio Station the time is 117.5 minutes. When two stations are tested (Rio and Bonneville or Mandalay Bay and Bonneville) the time between Mandalay Bay and Downtown is 5 minutes with a 3 minutes dwell at Mandalay Bay. The time between Rio and Downtown is 4 minutes with a 3 minutes dwell at the Rio Station.

C. Sensitivity Analysis for Travel Time, Headway, and I-15 Delay

1. Introduction

In order to evaluate how these three variables affect ridership, a series of model runs were made where everything was held constant except the dependent variable being evaluated. The alternative used for this analysis was the Rio HSR station with a monorail connection, and taxi service to locations not served by monorail. All runs used the 2012 trip table.

2. Running Time Sensitivity

A range of High Speed Rail in-vehicle running times between Victorville and the first station in Las Vegas were tested. This was done to illustrate the relationship between HSR running times and ridership. Runs were made with times 10 minutes faster than the 116 min base, and with times 5 and 10 minutes slower than the base. Table 9 below shows the ridership by prior mode. Based on the elasticities, this is a fairly important variable. For the auto diversion model, the elasticities are between -0.47 and –0.53. However, the travel time is twice as important to air travelers. The elasticity in the air model is almost double what it is for auto, between –1.002 and –1.156.

Table 10
HSR Ridership vs. Change in Running Time

HSR Runtimes	Ave Friday HSR Trips	Ratio, Annual To Peak Day	Annual Trips By Mode	Annual HSR Trips	Market Share	Ave Friday HSR Trips
106 Min	**From Auto**	12,596	252	14,994,213	3,175,542	21.2%
	Day Trips	1,633	252		411,545	2.3%
	From Air	3,007	168	2,074,520	504,305	24.3%
	From Bus	1,293	210	1,180,227	271,366	23.0%
	Totals	18,529		18,248,960	4,362,757	23.9%
116 Min	**From Auto**	12,077	252	14,994,213	3,044,727	20.3%
	Day Trips	1,566	252		394,592	2.2%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	1,240	210	1,180,227	260,187	22.0%
	Totals	17,630		18,248,960	4,160,255	22.8%
121 Min	**From Auto**	11,824	252	14,994,213	2,980,790	19.9%
	Day Trips	1,533	252		386,306	2.1%
	From Air	2,624	168	2,074,520	439,964	21.2%
	From Bus	1,214	210	1,180,227	254,723	21.6%
	Totals	17,194		18,248,960	4,061,783	22.3%
126 Min	**From Auto**	11,574	252	14,994,213	2,917,834	19.5%
	Day Trips	1,501	252		378,147	2.1%
	From Air	2,504	168	2,074,520	419,847	20.2%
	From Bus	1,188	210	1,180,227	249,343	21.1%
	Totals	16,766		18,248,960	3,965,171	21.7%

3. Headway Sensitivity

Headway is not a strong variable in terms of elasticities. At a 60-minute headway, auto elasticity is only -0.1. However, because the differences are large, 30 to 60 and 60 to 120, it is an important ridership variable. Ridership goes from 4.16 million to 3.86 million when service changes from twice an hour to once an hour. When the headway further decreases to once every 2 hours the ridership drops more rapidly, with ridership at 3.18 million. Frequency of service did not show up as a significant variable for air passengers. Perhaps because they are already basing their travel on an airline schedule, the difference between twice an hour and once an hour is not important to them. It is possible that very infrequent service might have an impact on air travelers, but headways greater than 2 hours were not included in the model. The differences in ridership between once an hour and twice an hour do indicate that when the headways vary throughout the day, this should be taken into account when forecasting ridership. However the impact is minimized because more people do travel in the peak when twice an hour service is offered.

Table 11
HSR Ridership Vs Change in Headway

HSR Headway	HSR Fare $55	Ave. Friday HSR Trips	Ratio, Annual to Pk Day	Annual Trips By Mode	Annual Trips HSR	Market Share
30 Min.	**From Auto**	12,077	252	14,994,213	3,044,727	20.3%
	Day Trips	1,566	252		394,592	2.2%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	1,240	210	1,180,227	260,187	22.0%
	Totals	17,630		18,248,960	4,160,255	22.8%
60 Min.	**From Auto**	11,055	252	14,994,213	2,786,952	18.6%
	Day Trips	1,433	252		361,185	2.0%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	1,184	210	1,180,227	248,516	21.1%
	Totals	16,420		18,248,960	3,857,403	21.1%
120 Min.	**From Auto**	8,942	252	14,994,213	2,254,395	15.0%
	Day Trips	1,061	252		267,431	1.5%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	958	210	1,180,227	201,027	17.0%
	Totals	13,709		18,248,960	3,183,603	17.4%

4. Impact of I-15 Capacity and Congestion on Ridership (with and without widening)

Runs were made to evaluate the impacts of I-15 congestion on ridership. The base for this analysis was the Rio Station Alternative assuming the monorail spur, which is projected to generate 4.1 million round trips in 2012. It is important to note that this base run already has some auto delay as input to the model run. The delay used is equivalent to delay encountered in a peak category of travel day in 2005. Note that this is average daily delay, not highest hour delay. This corresponds to the delay experienced by survey respondents who indicated their sensitivity to delay.

While highway delays occur throughout the Southern California freeway system, delays on I-15 happen on a recurring basis. The worst case is Sunday evening between Barstow and I-615. However delay also occurs Friday and Saturday on I-15 northbound entering Nevada. Some improvements to I-15 are already under construction or complete. These improvements are in the southbound direction between Barstow and Victorville. Widening and intersection improvements in the northbound direction are also under construction. Additional improvements are planed between Barstow and the Nevada State line. These are currently scheduled to be complete by 2009. Widening all sections of I-15 between Barstow and the Nevada State line is not scheduled at this time but is under consideration.

Clearly, the completion schedule and extent of these improvements will impact highway congestion. As traffic to Las Vegas grows between now and 2012, congestion will get worse. However, some of the scheduled improvements will mitigate some of the expected congestion. The delay was tested under two conditions, to reflect varying rates of completion. In this analysis, it was assumed that the most optimistic 2012 future is that all the announced improvements will be completed by 2012. These improvements should accommodate growth between 2004 and 2012, but possibly may not reduce congestion from current levels.

Improvement levels that would result in lower congestion levels in 2012 were tested, and as expected resulted in a decrease in HSR use. It is further assumed that highway improvement projects not scheduled now, will not be complete by 2012. A large improvement project completed by 2012 (say, continuous widening of I-15 from Victorville to I-215 in Las Vegas) would result in a reduction in congestion, and a decrease in HSR ridership from the base level of 4.1 million 2-way trips.

Two levels of delay were tested. One assumes that improvements between Victorville and Barstow are complete, but all the improvements on I-15 between Barstow and Nevada are not compete. The additional delay for this scenario is 35 minutes. Keep in mind that this is in addition to current delay, and is an average between Northbound and Southbound traffic. (Sunday traffic to California is more congested than Friday northbound travel.) The worst-case scenario hypothesizes that all the planned improvements between Barstow and Victorville will not be completed by 2012, and meaningful improvements will not be completed on I-15 between Barstow and Nevada. The additional delay for this scenario is 55 minutes.

Another factor is involved in evaluating the impact of congestion and delay on ridership. Currently, the worst congestion only occurs Friday and Saturday northbound and on Sunday southbound. Based on traffic counts at the Nevada border, it would appear that congestion does not extend throughout the day, even on Friday and Saturday. Currently all travelers to Las Vegas do not experience delay. Sixty-seven percent of the trips occur at a time during the week when there is no delay. Another 20% experience delay, but only 13% of the trips experience the worst case congestion. This measure of peaking was used to develop ridership estimates based on congestion. For instance, in the worst case congestion, 67% of the trips would not experience additional congestion so ridership for that group should be based on mode share reflecting no additional congestion. However, 20% of the trips would experience moderate congestion represented by the 35 Minute delay. Finally, 13% of the trips would experience severe congestion in line with the run made with the 50 minute delay. The composite of these trips is a forecast of 3.6 million trips diverted from auto. This ridership is higher than the 3.4 million trips forecast with no delay, but lower than the 4.1 million diversions that would be expected if heavy congestion were to occur every day all year round. These estimates should be used as ranges due to the uncertainty associated with the extent of future delay.

Table 12

Ridership Depending on Congestion

Modeled Conditions	HSR from drive	Normal Flow	Moderate Congestion	Heavy Congestion	Ridership Increases Only During Peak
	100% Effect	67%	20%	13%	
Base Delay	3,439,319	2,302,216	697,710	439,393	3,439,319
35 min	3,745,995	2,302,216	697,710	478,573	3,478,498
50 min	4,058,569	2,302,216	759,923	518,506	3,580,645

Estimated 2012 Ridership with Congestion Only During Peaks

Assumed Status of I-15	HSR from Auto	HSR from Bus	HSR from Air	Total HSR Trips
All I-15 Improvements complete	3,439,319	260,187	460,750	4,160,255
Barstow to Victorville Complete	3,478,498	263,151	460,750	4,202,399
Planned Improvements Not Completed.	3,580,645	270,878	460,750	4,312,273

Ridership variation with delay is shown below. The delay elasticities increase at a higher rate as delay gets longer. When 35 minute delay is added, the auto model elasticity is a relatively low

.094. However as the added delay nears an hour, the elasticity significantly increases to 0.168. If highway congestion would result in a 60 or 70 minute delay on a regular ongoing basis, the impact on ridership would be positive. As noted previously, as some improvements are already being carried out on I-15, this worst-case scenario does not seem likely at this point in time. Of course diversion from air is not impacted by highway congestion.

Table 13
Sensitivity of Ridership to Delay

I-15 Delay	HSR Fare $55	Ave. Friday HSR Trips	Ratio, Annual to Pk Day	Annual Trips By Mode	Annual Trips HSR	Market Share
Reduction in Delay	From Auto	11,824	252	14,994,213	2,980,739	19.9%
	Induced Day Trips	1,533	252		386,299	2.1%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	1,214	210	1,180,227	254,719	21.6%
	Totals	17,318		18,248,960	4,082,507	22.4%
No New Delay	From Auto	12,077	252	14,994,213	3,044,727	20.3%
	Induced Day Trips	1,566	252		394,592	2.2%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	1,240	210	1,180,227	260,187	22.0%
	Totals	17,630		18,248,960	4,160,255	22.8%
Additional 35 Min Delay	From Auto	13,154	252	14,994,213	3,316,219	22.1%
	Induced Day Trips	1,705	252		429,777	2.4%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	1,350	210	1,180,227	283,387	24.0%
	Totals	18,957		18,248,960	4,490,132	24.6%
Additional 50 Min Delay	From Auto	14,252	252	14,994,213	3,592,930	24.0%
	Day Trips	1,848	252		465,638	2.6%
	From Air	2,747	168	2,074,520	460,750	22.2%
	From Bus	1,463	210	1,180,227	307,034	26.0%
	Totals	20,310		18,248,960	4,826,352	26.4%

D. Ridership and Revenue Forecasts

Ridership and revenue forecasts are based upon a primary indicator of Las Vegas area economic activity—hotel, motel, and timeshare/condo availability and usage—and the base fare of $55.00 per one-way trip presented previously.

It is to be emphasized that the projections presented below are based upon specific sets of circumstances and conditions, as noted below.

- A continuation of generally good economic conditions, both nationally and with respect to the Las Vegas urban areas;
- The maintenance by Las Vegas of its current competitive position within the gaming/tourism field and the continued achievement of reasonable hotel/motel room occupancy rates;
- The promotion and operation of the high-speed rail project with a dedicated management team in an efficient, customer-oriented manner, and the provision of a suitable promotion budget;
- No government actions, at any level, which will adversely affect ridership and/or fare box revenues of the high-speed rail system.

Information outlining recent and near-term future levels of Las Vegas lodging rooms is presented in the accompanying table.

Table 14

Projected Las Vegas Lodging Rooms(1,000's)

	2003(3)	2004(1)		2005(2)		2006(2)		2007(2)		2008(2)		2009(2)		Projected Remaining(2)	
		% Chg	Amt.	% Chg	Amt.	% Chg	Amt.	% Chg	Amt.	% Chg	Amt.	% Chg	Amt.	% Chg	Amt.
Hotels/Motels			127.7	3	131.5	1	132.8	3	136.8	7.2	146.7	3.3	151.6	10.1	166.9
Timeshare/Condo/ Condo "Hotels"/ Rentals			4.7	14.9	5.4	44.4	7.8	55.1	12.1	59.5	19.3	8.3	20.9	108.1	43.5
Totals	127.4	3.9	132.4	3.4	136.9	2.7	140.6	5.9	148.9	11.5	166	3.9	172.5	22	210.4

(1) Actual rooms as of December 31, 2004.
(2) Projected rooms from December 1, 2005 Construction Bulletin.
(3) From URS Downtown Monorail Report.

The average growth rate for hotel/motel rooms between 2004 and 2009 is 3.5 percent annually. If the balance of the current projection, (based on the Las Vegas Construction Bulletin), takes roughly three years to occur, then this growth level is consistent with that future build-out of currently planned development. However, it is likely and prudent to consider future constraints on growth over the long term due to such factors as: development site availability; infrastructure needs and costs (including water); and the effects of competitive leisure time locations. It is thus reasonable to use, for long-term HSR forecasting purposes, a growth in hotel/motel rooms of somewhat under 3 percent per year for the 2010-2020 decade, 2 percent per year for 2020-2030, and 1 percent a year for 2030-2040.

The information summarized in the above table indicates that timeshares, condominiums, condo "hotels" and rental apartments will be constructed and utilized at a much faster rate than hotel/motel rooms over the ensuing decades. This is a clear market change from previous decades, but current activity strongly supports this shift in the composition of rooming stock in Las Vegas. Based upon a very low base level, the average 2004-2009 growth in timeshares/condos averages 36 percent annually. The "build-out" information indicates a slightly lower, but still very substantial, annual rate of development. Since the same constraints on overall Las Vegas area development over the succeeding decades that are noted above apply to timeshares/condos, it appears reasonable to assume a roughly 13 percent annual growth rate for the decade starting in 2010, 4 percent for 2020-2030, and 3 percent annually for 2030-2040.

However, high-speed rail ridership generated by occupants of timeshares/condos needs to reflect the facts that a higher duration of stay in such units is most likely, as is a higher vacancy rate. Thus before combining the timeshare/condo and hotel/motel rates, the former growth factors should be reduced. In the weighting process of the hotel/motel and timeshare/condo rates, it is also useful to note that in 2004 timeshare/condo rooms amounted to approximately 4 percent of total rooms in the Las Vegas area, whereas in 2010 and the years immediately following, available information indicates that timeshares/condos will constitute approximately 20 percent of the Las Vegas room stock.

Based upon the foregoing considerations, the basic growth in high-speed rail ridership is estimated at 4.0 percent annually for the decade starting in 2010, 2.3 percent annually for the 2020-2030 decade, and 1.2 percent annually for the 2030-2040 period. Once the high-speed rail project is open to the public, there will be a period of time during which ridership is building up to forecast levels due to a lack of familiarity with the new service and an adjustment of travel and Las Vegas visitation habits. This is typically termed "ramp-up" and deductions from early year ridership levels are estimated based upon comparable facilities and experience elsewhere. In the case of the subject project, there are no "comparables" and it is thus prudent to use a ramp-up deduction of 40 percent during the first year of operation, 20 percent during the second year and nothing in the third and subsequent years.

The following table presents annual ridership and revenue levels for the 2010-2040 period, based upon the considerations and factors outlined above. The revenue projections assume continued growth in the consumer price index (CPI) of 2 percent annually on the average, which is reflected in a fare increase of 6 percent every three years. Since the periodic increases are consistent with general price levels, elasticity deductions are not appropriate. The ridership assumes the base alternative where the Rio site is the HSR station in Las Vegas, and Victorville is the only station in California. Consequently, ridership for a possible Barstow station is not included.

Table 15
HSR Ridership and Revenue

		Round Trips by Previous Mode in Millions					Fare	Revenue
Year	**Growth**	From Auto	Day Trips	From Air	From Bus	Total Ridership	Round Trip CPI Adj.	Values in Millions
2010	4.00%	1.374	0.178	0.208	0.117	1.877*	$ 110.00	$ 206.5
2011	4.00%	2.363	0.306	0.358	0.202	3.229*	$ 110.00	$ 355.1
2012	4.00%	3.045	0.395	0.461	0.260	4.160	$ 110.00	$ 457.6
2013	4.00%	3.167	0.411	0.479	0.271	4.327	$ 116.73	$ 505.1
2014	4.00%	3.293	0.427	0.498	0.281	4.500	$ 116.73	$ 525.3
2015	4.00%	3.425	0.444	0.518	0.293	4.680	$ 116.73	$ 546.3
2016	4.00%	3.562	0.462	0.539	0.304	4.867	$ 123.88	$ 602.9
2017	4.00%	3.704	0.480	0.561	0.317	5.062	$ 123.88	$ 627.0
2018	4.00%	3.853	0.499	0.583	0.329	5.264	$ 123.88	$ 652.1
2019	4.00%	4.007	0.519	0.606	0.342	5.475	$ 131.46	$ 719.7
2020	2.30%	4.099	0.531	0.620	0.350	5.601	$ 131.46	$ 736.3
2021	2.30%	4.193	0.544	0.635	0.358	5.730	$ 131.46	$ 753.2
2022	2.30%	4.290	0.556	0.649	0.367	5.861	$ 139.51	$ 817.7
2023	2.30%	4.388	0.569	0.664	0.375	5.996	$ 139.51	$ 836.5
2024	2.30%	4.489	0.582	0.679	0.384	6.134	$ 139.51	$ 855.7
2025	2.30%	4.592	0.595	0.695	0.392	6.275	$ 148.05	$ 929.0
2026	2.30%	4.698	0.609	0.711	0.401	6.419	$ 148.05	$ 950.4
2027	2.30%	4.806	0.623	0.727	0.411	6.567	$ 148.05	$ 972.2
2028	2.30%	4.917	0.637	0.744	0.420	6.718	$ 157.11	$ 1,055.5
2029	2.30%	5.030	0.652	0.761	0.430	6.873	$ 157.11	$ 1,079.7
2030	1.20%	5.090	0.660	0.770	0.435	6.955	$ 157.11	$ 1,092.7
2031	1.20%	5.151	0.668	0.779	0.440	7.039	$ 166.72	$ 1,173.5
2032	1.20%	5.213	0.676	0.789	0.445	7.123	$ 166.72	$ 1,187.6
2033	1.20%	5.275	0.684	0.798	0.451	7.209	$ 166.72	$ 1,201.8
2034	1.20%	5.339	0.692	0.808	0.456	7.295	$ 176.93	$ 1,290.7
2035	1.20%	5.403	0.700	0.818	0.462	7.383	$ 176.93	$ 1,306.2
2036	1.20%	5.468	0.709	0.827	0.467	7.471	$ 176.93	$ 1,321.9
2037	1.20%	5.533	0.717	0.837	0.473	7.561	$ 187.76	$ 1,419.6
2038	1.20%	5.600	0.726	0.847	0.479	7.652	$ 187.76	$ 1,436.6
2039	1.20%	5.667	0.735	0.858	0.484	7.743	$ 187.76	$ 1,453.9
2040	1.20%	5.735	0.744	0.868	0.490	7.836	$ 199.25	$ 1,561.4
Total Revenue 30 Year Period, Current Dollars								**$ 28,629.9**

***** Includes ramp-up deduction

F. Model Development and Documentation

1. Southern California to Las Vegas Travel Market

The first step in estimating market share for a proposed project is to establish the size of the total market. When the market estimate for the previous study of high speed rail between Victorville and Las Vegas was being carried out, recreation travel had not yet stabilized after the impacts of 9-11. Now, Las Vegas visitation is finally beginning to grow again, and the impacts of airport security measure implemented after 9-11 have stabilized. To the extent possible, the assumptions for this study have been updated to reflect current conditions. In most cases the revised data is from 2004.

There was some difficulty in establishing the highway control for travel between Southern California and Las Vegas. The main source of ambiguity had to do with auto trips. The difficulty was in rationalizing the traffic counts of vehicles entering Nevada from California with the Las Vegas Convention and Visitor Authority's estimate of Las Vegas visitors from Southern California. When traffic counts were used to measure auto travel, total trips exceeded the LVCVA visitor estimate.

Since the ambiguity revolved around the question of what share of the I-15 vehicles had Las Vegas destinations, it w4as decided to do a survey of I-15 users. The survey was carried out at Baker, California a/o November 10, 11, and 12, 2005. Three types of data were collected; Mainline Classification Counts, Ramp License Plate Counts, and Interviews at the parking lots of service of stations and restaurants. The table below shows an estimate of the share of I-15 vehicles that have destinations in Las Vegas. The table combines information from the various surveys mentioned above. Counts were not taken for the complete 24 hour period, so the values were expanded using 24 hour I-15 count data. The number of vehicles was converted to annual trips by using a ratio between summer average Friday traffic and annual travel.

Table 16

I-15 Survey Expanded to Annual Auto Visitor Control

Survey Expanded To 24 Hr	Total Daily Vehicles	Privately Owned Vehicle	Share POV	California Plates	Less Through Traffic	LV Visitor Share of I-15
Mon-Thur	19,199	16,343	85.1%	13,565	12,670	77.5%
Fri	33,782	30,943	91.6%	27,601	25,779	83.3%
Sat	19,497	17,468	89.6%	14,655	13,688	78.4%
Sun	39,408	37,416	94.9%	34,311	32,046	85.6%
Total Weekly	169,483	151,201			122,193	
Ave Day of Week	24,212	21,600	89.2%		17,456	80.8%
2004 Count, California Nevada Border	Tot Vehicles		Annual I-15 Auto		Annual to Las Vegas	Share to Las Vegas
Annual 1-way Vehicles	7,475,291		6,668,934		5,389,500	**72.1%**

The mainline counts established that autos made up 89.2% of the I-15 traffic. Based on the ramp survey, it was determined that 80.8% of the autos and other privately owned vehicles had California plates. Using origin destination data collected in the interview survey, the share of vehicles with destinations other than Las Vegas was established. These trips were removed, as shown in the table above. Based on these reductions, it was determined that 72.1% of the vehicles on I-15 carried passengers with destinations in Las Vegas. The average occupancy of the vehicles surveyed was 2.46 persons per vehicle; and the average number of daily one-way persons traveling from California to Las Vegas was 36,324.

The survey showed that not all the California trips on I-15 come from Los Angeles, Orange County or Southern San Bernardino County. Seven percent of the vehicles came from San Diego. Another 8.4% came from north of Los Angeles. Surprisingly, more than half of these northern trips come from Sacramento, Oakland and places even further north. A somewhat smaller share comes from Bakersfield, Fresno, and other closer in areas. The Barstow area generates 2.9% of the I-15 trips. The San Diego trips can use the Victorville station. However, it is not reasonable to expect that the trips from Barstow and north would use the Victorville station. They could use a Barstow Station and so the Barstow station was evaluated.

Table 17
I-15 Survey Information Converted to Annual

2004 S. California to Las Vegas Travel Estimate	Survey Based Estimate	Origin Share of I-15 Trips
I-15 AADT at Border (1-way)	7,475,291	
Visitor Share of I-15 Count	72.1%	
Annual Auto Visitor Vehicles	5,389,500	
Persons per Auto	2.46	
Annual Auto Visitor Persons	13,258,169	
Auto LA Metro	10,435,211	78.7%
Victorville Area	408,842	3.1%
Barstow / North	379,639	2.9%
Bakersfield	262,827	2.0%
Bishop	116,812	0.9%
Fresno	87,609	0.7%
Sacramento/Folsom	311,499	2.3%
Oakland/San Francisco	214,155	1.6%
Red Bluff/Anderson	116,812	0.9%
Auto San Diego	*924,762*	7.0%
Annual Auto Visitor Persons	13,258,169	100%
Less Day Trips	-1,687,403	
Stay Other Than Hotel/Motel	-2,892,691	
Auto Visitors Consistent with LVCVA Visitor Estimates	8,678,074	
Air (LA Metro Only)	1,573,315	
Bus (LA Metro Only)	897,035	
Total Visitors from Southern California	11,148,424	
2004 Las Vegas Visitors	37,388,781	
S. California Share	29.8%	

An important part of the interview survey was to determine how much of the travel to Las Vegas would be day trips, and what share of the other visitors do not stay at hotels or motels. The survey showed that 12.7% of the trip makers were day trips, and another 21.8% of the trip makers did not use public overnight accommodations. This explains why auto based trip makers can not be reconciled with the Las Vegas Convention and Visitor Authority's (LVCVA) visitor estimate. LVCVA assumes that only 1% of their visitors are day-trippers. Clearly, that 1% does not apply to California visitors. In addition, LVCVA does not count visitors who stay in timeshares, condominiums or at friend’s houses.

It can be see from the I-15 survey that these uncounted visitors are significant. It is possible that trip makers who do not stay at public accommodations are less likely to utilize Las Vegas entertainment facilities. This possibility may contribute to the observation that there are more auto trips to Las Vegas than the LVCVA annual estimate for California visitors. When comparing the study estimate to the LVCVA estimate of visitors from Southern California, these auto trip types should not be included since they would likely not be included in the LVCVA Visitor Profile estimates. The table above shows that with these trips removed, the study estimate of the Las Vegas market is 29%.

New visitor controls were established based on the survey, and a revised California to Las Vegas trip table was developed. These can be considered as one-way trips or round trips. The total average Friday market for California to Las Vegas travel was 56,700 daily trips, or 14.24 million annual trips. Of these, 11.77 million were by auto, 1.57 million by air, and 0.9 million by bus. The bus volume was based on the classification counts taken at Baker and is higher than was used in previous visitor controls. The air travel estimate is described below. These numbers do include the San Diego area, but do not include autos bound for Barstow and points north. There were 1.49 million trips from Barstow, Bakersfield, Sacramento, Oakland and so on. These trips can only be served by Desert Xpress service if there is a Barstow station. The air and bus markets were limited to the tributary areas of the five Los Angeles area airports.

Air travel to Las Vegas from California airports was updated using the FAA 2004 airport-to-airport travel survey and 2004 airport activity reported by individual California airports. The passenger activity at McCarran airport (LAS) in Las Vegas was also used in the analysis. The FAA travel survey is developed from a 10% sample of airline passengers. However, an analysis of the data showed that not all airports had a ten percent sample. Because of this, the FAA origin destination data was used to establish the percentage of trips headed to LAS from each airport. The percentage was then multiplied by the annual air traffic activity reported by each airport for 2004. The Table below shows the estimated trips to Las Vegas by each of the study area airports

Table 18
Air Travel Control for 2004

Traffic to Las Vegas (LAS)		Annual	Pk Month	Pk Week	Weekend Day
LAX	Los Angeles	745,569	65,610	14,815	4,445
LGB	Long Beach	82,605	7,269	1,641	492
BUR	Burbank	326,145	28,701	6,481	1,944
ONT	Ontario/San Bernardino	205,426	18,077	4,082	1,225
SNA	Santa Ana	213,571	18,794	4,244	1,273
LA Metro Area Subtotal		1,573,315	138,452	31,263	9,379

2. Airport and Highway Measures of Congestion and Delay

The previous study did not explicitly take into account security checkpoint wait times and other expected delays, which can occur at individual airports. Data describing these delays were found from a number sources. Probably the most reliable data are the Security Checkpoint Wait times provided by the Transportation Security Administration. Another important source of delay data is the Delta customer advisory information provided at their web site. In addition to these sources, surveys carried out by Travelocity since 9-11 were also used. Data was usually available for peak and off peak travel times. The difference between these two measures was used to quantify airport delay.

Table 19
Airport Delay Measures

Airport	Airport Delay Used In Model			Peak				Off Peak			
				Delta Study			TSA Times	Delta Study			TSA Times
	Off Pk Airport Time	Peak Airport Time	Airport Delay	Total	Curbside	Counter	Security	Total	Curbside	Counter	Security
Burbank (BUR)	13.0	21.5	8.5	21.5	5	15	9	13	5	10	3
Los Angeles (LAX)	27.5	59.5	32.0	59.5	55	60	20	27.5	25	30	9
Ontario (ONT)	13.5	35.0	21.5	35	10	15	20	13.5	5	5	6
Orange County (SNA)	13.0	39.0	26.0	39	20	30	9	13	5	10	3
Las Vegas (LAS)	10.0	30.0	20.0	30	15	30	20	10	5	10	6

In this study, highway travel times are calculated using a highway network provided by the Orange County Transportation Authority (OCTA). For this study update, an effort was made to update the congested speeds on the network. In order to quantify Los Angles area congestion (including parts of Ventura, Orange, and San Bernardino Counties) data was collected from a number of sources. The first step was to take Southern California locations published in a ranking of the 25 worst congestion locations throughout the United States. There were seven study area locations in this reports sponsored by American Highway Users Alliance. The worst intersection in the U.S. was reported to be US 101 (Ventura Freeway) at the I-405 interchange.

After these recurring congestion locations were identified, an effort was made to identify segments of freeways where delays tend to occur. The best discussion of congestion was a list of segments “Freeways to Avoid” found on the Total Escape Web Site. When clarification was needed for some locations, real time traffic reports of speed and delay provided by Sigalert were used. Highway travel time was then calculated from every study area ZIP to nearby commercial airports and to Victorville. Travel times were calculated twice, once using the typical speeds found in the OCTA model and then using the speeds from the updated congestion network. The difference between the two sets of travel times was used as the measure of traffic delay.

3. Southern California Demographic Analysis

Las Vegas trip ends are allocated to Southern California ZIP codes based on population. The population in the ZIP level database was updated to 2004. This update was based on a report developed by the State of California, Dept of Finance, Demographic Research Unit. In some places population changed significantly. Much of this growth occurred in the County of San Bernardino. Victorville, Apple Valley and Hesperia were among the fast growing cities.

Population projections were also developed for 2012. Population projections by County were also available from the Dept of Finance. In order to apply the county forecasts to cities within the counties, the assumption was made that cities showing higher growth between 2000 and 2004 would continue to grow through 2012. While this effort was made to capture any change in trip origin distribution due to development, there was no noticeable change in distribution between

2004 and 2012. This may be because the trips coming from heavily developed areas probably "overpower" the faster growth occurring around the edges.

There were three levels of analysis used in updating trips to Las Vegas from Southern California. First, total trip controls were established for auto and air travel. Then, these trips were allocated to districts call Super Zips. This allocation process used trip generation and distribution values established in a number of surveys. Charter bus estimates were added at this point. Finally the trips were allocated by mode to each ZIP in the study area using the population information described above.

4. Web Survey Used to Assess HSR Market

A web based panel survey was carried out to determine how strongly people would value the reliability, fun, comfort, convenience, and perceived safety of HSR as compared to the auto and air modes. The survey incorporated a stated preference element and analysis using statistical modeling methods. The survey sample of 400 was drawn from Resource Systems Group Survey Café Panel, a nationally-representative participation panel with industry-leading response rates that has been used for numerous high-profile survey projects. The proposed high speed rail service was described and respondents were asked how likely they would be to make trips to Las Vegas using this service.

The stated preference survey was then used to determine the conditions under which travelers would use the proposed HSR service. This information was then analyzed using statistical analysis techniques. This resulted in two-mode choice models estimated from the survey results. The first was a model for binary choice between Auto Travel and the Las Vegas HSR. The second was model for binary choice between Air Travel and Las Vegas HSR. The following three tables provide a documentation of these models.

Table 20

Mode Choice Parameters, Las Vegas HSR Stated Preference Survey

Model Application Inputs

HSR

Travel time (Victorville to Las Vegas)	105 minutes used in SP survey
Fare (per person, one way)	$40-$70 range tested in SP survey
Frequency of service	Pick from list of levels tested in SP survey
Access cost per mile (by auto)	$0.25-$0.29 range tested in SP survey
Average minutes delay for HSR trip	This is for whole trip
Egress time in Las Vegas (average in minutes)	10-20 minutes tested in SP survey
Egress cost in Las Vegas (average in dollars)	$5-$10 tested in SP survey

Auto

Average party size for current auto travelers	2.70 average from sample used for model estimation
Median household income for current auto travelers	$70K is midpoint of median income of sample used
Travel time Victorville to Las Vegas (minutes)	165 minutes
Distance Victorville to Las Vegas (miles)	188 miles
Cost per mile	$0.25-$0.29 range tested in SP survey for auto access
Average minutes delay for auto trip	This is for whole trip

Air

Average party size for current air travelers	2.31 average from sample used for model estimation
Median household income for current air travelers	$70K is midpoint of median income of sample used
Flight time (Origin Airport to Las Vegas)	64 minutes average from sample used for model
Average air fare (per person, one way)	$73.25 average from sample used for model estimation
Average access cost (per person, one way)	$6.88 average from sample used for model estimation
Average minutes delay for air trip	This is for whole trip
Egress time in Las Vegas (average in minutes)	30-45 minutes tested in SP survey
Egress cost in Las Vegas (average in dollars)	$5-$10 tested in SP survey

Table 21
Binary Choice Model between Auto Travel and Las Vegas HSR

Variable	Label	Units	Estimate	Standard Error	T-Ratio	Value Of Time
Travel Time	Time	Minutes	-0.006	0.001	-6.4	$ 9.00
Cost of Travel	Cost	$*	-0.410	0.023	-18.2	
Reliability (Average Minutes Late)	RelAvMins	Minutes	-0.004	0.005	-0.9	
Distance to Victorville	AcDist	Miles	-0.008	0.003	-1.0	
Frequency – 2 per Hour	Freq2pH	(0,1)	0.722	0.138	5.2	
Frequency – 1 per Hour	Freq1pH	(0,1)	0.606	0.136	4.4	
Frequency – 1 per 2 Hours	Freq1p2H	(0,1)	0.348	0.139	2.5	
Frequency – 1 per 4 Hours	Freq1p4H	(0,1)	0.000	0.000	0.0	
Curent Mode Constant	cmcon	(0,1)	0.188	0.277	0.7	

Number of Observations	2400
Number of Respondents	300
Log Likelihood	-1304.18

*Cost of travel is total cost of travel divided by party size

Cost is also divided by natural log of income, where income is household income in $

** VoT is evaluated at $70,000 per annum household income

Notes:

Reliability is specified for just the auto alternative and is in terms of average minutes late. It has the correct sign and a reasonable magnitude (i.e. it is similar to the other time coefficient in the model), but it is not statistically significant

Sensitivity to in-vehicle time was found to be statistically similar to access and egress time

Table 22
Binary Choice Model between Air Travel and Las Vegas HSR

Variable	Label	Units	Estimate	Standard Error	T-Ratio	Value of Time**
In-Vehicle Time	IVTime	Minutes	-0.012	0.005	-2.4	$ 30.44
Access, Wait and Egress Time	AcEgTime	Minutes	-0.025	0.004	-5.6	$ 60.69
Cost of Travel	Cost	$*	-0.104	0.015	-7	
Reliability (Average Minutes Late)	RelAvMinutess	Minutes	-0.018	0.020	-0.9	
Curent Mode Constant	cmcon	(0,1)	-0.243	0.317	-0.8	

Number of Observations	408
Number of Respondents	51
Log Likelihood	-204.21

*Cost of travel is total cost of travel divided by party size and divided by log of household income in thousands

The model was significantly improved by transforming cost by 1/log (income), indicating that cost sensitivity is inversely proportional to the log of income

Notes:

Reliability (represented here as average minutes late) has the correct sign and a reasonable magnitude (i.e. it is similar to the other time coefficient in the model), but it is not statistically significant

A specification has not been found that shows frequency to be statistically significant

5. Model Sensitivity Analysis Statistics

Research Systems Group carried out a sensitivity analysis on the air model and the version 3 auto model (without the income effect), the results for which are shown in the following Table.

Random numbers were drawn independently for each iteration for each coefficient from a univariate normal distribution. There were 1000 iterations run.

The results show that the market shares estimated using the models have a 95% confidence interval around them of +/- 8.5% for the auto model and +/- 8.4% for the air model.

Table 23
Sensitivity Analysis Statistics

	Auto Share	HSR Share vs. Auto	Air Share	HSR Share vs. Air
95% Confidence Interval: 1.96*St Dev	8.5%	8.5%	8.4%	8.4%
Lower Bound of 95% Confidence Interval	62.3%	20.6%	51.6%	31.6%
Upper Bound of 95% Confidence Interval	79.4%	37.7%	68.4%	48.4%
Standard Deviation of iteration results	4.4%	4.4%	4.3%	4.3%
Minimum of iteration results	56.2%	16.9%	46.4%	27.8%
Maximum of iteration results	83.1%	43.8%	72.2%	53.6%
Number outside 95% Confidence Interval	46	46	46	46
% of iterations outside Confidence Interval	4.6%	4.6%	4.6%	4.6%

APPENDIX C

DESERTXPRESS RIDERSHIP & REVENUE AUDIT

Technical Memorandum: FRA Summary

September 2007

Prepared for:

Federal Railroad Administration
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SUMMARY

Introduction

1. ACS Infrastructure North America (ACS), a division of Iridium Concesiones de Infraestructuras S.A., one of the world's largest transportation concession and construction companies, is considering participation in the DesertXpress project. As part of their analysis, they commissioned Steer Davies Gleave (SDG) to carry out a review/audit of the traffic and revenue forecasts prepared by URS on behalf DesertXpress Enterprises Inc. (DXE), in support of the Victorville California to Las Vegas High Speed Train referred to as the DesertXpress.

2. DXE has informed ACS and SDG that the Federal Railroad Administration (FRA) is conducting an independent peer review of the draft URS study to *"analyze the soundness of the technical approach and data collection effort, the likelihood of the assumptions on which the forecast is based, and the reasonableness of the results"*.

3. In this context, DXE has asked ACS and SDG if they might prepare a technical memorandum summarising the review/ audit which can be passed to the FRA to assist them, and has stated that they have authorized ACS to release such memorandum directly to FRA so the FRA can provide this memorandum to their own independent consultants, Cambridge Systematics.

4. In response, SDG have prepared this document. It should be noted that the SDG report to ACS/Iridium is considered by both ACS/Iridium and DXE to be proprietary and confidential. This memorandum consists of non-proprietary excerpts from the Executive Summary of the report that are germane to the scope of the FRA's independent peer review in support of the EIS.

5. The scope of work of the SDG assignment for ACS/Iridium included several tasks which appear to be relevant to the scope of the FRA's independent peer review for the Environmental Impact Statement (EIS), including the following:

   - Review the URS ridership and revenue report and the data collected by URS for its study, including observed economic and traffic data (car, airplane and bus) and Stated Preference surveys undertaken;
   - Review the methodology used by URS to evaluate ridership capture rates, competing modes and forecast ridership and growth factors;
   - Identify key risks and produce a report with tasks carried out and conclusions.

   This memorandum summarizes the above SDG tasks.

6. In addition to the above audit of the forecasts, Iridium also requested advice on:

   - Operations (train plan, number of trains needed);
   - Other potential sources of revenues (advertising, stations retail, etc); and
   - The car park size and access junctions' capacity at Victorville station.

   This memorandum summarizes this advice, and includes DXE's comments to the SDG advice in these areas of investigation.

The Project

7. The DesertXpress High Speed Train is to run from Victorville, CA to Las Vegas, NV. Victorville is 80 miles northeast of downtown Los Angeles and located on the existing I-15 highway running between LA and Las Vegas. All drivers travelling from Southern California to Las Vegas must pass Victorville.

8. The train service will run at about 125 mph and allow an end to end Las Vegas to Victorville journey time of less than two hours. Trains will be operated by 10-car train sets and have *initially* been assumed to depart every day of the year from 6 am to 10 pm, running every 20 minutes from Friday to Sunday and every hour during the rest of the week.

9. Various facilities and services would be provided on board the train and at Victorville station, where users will also be able to park their car at no additional cost. These services could include hotel check-in facilities, baggage services, valet parking and entertainment.

The URS Forecasts

10. Passenger forecasts were developed by URS for the proposed high-speed rail service.

11. These forecasts were produced using a *spreadsheet-based forecasting model* which looked at the *mode capture of different flows* to Las Vegas for car, air and rail travel.

12. In order to estimate the capture rate of the various modes, a suite of binary logit choice models was used. These models relied on coefficients derived from an internet-based *stated preference (SP) survey* of selected Southern California residents, carried out by Resource Systems Group Inc. (RSG).

13. Since the URS report was prepared before the probable decision to operate the Regina EMU train sets, which are able to achieve a run time of close to 100 minutes, the assumptions underlying the *URS* ***Base*** *Case* were a $55 one-way fare (2012 prices) and a rail journey time of 116 minutes from Victorville to the future Rio station (or other possible locations in Las Vegas, where a projected monorail branch may also provide a link to the main monorail line which presently runs parallel to the Las Vegas Strip).

14. In this base case, it was estimated that the total 2012 market between Southern California and Las Vegas was 18.2 m round trips. It was then projected that the DesertXpress would capture 22.8% of the total market.

15. Additionally, it was estimated that the new HSR service would generate a further 0.4 m (day) trips, giving a total traffic on the HSR of 4.16 m round trips per year. These forecasts are summarised in Table 1 and Table 2 overleaf.

TABLE 1 URS 2012 BASE CASE FORECAST OF DX RIDERSHIP

	2012 Trips By Mode no DX	2012 Market Share no DX	2012 Trips by Mode with DX	2012 Market Share with DX
Car	14,994,213	82%	11,949,486	64%
Air	2,074,520	11%	1,613,770	9%
Bus	1,180,227	6%	920,040	5%
DesertXpress	--	--	4,160,412	22%
TOTAL	**18,248,960**	**100%**	**18,643,708**	**100%**

Source: URS Ridership and Revenue Study, Table 1, SDG Analysis

TABLE 2 URS 2012 BASE CASE FORECAST OF DX RIDERSHIP

Diversion to DX	Annual DX Trips	Capture	DX Demand
From Car	3,044,727	20.3%	73%
From Air	460,750	22.2%	11%
From Bus	260,187	22.0%	6%
Induced Day Trips	394,748		9%
TOTAL	**4,160,412**	**22.8%**	**100%**

Source: URS Ridership and Revenue Study, Table 1, SDG Analysis

The Total Travel Market

16. In order to estimate the size of the total market of travellers between Southern California and Las Vegas, for the I-15 highway mode, URS relied on NDOT traffic count data to determine the total average daily traffic on the I-15 but found some differences compared to travel information published by the Las Vegas Convention and Visitors Authority. In an effort to understand those differences and develop reliable highway mode travel data, a roadside survey was carried out at the access/ egress from the service station on the I-15 at Baker to determine the following information about the car market:

- The percentage of trucks;
- The visitor share of traffic;
- Average vehicle occupancy; and
- O-D patterns, including the percentage of motorists whose final destinations were within the Las Vegas area.

17. These results are reported by URS in Table 17 of their report. We note that URS then ensured that this data reflected LVCVA visitor estimates.

18. Trips by air from Southern California to Las Vegas were estimated using 2004 airport travel surveys.

19. *We agree that the estimates prepared by URS for the total volumes in the base year and for the growth rates for subsequent years appear reasonable.* We do note, however, that in our analysis we have applied a reduction to base demand levels to reflect the number of trips which we believe are undertaken during those hours when, under the presently proposed operating plan, the service is not operated. (Subsequently, DXE has indicated that it would of course be possible to develop a different operating timetable which would include the operation of trains later into the evening – and thus capturing further passengers.)

Traffic Capture

20. In order to estimate the rate of capture of traffic from each of the different competing modes, a suite of binary logit choice models was developed. These models were estimated using analysis carried out by RSG, including an internet-based stated preference (SP) survey carried out among residents of Southern California.

21. We believe that these surveys do give useful insights into the potential of capture of the new rail service; however, we do have some doubts about the robustness of the SP analysis. The number of choice attributes included was high, which made the SP exercise very complex. However, the selection of attributes was conventional – focussing on time and cost – with a complicated representation of trip length reliability. Overall, this has resulted in 46% of respondents non-trading (not varying their choice between rail and current mode) which we feel is high.

22. It is not clear that the attribute set incorporated in the analysis in reality encompassed the true factors defining the user's choice (i.e. the softer factors of comfort/ the on-board entertainment etc.). Perhaps as a result, the only attributes to which respondents reacted strongly were variations in the cost of the service.

23. Finally, the scaling parameter derived from the SP analysis and incorporated directly into the mode choice model was very small. This ensures that the curve describing the change in capture with change in relative generalised cost is very flat and makes the forecasting model irresponsive to small changes in generalised time. The results obtained from the model were very sensitive to the choice of the scaling factor itself.

The SDG Analysis

24. In order to gain more understanding – *Who travels and how?* – we arranged for a specialist company to carry out a second internet based survey. This small survey was again targeted at adult residents of counties in Southern California who had travelled to Las Vegas within the past year. The key objectives were to gain further understanding of how people perceived the current travel arrangements to/from Las Vegas and to understand what factors might influence their choice to use the proposed DesertXpress rail service.

How do people get to Las Vegas now and what do they think of it?

25. At the moment, those travelling to Las Vegas by car do so because of *cost and convenience*. People travelling by plane did so to obtain a *faster journey* (and also because they found that mode convenient). They agree that the drive can be stressful, but satisfaction levels for getting to Las Vegas are very high both for car and plane. Few respondents in our survey claim to have experienced significant congestion on the road or at the airport. In the URS study, it is estimated that 20% of travellers experienced some congestion on I-15 and 13 % significant congestion.

26. The majority of car drivers do at present use their cars to travel around Las Vegas during their stay, although only a small proportion say that this is necessary – and that this alone would stop them from changing mode and using the train.

27. However, within the sample there is a group of people amongst both car users and flyers who would not consider travelling to Las Vegas in any other way than they do at present.

28. The responses in the survey tend to suggest that travellers are broadly happy with their present choices. To attract traffic, DesertXpress will have to rely to a large extent on the "pull" factors the service would offer. This has already been understood by DXE from their own focus groups - and is consistent with their plans as they have reported them to us.

What do people think of the DesertXpress service?

29. Across the board there was broad support for the DesertXpress proposal; most respondents rated it a *good* or *very good* idea and were willing to consider using it. However, as mentioned above, around a fifth of our sample was not interested in the service.

30. To capture passengers the "pull factors" need to be maximized, i.e., it is essential that the service includes all the possible added services. The inconvenience of having to change mode in Victorville must be reduced to a minimum; free and secure parking at Victorville should be provided and as many elements as possible which add to the seamlessness of the trip (free hotel shuttle services and available taxis at the arrival station in Las Vegas) must be integrated in the DesertXpress concept.

31. Key facilities such as the ability to book tickets in advance or as part of a hotel package, provision on board of food, entertainment, the possibility to book a Las Vegas show, internet access and the possibility of having your luggage checked in at the station and delivered directly to your hotel room were important factors influencing people's decision to use the service. As we noted above, although these factors do not play a significant role in the forecasting models, *DXE have stated to us that they also had identified these requirements and were committed to meet them as far as possible.*

Steer Davies Gleave Forecasts

32. In our conversations with URS and RSG, and in our review of the reports with which we have been provided, we have been able to confirm that the methodology developed by URS for the analysis of the potential traffics for the DesertXpress is in line with that commonly adopted. As such, it is seen to be appropriate for the first phase of the project development process, which includes initial financial planning and environmental impact analysis. For the purposes of more detailed financial planning and the preparation of the final plan of finance, additional detailed work will be needed to prepare what are commonly referred to as "Investment Grade" forecasts.

33. In our brief in our assignment for Iridium, however, we have been asked to move forward from the initial forecasts and provide to our client a further analysis of the forecasts and the risks around them. These estimates were prepared for the purpose of proprietary financial planning/sensitivity analysis, and as such they are not themselves included in the document.

34. In the development of these forecasts, we have retained in great part the assumptions/parameters developed by URS. In particular:

- We have retained the overall estimates of the total market for travel between South California and Las Vegas for the base and future years.
- However, in the light of the *presently proposed* operating schedule, we have reduced 'In Scope Demand' to reflect the proportion of trips likely to be met outside the planned operating hours of the DesertXpress
- We have assumed a train time of 100 minutes and a fare of $55 each way in 2012 prices ($50 in 2007 prices).
- We have retained the capture model structure developed by URS, but have adjusted some of the inputs in the light of our own analysis for the purpose of assisting ACS with their preparation of alternative proprietary project financing scenarios.
- We have taken a more conservative view on the amount of traffic that might be captured from bus.
- We have adjusted downwards the estimated level of induced number of day trips.

35. Our forecasts assume a full range of services including dining, entertainment, hotel and luggage check-in, internet and retail facilities. In addition, we assume an as seamless and stressless trip as possible, which can be ensured by offering free and secure parking with valet, frequent trains and abundant connecting possibilities from the arrival station to the final destination, such as courtesy shuttle buses.

Key Risks

36. In addition to the envelope of risk around these forecasts (inherent in the nature of the forecasting process and the development of traffic forecasting and capture models), we have identified a number of exogenous factors which might impact on the market position of the DesertXpress service.

- Upgrade of the competing road infrastructure
  - As discussed, there are some plans for the upgrade of the I-15. However, those upgrades scheduled for the years up to 2012 have already been included in the Base Case. These improvements allow the present levels of service to be maintained despite traffic growth. In this context, it is not regarded as likely that further investment could be made to further increase the modelled performance of the road.
- DXE states that they are unaware of any funded projects in the pipeline in either state that would add any significant mileage of general traffic lanes – only truck climbing lanes in certain locations.
  - Competing (Amtrak) rail service
- Although discussed in the past, the project to run Talgo-type train sets over refurbished tracks was shelved in the early 2000s It is DXE’s understanding that there is no funding and no proposal on the table for such service
  - Even if such a service were to be built were built, it would be difficult (impossible on the original plans) for Amtrak to put in place a service which could compete with DXE in terms of speed and quality.
- Competing (Maglev) rail service
  - When this project was initially discussed, only some $45 million out of the $1.3 billion required *for the first section* could be raised. It is very unlikely that such a scheme could ever be financed.

Possible Upsides

37. Steer Davies Gleave have identified the following key upsides to the DesertXpress project:

- Fuel price increase
  - Likelihood: high
  - Impact: medium, if the train fare remains unchanged, DesertXpress will become more competitive than air or car
- More scope for day trips
  - Likelihood: high, DesertXpress would allow for day trips to be made
  - Impact: low, these additional trips would only represent a small proportion of total trips
- Implementation of High Speed Rail in California
  - Likelihood: medium, plans are underway to implement High Speed Rail in the long term
  - Impact: medium, this would increase mobility within the region

- Extension of DesertXpress
  - Likelihood: there are proposals on the table for some further rail extensions across the north of the Los Angeles region. However, given the uncertainties associated with such proposals – and the substantial delay inherent in the implementation of such major schemes – these proposals have not been included in the present analysis.
  - Impact: high

Parking Arrangements in Victorville

38. The roads in the vicinity of the location of the Victorville station currently carry relatively light traffic flows and there would appear to be plenty of space available to enhance the junctions if necessary, although more work would be needed to verify this.

39. Given the scale of the car park, its design, both physical and operational, will be critical to achieving a short transfer time between car and train, by allowing appropriate management arrangements such as allowing for a sufficient number of parking spaces and by ensuring a short transfer time from cars to trains.

Review of Systems Operations

40. In general, Bombardier's 'Systems Operations Plan', provides a reasonable overview of the system and how it should be operated. It does make certain assumptions that do potentially have financial implications and therefore associated risk. These are summarised as follows.

Service Run Times Assumptions

41. The run times assumptions do appear 'tight' and could potentially erode the amount of dwell time available to disembark/board passengers, luggage and undertake the minimum amount of time required for cleaning and re-stocking of supplies. In addition, this would impact the amount of recovery margin available during perturbed conditions. Increases to the run time will have a direct impact on the number of services required and associated investment costs. It should be noted here that DXE has stated that Bombardier's run times are not "assumptions". Rather, that they are calculated by Bombardier's comprehensive train simulation model that represents the alignment and the train performance in detail, and further, that their operating plan then adds significant added time to determine the operating schedule, fleet size, train miles and hours, energy consumption, etc. Further, they state that DXE has had a highly qualified independent technology consultant under contract, Interfleet Ltd. based in the UK, who has reviewed and will continue to review, Bombardier's work.

42. It is unclear whether the Regina service will operate on the limited 4.5% maximum grade or the unrelieved 5.8% grades. The latter condition will increase the end-to-end run times. DXE has stated that the run times calculated by Bombardier's simulation model were based upon the 4.5 % grades, specifically the vertical and horizontal alignment that they have identified as the "Applicant's Proposed Action Alternative" alignment shown on the 1"=1000' plan and profile drawings.

43. In both cases it is unknown if the train is capable of overcoming the grades with a single motor failure and whether a shunting train would be required to assist. This would have a direct impact on the fleet size requirements, as well as a disruptive impact on the timetable. DXE states that Bombardier has modelled loss of propulsion on a 10-car Regina EMU train with a range of powered cars being assumed (from six to as many as all 10 of the cars on the train being powered) to ensure that the train will overcome the grades under such a failure scenario – and that it does so.

Fleet Size

44. The Plan indicates that the 2012 timetable will require 12 in-service trains, 2 hot spares and 2 maintenance trains. The SDG analysis indicates that the service will require one less maintenance train resulting in a potential saving. This means the service could function with 15 rather than 16 trains.

CONTROL SHEET

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