APPENDIX I

FINANCIALLY UNCONSTRAINED SCENARIOS

Background

As part of their effort to identify 2030 mobility needs, WFRC and MAG sought to construct scenarios that can maintain the current annual delay per capita roughly the same in the future (currently modeled at 17 hours per year). The approach attempted to identify the level of investment needed in each type of major infrastructure – freeways, arterial streets, and transit – in order to avoid increasing average annual delay per person.

The first, or "blue" scenario had a heavy emphasis on freeways; the second or "yellow" scenario had a heavy emphasis on arterials and transit in lieu of freeways; the third "green" scenario combined the most effective and practical elements of both blue and yellow.

The WFRC-MAG travel demand model has a lane optimization feature designed to "build its way out of severe congestion". Normally the model causes people to shorten their trips somewhat when there aren't enough lanes to eliminate congestion, reflecting that people decide where to work, purchase a home, or even go shopping based partly on the fact that congestion makes it difficult to travel very far. The lane optimization feature automatically adds lanes to match demand, which never allows congestion to get extreme, but also allows people to "spread out" more. In the real world, sustaining such ease of travel over many years results in many people who enter the housing or job market being more inclined to increase the distance between their home and workplace.

This phenomenon highlights that demand on roadways, often measured as Vehicle Miles Traveled (VMT) is not a fixed quantity. When average traverse speeds are high as in an uncongested freeway scenario, people make lifestyle decisions that create a dependency on maintaining that high speed ability. This is a major reason why growth in VMT has traditionally outpaced growth in population.

The model can be set to automatically size lanes to any desired level of service. It can even remove lanes that aren't being fully utilized if desired. In this case, the model was instructed to size facilities such that the average volume to capacity ratio (VC ratio) was about 0.9 in the PM peak three hours. This means there is likely a 30-minute period in which roadways are in mild failure, but is arguably more tolerable than the 1.0-1.5 values not uncommon in the presently adopted RTP.

This technical memo is a report on how the different scenarios were designed, and the results of those scenarios, to the end that WFRC and MAG could learn from the results in developing the 2030 RTP. Note that the numbers in this memo are for the 4-county region, not the 3-county region, which is reported in Chapter 3.

Method For Freeway Lane Optimization

Approach to Freeways in the Freeway (Blue) Scenario

- For WFRC, all existing or conceivable freeways were identified. Conceivable freeways included Highland Drive in Sandy / Draper, Bangerter Highway, Mountain View Corridor, U-111, 10000 South in South Jordan, 6200 South area in Taylorsville. In Davis and Weber Counties it included Legacy Parkway, North Legacy, and Highway 89. MAG had East Lake, West Lake, SR 73 in Cedar Valley, a causeway, and an alignment through the American Fork / Highland area all classed as freeways.

- Model was told it could make these freeways any size it desired, including eliminating it as a freeway if there were insufficient demand to support two-lanes each direction.

Approach to Arterials in the Freeway (Blue) Scenario

- It is not rational to assume that the population reflected by the demographic allocation can be supported without any new or widened arterials. If it were modeled this way it would unfairly reflect excessive congestion in this scenario that cannot be attributed to the freeways themselves. Planned widenings up to 2010 were allowed, but none beyond. If the road was not built by 2010, it was allowed to be built simply for connectivity, but was likely just a 2-lane or 4-lane road. No new 6 or 8 lane arterials were allowed.

Approach to Transit in the Freeway (Blue) Scenario

- The Commuter Rail line from Ogden to Provo was included. The Mid-Jordan light rail line was included. All other planned light rail extensions were modeled as BRT. Background buses were held at expected 2030 levels.

Method For Arterial Lane Optimization

Approach to Freeways in the Arterial / Transit (Yellow) Scenario

- No new freeways or freeway widenings were allowed beyond what has already been planned for 2010. Mountain View Corridor was built as an expressway (Access controlled, but without grade separations, similar to Bangerter Highway)

Approach to Arterials in the Arterial / Transit (Yellow) Scenario

- All arterials in the WFRC area were allowed to grow to as large as necessary attempting to reach an average v/c of .90. They kept their same functional class, so even if a collector were upgraded to an arterial, it still had the per lane capacity of a collector. This tends to over exaggerate how many lanes are truly required, and was noted in analysis. The process was the same in the MAG area, but only arterials identified in an earlier public involvement process were allowed to be widened (Quad Studies).

- Arterials were not allowed to be lowered below the 2010 value, even if they were not fully utilized. However, they were allowed to be lower than their presently anticipated 2030 value if they were not fully utilized.

Approach to Transit in the Arterial / Transit (Yellow) Scenario

- The full 2030 transit plan from the 2004 Regional Transportation Plan was included. In addition, a number of new BRT and streetcar lines were included.

Highlights Of Lane Optimization Approach

Table I-1 highlights many of the key results observed from the needs assessment model runs. One of the goals of the needs assessment was to see how much of each type of infrastructure would be needed to prevent delay per person from increasing. In row 5, the model estimates the average person experiences 17 hours of delay per year presently, and 29 hours in the most recent 2030 fiscally constrained plan. A heavy emphasis on freeways (blue run) is not able to improve this much despite an additional $3 billion investment. Emphasis on arterials and transit in the yellow run would conceivably maintain congestion at the same level per person, and cost considerably less than the blue alternative. However to accomplish this would require many arterial streets to be excessively large, and is in fact not practical. A blending of the most effective and practical elements of blue and yellow resulted in a green run, which was still very effective.

Table I-1

UNCONSTRAINED SCENARIO MODEL RESULTS

	A	B	C	D	E	F
1		**2006**	**RTP**	**Blue: Freeway Optimization**	**Yellow: Arterial & Transit Optimization**	**Green: Blend of best blue & yellow**
2	***Hours delay per person per year*** *(excludes incident-induced delay)*					
3	Fwy delay	6	11	10	8	7
4	Art delay	11	18	17	7	9
5	Total delay	17	29	26	16	16
6	***Delay per lane mile (hours/day)***					
7	Fwy delay per lane mile	28	45	31	45	32
8	Art delay per lane mile	14	27	28	9	12
9	Total delay per lane mile	17	32	29	16	16
10	***% Change in lane miles over 2006*** ***(Note: 2006-2030 Population increase regionally is 47%)***					
11	Fwy	NA	51%	96%	18%	29%
12	Art	NA	27%	12%	56%	45%
13	Total	NA	35%	34%	48%	44%
14	***Rough estimate of new capacity cost in millions*** *(2006 dollars, see footnotes)*					
15	Fwy	11,000	7,000	11,500	2,000	4,000
16	Art	15,000	4,000	2,500	8,000	7,000
17	Transit	2,000	2,000	2,000	4,000	3,000
18	Planning-level 2006 cost (in millions)	$ 28,000	$ 13,000	$ 16,000	$ 14,000	$ 14,000
19						
20	***Vehicle hours traveled***	1,160,000	2,010,000	2,054,000	1,851,500	1,859,000
21	***Pct. Change in VHT from 2004 RTP***	NA	0%	2%	-8%	-8%
22	***Daily Vehicle Miles Traveled***	42,000,000	71,000,000	78,700,000	68,100,000	73,500,000
23	***VMT per household per day***	62	72	80	69	74
24	***Pct. Change in VMT from 2004 RTP***	NA	0%	11%	-4%	4%

Transit run assumes not only the $2B for planned CRT/LRT, but additional $2B for streetcars, etc. Fwy and Art runs assume no new premium service, but instead normal expansion of buses with population.

Arterials priced at $15M per an average facility (with ranges from $5-20 million), or $3.75 M per lane mile ($15M/4 travel lanes)

Freeways priced at $65M per mile for an average 8-lane facility (ranging from $25M for median fills, to $50M for exurban new construction, to as high as $110M per mile for high grade urban reconstruction such as SL's I-15). Where the model provides new lane miles, $8.1 M per lane mile was set as typical for this scenario ($65/8 travel lanes typically)

Rows 6 through 9 highlight the delay per lane mile in a typical day. Recall from row 3 that a major investment in freeways did not reduce overall freeway delay much. Row 7 shows that the delay per lane mile is significantly improved, but there are simply many more lane miles. The green run is able to maintain most of the improvements to freeways gained in the blue run, but also reduce delay on arterials, and all for a lower cost. Rows 10-13 highlight the increase in lane miles from the last RTP, and compares it the increases in each run. Note that the most recent RTP increases freeway lane miles at about the pace of population growth, but surface street miles are much more modest. The green run, which is more effective at reducing delay, instead emphasizes increasing surface street capacity with population growth.

Row 21 shows that increasing freeway lane miles tends to increase total travel time because while there is somewhat less congestion per lane mile, people are driving more miles. In the yellow and green runs, even though the emphasis is on surface streets and transit which by definition are slower than freeways, there is actually a reduction in the overall travel time in part because people select destinations closer to home. This is visible in rows 22 through 24, where the total VMT is substantially higher in the blue alternative, even though the locations of houses and jobs are identical in every case.

More detail and maps of these model runs are available elsewhere. Here is a brief summary of the major themes observed in this exercise and supporting academic research, and concepts to consider for policy emphasis.

General Observations From Blue, Yellow, And Green Runs

- Neither optimizing freeways nor arterials separately is able to reduce delay per capita to the 2006 level.
- Focusing on arterials and transit together (yellow run), and a mix of arterials, transit, and freeways (green run) were theoretically able to maintain delay per capita at the 2006 level.
  - However the size required for some arterials is not buildable by just adding lanes. Yellow run goals would need to be achieved in part with innovative arterial treatments such as Continuous Flow Intersections, one-way couplet intersections, mixed land uses, vehicle reduction strategies.
- Any action that improves overall speeds (freeway, arterial, or transit) facilitates a continuation of far-flung lifestyles – a component of induced demand.
  - Because freeways offer the highest speeds, they induce higher VMT.
  - Even without accounting for land use changes, up to 25% of any new freeway capacity may be consumed by induced demand.
- Prior to 2030, some maximum width freeway sections will still fail in spite of constructing alternative routes. I-15 in SL County will likely be the first.
- A dollar spent on improving alternatives to freeways (arterials / transit) is generally more effective at reducing delay than the same dollar spent expanding freeways.
  - This is largely due to the fact that freeway construction is extremely expensive, and induces more demand.
  - Good transit can have a strong impact in peak periods.
- If traditional freeways are emphasized over the alternatives, all the more people will have far-flung lifestyles at the day when freeways cannot be affordably widened, plus the alternatives will be insufficient.
- If the region continues to emphasize alternatives to freeways, then people will begin to make closer to home lifestyle choices, resulting in lower cost infrastructure and less freeway dependency.

Key Fact: Our Widest Freeways Will Still Fail, And Failure Is Very Inefficient

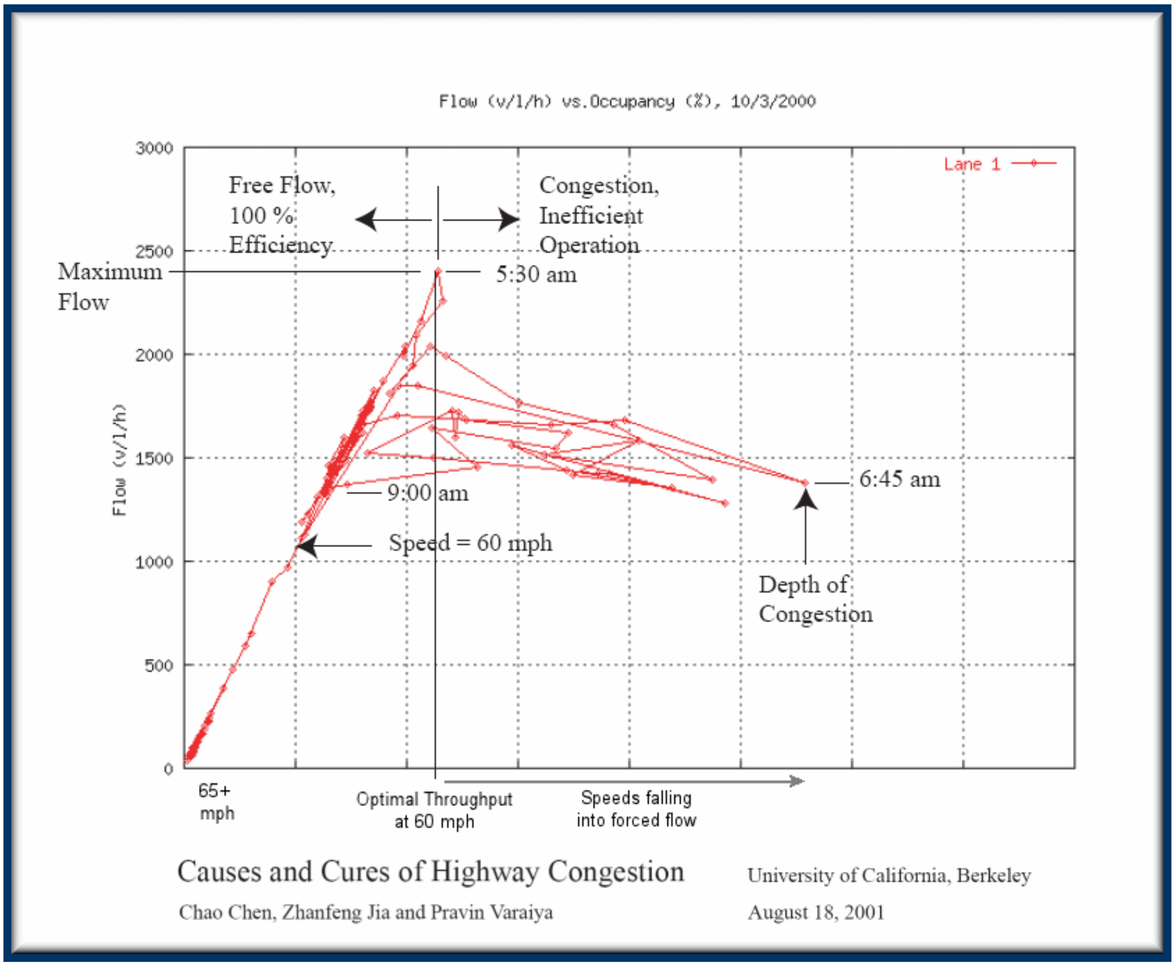
Perhaps among the most important observations in this research is the fact that some sections of I-15, in spite of having 6-lanes per direction, will still surely fail prior to 2030 even if an additional lane or even two is added. This fact raises two important questions:

  - How inefficient is a freeway in failure?
  - Are there options that prevent failure or lessen the intensity of failure?

Recent research shows that when congestion forces freeway speeds to fall much below 60 mph, they drop from carrying 2,200 vehicles per hour per lane to 1,500 – a loss of 30%. In other words, 6 southbound lanes at 60 mph is equal to 13,000 cars per hour, but the same lanes at 20 mph can only move 9,000 cars per hour. Thus when this freeway's speeds collapse, it is as if there is a 4-lane freeway rather than 6 lanes – and the freeway is more like a slow-moving parking lot. The figure below (I-1) shows how a typical AM peak may occur. Speeds are steady between 60 and 70 mph up until maximum flow is reached, typically around 2,200 vehicles per hour per lane. At that point the freeway destabilizes and both speeds and throughput drop significantly.

FIGURE I-1

FLOW vs. OCCUPANCY (%)



Key Fact: Billions of dollars worth of untapped capacity exists
The same research noting the inefficiency of forced flow also notes that high speeds can be easily maintained on freeways by some very simple means, though implementing the policies can be very challenging.

High speeds and throughput can be maintained simply by reducing the number of vehicles entering the mainline. This goal can be advanced by several means:

1. Improve transit and surface street alternatives that compete with the freeway.
2. Reduce overall demand by land use balancing, demand management strategies.
3. Implement congestion pricing when speeds begin to dip.
4. Implement aggressive ramp metering when speeds begin to dip.

Researchers emphasize that just the last option can be made to work by simply turning down the meter rate below what people are typically used to. To deal with the backing onto arterials that would surely occur, one could add more storage lanes on the ramp. The result is to transfer delay from the mainline to the ramp, but the trade is not one for one. They estimate that such a program in

Los Angeles would reduce total freeway system delay from 700 million hours per year spent mostly on the mainline to just 200 million spent entirely on the ramps. In other words, someone who today experiences a 2-minute ramp delay enters an overloaded mainline where they then waste 15 more minutes. If they would instead endure 5 minutes on the ramp, there would be zero additional losses, for a 70% overall savings.

The Wasatch Front and Mountain Land freeways will periodically experience failing conditions due to lack of funding for planned widenings. The region is also quickly approaching the point at which freeways that cannot be easily widened will still fail. In both cases pursuing aggressive freeway management strategies such as these will provide significant mitigation. The recovery of 30% loses will equate to billions of dollars in reclaimed infrastructure efficiency as well as economic efficiencies.