Comparison of Urban Maglev to Freeways, Light Rail, and People Mover Systems

January 2005
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• Capital and O&M cost comparison with LRT and APM systems
• Comparison with San Diego freeway projects
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Overall Purpose

Urban Maglev

Compare the capital and O&M costs of the Urban Maglev technology to freeways, light rail (including planned San Diego extensions), and Automated People Mover (APM) Systems.
Technical Approach

- Estimate cost for Urban Maglev using data developed for the 6\textsuperscript{th} quarter FTA report.

- Use data for planned San Diego LRT and freeway extensions.

- Use worldwide data available for LRT and APM systems.

- Make comparisons normalized to freeway and LRT peak throughput values.
Comparison of Capital and O&M Costs of Urban Maglev with LRT, and APM Systems
## Comparison With Urban Maglev

<table>
<thead>
<tr>
<th>System</th>
<th>Capital Cost $/mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Maglev – 3,000 pphpd*</td>
<td>56.3</td>
</tr>
<tr>
<td>Urban Maglev – 12,000 pphpd*</td>
<td>88.3</td>
</tr>
<tr>
<td>SD Trolley Mission Valley East – 9,600 pphpd</td>
<td>87.2 **</td>
</tr>
<tr>
<td>Las Vegas Monorail</td>
<td>89.0</td>
</tr>
<tr>
<td>World-Wide LRT (Average) ***</td>
<td>80.4</td>
</tr>
<tr>
<td>World-Wide LRT (Low)***</td>
<td>23.0</td>
</tr>
<tr>
<td>World-Wide LRT (High)***</td>
<td>177.0</td>
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<tr>
<td>World-Wide Average Urban Automated People Movers***</td>
<td>103.2</td>
</tr>
<tr>
<td>World-Wide Average Airport Automated People Movers***</td>
<td>118.8</td>
</tr>
</tbody>
</table>

* Maglev costs are for a complete double track, elevated system, including stations, vehicles, power, communication and signaling. No tunneling or unusual civil structures assumed. Data from Low Speed Maglev Technology Development Program, Final Report, March 2002.

** Based on SANDAG. System is 5.8 miles long, 51% elevated, 36% at-grade, and 13% underground.

Mission Valley East LRT Project

5.8 miles in length, 51% elevated, 36% at-grade, and 13% underground

Urban Maglev
Estimate for Urban Maglev on Mission Valley East Alignment

Estimate cost for a 9,600 pphpd Urban Maglev for the Mission Valley East alignment.

- Cost for an elevated Urban Maglev, linearly extrapolated to 9,600 pphpd = $79.8 M/mile*
- At-grade cost is about $20M/mile less** = $59.8 M/mile.
- Assume cut-and-cover, tunneling costs of $200M/mile
- 51% elevated, 36% at-grade, 13% underground.

The cost is then approximately:

\[ 0.51 \times 79.8 + 0.36 \times 59.8 + 0.13 \times 200 = 88.2 \text{M/mile} \]

This cost approach has uncertainties w.r. to tunneling and unusual civil structures

* Cost = ($0.00356M/passenger) \times (Throughput) + $45.62M

** Based on cost breakdown from 6th Quarter Urban Maglev Report (November 30, 2001).
Estimate for San Diego Trolley Mission Valley East

**Urban Maglev**

Estimate cost of Mission Valley East LRT project without the cost of the SDSU tunnel, Grantville Station, and the Alvarado bridge.

- Mission Valley East Total Cost = $506M
- SDSU Tunnel Cost = $100M
- Grantville Station = $12M
- Alvarado Bridge = $5M
- Net Cost of System w.o. the above = $389M
- Cost per mile for combination of elevated and at-grade alignment system = $389M/5.8miles = $67M/mile
- Urban Maglev Cost using same percentage of at-grade and elevated alignment = ($79.8M/mi x 0.51 + $59.8M/mi x 0.36) / (0.51 + 0.36) = $71.5M/mi
# O&M Costs per Vehicle-Mile Compared to Other Systems*

<table>
<thead>
<tr>
<th>Magnetic Levitation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GA Urban Maglev</td>
<td>$3.67</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Light Rail</th>
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</tr>
</thead>
<tbody>
<tr>
<td>San Diego Trolley</td>
<td>$4.53</td>
</tr>
<tr>
<td>St. Louis BSDA</td>
<td>$7.47</td>
</tr>
<tr>
<td>San Jose VTA</td>
<td>$12.62</td>
</tr>
<tr>
<td>Pittsburgh PAT</td>
<td>$14.86</td>
</tr>
<tr>
<td>Boston “T”</td>
<td>$16.00</td>
</tr>
<tr>
<td>San Francisco Muni</td>
<td>$19.07</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>People Mover</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Miami</td>
<td>$16.24</td>
</tr>
<tr>
<td>Detroit</td>
<td>$17.27</td>
</tr>
<tr>
<td>Jacksonville</td>
<td>$32.31</td>
</tr>
</tbody>
</table>

*GA O&M cost projections are from Urban Maglev 6th quarter report; maintenance costs include periodic replacement of magnets, which is conservative based on experience to date.

* San Diego Trolley O&M costs are from recent published SANDAG data.
Comparison of Urban Maglev With Planned Freeway Extensions
Basic Data Used for Freeway Comparisons:

- An equivalent Freeway, “Free-Flows at 60 mph with 1600 vehicles per hour per lane”. [Parsons, also “Comparison of Maglev to Freeway”, April 2003]

- Assuming ~1.7 passengers per vehicle, freeways require 8 lanes (4 lanes in each direction) for a 60 mph capacity of ~10,608 passengers per hour per direction.

- Freeway construction costs average ~ $11 M per lane-mile. Costs for planned SD projects vary from a low of $3 M to a high of $84 M per lane-mile.
# Freeway Cost Comparison ($M per mile)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Maglev</th>
<th>Freeway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Double Track @ 30 mph</em></td>
<td><em>8-Lanes @ 60 mph</em></td>
</tr>
<tr>
<td></td>
<td><em>3-Car Trains</em></td>
<td><em>4 Lanes each Direction</em></td>
</tr>
<tr>
<td></td>
<td><em>(10,608 pphrd)</em></td>
<td><em>(10,608 pphrd)</em></td>
</tr>
<tr>
<td>Eligible Federal Cost</td>
<td>75.4</td>
<td>89.6</td>
</tr>
<tr>
<td>Vehicles/Cars</td>
<td>7.9</td>
<td>5.3</td>
</tr>
<tr>
<td>Total</td>
<td>83.3</td>
<td>94.9</td>
</tr>
</tbody>
</table>

- The freeway capacity for 4 lanes is ~10,608 passengers/hour/direction (pphpd).
- The cost for freeways is $11.2M/lane-mile x 8 lanes = $89.6M.
- Maglev cost is based on a 10,608 pphpd system, based on the linear scaling: Cost/mile = ($0.00356M/passenger) x (Throughput) + $45.62M, and includes the vehicles, and stations.
- The vehicles/cars cost for freeways is scaled based on throughput from previous high speed maglev presentation “Comparison of Maglev to Freeway”, April 2003.
Additional Maglev Benefits
Maglev Emits Far Fewer Pollutants
(Data normalized to 1.6 billion passenger miles per year per transport mode, ~Equivalent to 4 lanes of Freeway)

Legend:
- Green: Maglev (250 mph) Emissions from Central Station Electric Plant
- Blue: Automobile Emissions
- Purple: Airplane Emissions

Pollutants:
- Carbon Dioxide
- Carbon Monoxide
- Hydro-Carbons
- Oxides of Nitrogen
- Sulfur Dioxide
- Combustion Particulates
- Tire Particulates

Conclusions

- Maglev can be lower in cost than planned freeway extensions for comparable throughput.

- Maglev is more expensive than LRT systems on a per unit length basis (10% or more).

- Maglev offers the potential to be significantly lower in cost on alignments which require tunneling for noise abatement (cost savings of 50% or more depending on the alignment).

- Maglev O&M costs are expected to be lower than existing LRT and APM systems.

- Maglev offers additional benefits compared with freeways in reducing air pollution, and providing safe, quiet service.
Appendix

Data from SANDAG and Transnet Sources

Urban Maglev Cost Breakdown
Relevant Sources of Data


2. “2020 Regional Transportation Plan”, SANDAG, April 2000


4. “Comparison of Maglev to Freeway”, April 2003, GA presentation

5. Websites containing sources 2 and 3 and much additional data:

   (Caltrans freeway data)

   (TransNet information)

   (Transit fact sheets)

   http://www.sandag.org/index.asp?subclassid=9&fuseaction=home.subclasshome
   (SANDAG Public Transit Home Page)

   (Construction dollars by segment)
San Diego Trolley Route Data
Motivation for TransNet

To implement the facilities and programs in the Plan over the next 20 years, the region would need an additional $12.0 billion (in excess of the $17.98 billion assumed under the Revenue-Constrained Transportation Plan). The primary sources identified in the RTP for additional funding include new state and federal funding, an extension of the TransNet program, and increased user fees. User fees include higher transit fares, the use of tolls to subsidize highway improvements and transit operations, and higher gasoline taxes.

* "2020 Regional Transportation Plan", San Diego Association of Governments, April 2000, pg.14
Blue and Orange Are Existing Lines
LRT Data: Planned SD Trolley Extensions

<table>
<thead>
<tr>
<th>Extension</th>
<th>Cost (M/mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Coast Segment</td>
<td>$49.7</td>
</tr>
<tr>
<td>South Bay LRT Extensions</td>
<td>$33.6</td>
</tr>
<tr>
<td>Mission Valley East LRT</td>
<td>$87.2</td>
</tr>
<tr>
<td>Mission Valley West LRT</td>
<td>$36.6</td>
</tr>
</tbody>
</table>
SAN DIEGO REGIONAL TRANSIT CORRIDOR PLAN

REGIONAL PLAN
The San Diego Association of Governments (SANDAG), in conjunction with the Metropolitan Transit Development Board (MTDB), and the North County Transit District (NCTD) develops the Regional Transportation Plan (RTP). This fact sheet summarizes the RTP for the major corridors within MTDB’s area of jurisdiction. The fact sheet indicates the corridors within existing and future rail services as well as the corridors under study to determine what form of transit would be most appropriate in the future.

BLUE LINE
25.2 miles (41.1 km) with 31 stations from the International Border with Mexico to Rancho Mission Road in Mission Valley. 15-minute service most of the day (7:5 minutes service during morning and afternoon rush hours between Old Town and San Ysidro). The Blue Line includes 25 grade separations.

Status
July 1981 revenue service began on 15.3 miles (24.6 km) line from the Border to downtown San Diego. $116.6 million cost included right-of-way, second phase improvements, 24 light rail vehicles (LRVs) and 10 stations. July 1990 revenue service began on 0.5 mile (0.8 km) segment from Santa Fe Depot to Cedar Street. June 1996 revenue service began on 3.2 mile (5.1 km) segment from Cedar Street to Taylor Street in Old Town. $114 million cost included 3 stations, 4 grade separations, and 4 LRVs. November 1997 revenue service began on the 0.1-mile segment between the Old Town Transit Center and Mission San Diego. $224 million cost included 8 stations, 10 grade separations, 11 LRVs, and a 25-acre wildlife preserve for wetlands mitigation.

ORANGE LINE
25.2 miles (41.1 km) with 24 stations from downtown to San Diego. 14 miles and 8 stations shared with the Blue Line in downtown, 15-minute service most of the day, 30-minute service between El Cajon and San Diego. The Orange Line includes 10 grade separations.

Status
March 1986: revenue service began on 4.5 mile (7.2 km) line from downtown San Diego to Euclid Avenue. $30.6 million cost included 4 stations and 6 LRVs. June 1996: Revenue service began on 11.3 mile (18.1 km) segment from Euclid Avenue to El Cajon Transit Center. $108 million cost included 6 stations, 15 LRVs, and one grade separation. June 1996 revenue service began on 1.6 mile (2.4 km) Convoy Center segment from America Plaza Transit Stop to Imperial & 12th Transit Stop. $49 million cost included 4 stations and 5 LRVs. August 1996 revenue service began on 3.6 mile (5.7 km) segment from El Cajon Transit Center to San Diego Transit Center. $159 million cost included 3 stations, 7 LRVs and two grade separations.

MISSION VALLEY EAST EXTENSION
5.6 miles (8.9 km) of new tracks plus 1.0 mile (1.6 km) of shared existing tracks from the Mission San Diego Station in Mission Valley to the Grossmont Center Station in the City of La Mesa. The Mission Valley East extension will close the gap between the existing Blue and Orange Lines. It will have four new stations at Graniteville, San Diego State University, Alvarado Medical Center and 70th Street at I-8. It will provide connections to western Mission Valley, including Qualcomm Stadium, Mission Valley, Fashion Valley and Hazard Center shopping centers, several hotels, and Old Town State Park.

Status
Groundbreaking occurred in November 2000 and construction is underway with service scheduled to start in late 2004.

MID-COAST EXTENSION
10.7 miles (17.1 km) from Old Town to North University City. Alignment is generally parallel to I-5 from Old Town to University of California. San Diego (UCSD). It then heads east through UCSD to Executive Drive, and on to the terminus at Executive Drive and Judicial Drive.

Status
The final environmental impact statement has been completed for the first segment, the 3.4-mile (5.5 km) Balboa Extension. Alignment refinement studies are underway for the UCSD and University City segment.

I-15 CORRIDOR
Approximately 30 miles between North County Fair and the Pacific Fleet trolley station on the Blue Line. The I-15 Line would connect with the Blue Line at the stadium and Pacific Fleet stations, the Orange Line at a new station at I-15/Empire Avenue, the proposed Miramar Metro Line on the Miramar Transit Center, and the North County Transit District's (NCTD) proposed Oceanside-Encinitas Line at North County Fair. This line would serve the communities of South Escondido, Rancho Bernardo, Poway, Carmel Mountain Ranch, Sabre Springs, Rancho Penasquitos, Sorrento Ranch, Miramar, Kearny Mesa, Serra Mesa, Mission Valley, Mid-City, and Logan Heights.

Status
The Phase 2 report (Short-to-Mid-Term Plan) was adopted in November 1998, outlining development of a Bus Rapid Transit (BRT) system that utilizes an expanded system of High Occupancy Vehicles (HOV) lanes along I-15 to maintain high-speed operations. MTDB is currently working with Caltrans on environmental studies for the BRT/HOV improvements in the north I-15 corridor. Construction could begin in 2002.

COMMUTER RAIL
February 1995 revenue service began on the 43-mile (68.8 km) line from Oceanside to downtown San Diego. The line has 8 stations (3 served by AMTRAK and two served by the San Diego Trolley’s Blue Line). One-way travel is 55 minutes. NCTD is the lead agency with assistance from MTDB and SANDAG. NCTD is also planning a 22-mile Rail Transit project for Oceanside and Escondido. Parking and other improvements are planned for the Sorrento Valley Coaster Station, and a new Coaster station is planned for University City.

FUTURE EXTENSIONS
Other future Guideway projects require additional study and funding sources. The North Bay and Beach Area Guideway is currently underway to evaluate and select station sites.

ULTIMATE “REGIONAL RAIL” COMPONENT
By the year 2010, if funding permits, the San Diego region would be served by a 63-mile LRT network and a 22-mile commuter rail line. This network is incorporated in the RTP and is revised every two years by SANDAG. Several other types of rapid transit alternatives, tailored to meet specific community, passenger, and environmental needs, may also be in place. All Metropolitan Transit System and NCTD rail services would be coordinated with bus services which, together, would operate as one system.

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MISSION VALLEY EAST
LIGHT RAIL TRANSIT PROJECT

PROJECT STATUS
The Metropolitan Transit Development Board (MTDB) held a groundbreaking ceremony on November 17, 2000. Advanced utility relocation will begin at San Diego State University (SDSU) in Winter 2000. By June 2001, work is scheduled to begin on the tunnel and station. Construction on the rest of the project will be underway by late 2001.

ROUTE
The 5.6 mile (9.3 km) Mission Valley East (MVE) Light Rail Transit (LRT) segment will extend the San Diego Trolley’s Blue Line from the Mission San Diego Station (just east of Interstate 15) to a connection with the existing Orange Line near Baltimore Drive in La Mesa. The MVE line will travel primarily adjacent to Interstate 8, with a diversion from the freeway to serve SDSU. The LRT segment will include elevated and ground-level sections, and a tunnel under SDSU.

STATIONS
Four new stations are planned. Granville will be elevated, SDSU will be a subway station in the tunnel. The SDSU station will be integrated into the campus and further community redevelopment projects currently underway on the south side of campus. The SDSU station will have public rest rooms and full-time security officers. The Alvarado Medical Station and the 70th Street Station will be at ground level. Both the Granville and 70th Street stations will have park-and-ride lots. Bicycle racks and/or lockers will be provided at all stations. Graphics showing three of the four future stations, are shown on the reverse.

ADA
In compliance with the Americans with Disabilities Act (ADA), each station will have uniform design features and each light rail vehicle will be equipped with a wheelchair lift.

PUBLIC ART
Each station will include public art as an integral component of the station design. Four artists, one for each station, have been commissioned to develop artistic themes that reflect the history and character of the station areas.

BUS SERVICE
Bus routes will serve all four new stations.

OTHER FEATURES
A new access road between Waring Road and Alvarado Canyon Road will provide access to the Granville Station.

BENEFITS
The MVE project will provide the following benefits:
• Increase direct transit access to SDSU and the Alvarado Medical Center, two of Mission Valley’s major activity centers.
• Generate approximately 11,000 average daily riders at the four new stations, and significantly more on special events and school days.
• Attract over 2.5 million new annual transit riders in the region as a result of improved transit connectivity.
• Increase transportation capacity and improve mobility in the Interstate 8 corridor.
• Provide connections to future, planned transit improvements in the Interstate 15 and Interstate 5 corridors.

OPERATING PLAN
When completed, the Trolley’s route through Mission Valley from the Old Town Transit Center and the Grossmont Center Station will total 12.9 miles (20.6 km). The Trolley may operate the Mission Valley segment from Downtown via Old Town to the El Cajon Transit Center. San Diego Trolley, Inc., a nonprofit subsidiary of MTDB, will operate the line using electrically propelled vehicles in trains of up to four vehicles. The average operating speed will be 25 mph, with a maximum speed of 55 mph.

COST AND FUNDING
Estimated project costs are $491 million (including vehicles). Funding will include local (TransNet), state, and federal sources. In June 2000, MTDB and the Federal Transit Administration executed a Full-Funding Grant Agreement establishing the federal share of the project at approximately 80 percent of the total costs. Federal funds will consist of $13.7 million in Congestion Mitigation and Air Quality (CMAQ) and annual appropriations of Section 5309 Fixed Guideway-New Starts funding anticipated to total $33 million.

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Current SANDAG estimates indicate that the cost of this segment is $87.2M. The system is 51% elevated, 36% underground, and 13% at-grade.
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Mission Valley East Light Rail Transit Project
(Blue Line Extension)
Sam and Bob,

Thank you for your tour yesterday. It was great to see you again. Jim Hecht has gone through and answered your questions. We are looking to see if we can get the 60 page cost estimate electronically. If not, I will make a photo copy for you and mail it to you next week.

1) What is the current estimated cost, and what items are included (e.g. vehicles, commissioning, right-of-way, etc.)?
Current total project cost is $506M. This includes everything, including vehicles, start-up, right-of-way, fare machines, administration, design, planning, environmental, etc.

2) What is the peak capacity in terms of passengers per hour per direction?
The signaling and traction power systems were designed for 5 minute headways, our stations are designed to accommodate 4-car trains, and our cars are rated for a 200-person crush load. So, 12 trains/hour x 4 cars/train x 200 people/car = 9600 people/hour.

3) What percentage of the alignment is elevated, at-grade, and underground?
51% of the project is elevated, 36% is at-grade (mostly supported by retaining walls or on top of a box culvert), and 13% is underground.

4) What is the typical per-mile cost of dual track, elevated guideway, excluding everything else, such as stations, vehicles, ROW?
Our engineer’s estimate and construction contracts are split into hundreds of bid items and included in multiple contracts, so it is not easy to answer your question. To come up with a rough estimate, I’ll look at the per-mile cost of a typical bridge—the Alvarado Bridge that is 2047 feet long. Structure Excavation (Bridge) 593m³ x $50 = $29,650; Structure Excavation (Pier Column) 101m³ x $80 = $8,080; Structure Backfill (Bridge) 640m³ x $80 = $51,200; 2.13m CIDH Concrete Placing 73m x $140 = $10,220; 2.13 Conc. Piling (Rock Socket) 4m x $500 = $2,000; Prestressing Cast-In-Place Concrete 106,281 kg x $1.90 = $201,933; Structural Concrete, Bridge Footing 105m³ x $500 = $52,500; Structural Concrete, Bridge 3900m³ x $647 = $2,523,300; Minor Concrete (Curb) 1124m² x $80 = $90,320; TYP Spherical Bearings 12 x $4900 = $58,800; Architectural Treatment (Type A) 44m² x $112 = $4928; Sound wall (Masonry Block on Bridge) 170m² x $115 = $19,550; Joint Seal Assembly (MR60mm) 10m x $90 = $900; Joint Seal Assembly (MR90mm) 10m x $140 = $1400; Joint Seal Assembly (MR101-160mm) 29m x $225 = $6,525; Bar Reinforcing Steel (Bridge) 587,300 kg x $1 = $587,300. Miscellaneous Metal (Bridge) 4,200kg x $8.5 = $35,700; Metal Railing 1123m² x $86 = $96,578; Cable Railing 31m x $25 = $775; Isolation Casing 2800kg x $19 = $53,200; Plinth Concrete 1248m³ x $25 = $316,992; Direct Fixation Track 1248m³ x $410 = $511,680. Total $5,153,796. Per foot this equates to $2,517.73 and per mile this equates to $13.7 million for just this one out of the five LRT bridges. Note that this does not include the overhead catenary, traction power, or signaling.

5) What is the projected O&M cost?
From table 5-9 of the FEIS, the added annual operation and maintenance cost in 2015 dollars is $4,455,623.

6) What is the estimated cost of each station, in particular the elevated station near Mission Gorge Rd. and Highway 80?
We don’t have a cost estimate for the stations by themselves. Someone would have to go through the same exercise that I went through above for the bridges to calculate all of the earthwork, concrete, asphalt, etc. that is in each station. It would be much more difficult because the quantities may not all be separated out like they were for the bridges. Our rough understanding of the cost is that the elevated station at Grantville probably cost somewhere between $10 and $15 million, and the at-grade stations are probably somewhere between $2 and $3 million.

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San Diego, CA 92101
SAN DIEGO TROLLEY
PROPOSED MID-COAST SEGMENT

PROJECT STATUS
The Board approved the Alternative Analysis/Draft Environmental Impact Statement/Draft Environmental Impact Report in October 1995. The Board also approved a light rail transit (LRT) alignment for planning purposes (see map on reverse) as part of the adopted Mid-Coast Locally Preferred Alternative. The Locally Preferred Alternative includes the LRT project, plus Coaster station improvements (parking at the existing Sorrento Valley Station and a new station near Nobel Drive), and high-occupancy vehicle (HOV) lanes in the median of I-5 between Sorrento Valley and Mission Bay. The 10.7-mile (16.8km) LRT project is being divided into two segments.

Balboa Segment: Preliminary engineering for this 3.4-mile (5.5km) segment and three stations has been completed, and the final design phase can begin upon approval of the Federal Transit Administration.

University City Segment: Refinement studies are underway on the two portions of the alignment in the University City area.

ROUTE CHARACTERISTICS
Limit: From Old Town north to North University City, along the Interstate 5/San Diego Northern Railway corridor.
Connections with Rail and Bus Lines: Would provide transfer connections at the Old Town Transit Center to the Blue (Mission Valley LRT) Line and the Coaster Commuter Rail Line. Bus connections would be available at most LRT stations.
Route Length: 10.7 miles from the Old Town Transit Center, just south of the San Diego River, to the station at Executive Drive/Judicial Drive. Most of the line (6.4 miles) would be built in the existing San Diego Northern Railway right-of-way owned by MTDB.

ACCESS
Ridership: The full line to University City is estimated to have 17,900 boardings per day. The Balboa segment is forecast to have 6,400 boardings per day. The Mid-Coast Segment would serve virtually all major traffic generators along the alignment including Mission Bay, Pacific Beach, Clairemont, the University of California at San Diego (UCSD), and University City.
Stations: Nine stations would serve the following locations: Tecolote Road, Clairemont Drive, Balboa Avenue, Jutland Drive, Gilman Drive/I-5, Nobel Drive/La Jolla Village Square, UCSD, Executive Drive/Genesee Avenue, Executive Drive/Judicial Drive.
Parking: Park-and-ride lots for transit riders would be provided at seven of the nine stations.
Bus Service: Buses would serve designated stations; schedules would be coordinated at major transfer points.
Fare Collection: Self-service, barrier-free; rowing fare inspectors would check riders for payment.
Bicycle: Racks and/or lockers would be provided at designated stations.
Disabled: Wheelchair lifts would be provided on all trains; tactile mats in stations would assist passengers with visual impairments in boarding.

OPERATING PLAN
Vehicles: Electrically-propelled, articulated light rail transit vehicles; wheelchair accessible. Can be coupled into trains of up to four cars.
Average Speed: 25-30 mph.
Maximum Speed: 55 mph.
Frequency: 15-minute service during most of the day, with 10-minute rush hour weekday service in the future.
Operation Agency: Operation by San Diego Trolley, Inc., a subsidiary public corporation owned by MTDB.

FINANCIAL PROGRAM
Projected Costs: The full line is estimated to cost $532 million in year-of-expenditure dollars; $117 million for the Balboa segment and $415 million for the University City segment. The cost estimate for the University City segment will be refined in preliminary engineering.
Funding: Financing for the Mid-Coast Segment will depend on a mix of federal, state, and local funds.

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$49.7 M/mile

GENERAL ATOMICS
SAN DIEGO TROLLEY
PROPOSED SOUTH BAY LRT EXTENSIONS

PROJECT STATUS
The Metropolitan Transit Development Board (MTDB) approved the Otay Ranch Transitway Alignment for planning purposes in March 1993. MTDB is currently examining new alignments and variations south of Otay Mesa Road and east of SR 125 and continues to develop strategies to better coordinate land-use and transportation planning in the immediate vicinity. Ultimate construction is dependent on the development of Otay Ranch and Otay Mesa and the availability of capital and operating funds.

ROUTE CHARACTERISTICS
- **Limits**: Bounded by SR 54 to the north, SR 125 to the east, the International Border to the south and the San Diego Trolley Blue Line to the west.
- **Connections with other Bus & Rail Service**:
  - Would extend east from the Blue Line 24th Street Station via the Otay Ranch Segment and east from the Blue Line Iris Avenue Station via the Otay Mesa Segment. The Otay Ranch Segment would continue south along SR 125 to connect with the Otay Mesa Segment at the Otay Mesa Transit Center at Otay Mesa Road.
- **Route Length**:
  - Otay Ranch Segment - 16.6 miles
  - Otay Mesa Segment - 13.2 miles
  - **Total**: 29.8 miles

ACCESS
- **Stops**: A total of seventeen potential station sites, thirteen along the Otay Ranch Segment to serve the following general locations: Sweetwater River, Plaza Bonita, H Street/Terra Nova, Paseo Del Rey, Otay Ranch Villages 1, 5, 6, and 9, Otay Ranch Transit Center, Otay Ranch Eastern Urban Center, Lonestar Road, Otay Mesa Transit Center, and Otay Mesa Border Crossing. Three potential station sites along Otay Mesa Segment to serve Caliente Boulevard, Brown Field and La Media Road.
- **Ridership**: Serves virtually all major traffic generators within the corridor including National City, Bonita, Chula Vista, Rancho San Miguel, Eastlake, Otay Ranch, Otay Mesa, San Ysidro, Brown Field, and East Otay Mesa.
- **Parking**: Park-and-ride lots could be provided at eight potential stations.
- **Bus Service**: Buses would serve designated stations; schedules coordinated at major transfer points.
- **Fare Collection**: Self-service, barrier-free; roving fare inspectors to check riders for payment.
- **Bicycle**: Racks and/or lockers to be provided at designated stations.
- **Disabled**: Wheelchair lifts provided on all vehicles; tactile mats to assist visually impaired boarding at stations.

OPERATING PLAN
- **Vehicles**: Electrically-propelled, articulated light rail transit vehicles; trains of up to four cars.
- **Average Speed**: 25-30 mph.
- **Maximum Speed**: 50 mph.
- **Frequency**: 15-minute service during most of the day; 7.5-minute peak service in the future.
- **Operating Agency**: Operation by San Diego Trolley, Inc., a subsidiary owned by MTDB.

FINANCIAL PROGRAM
- **Projected Costs**: Approximately $1.0 billion in 2000 dollars, depending on the final alignment.
- **Funding**: Financing for the South Bay LRT Extensions would depend on a mix of federal, state, and local funds. Additional funding may come from Benefit Assessment Districts, contributions from Otay Ranch, and NAFTA (North American Free Trade Agreement).

November 2000

**Urban Maglev**
SAN DIEGO TROLLEY
MISSION VALLEY WEST LRT PROJECT

PROJECT STATUS
Board approved alignment for planning purposes in 1994. Preliminary engineering and environmental studies were completed in May 1992, and final design was completed in October 1994. Construction began in June 1995 and operations began on November 23, 1997.

ROUTE CHARACTERISTICS
Limits
The Mission Valley West LRT Project is from Interstate 5 (north of Taylor Street) to the east side of Interstate 15, mostly along the north bank of the San Diego River. The ultimate Mission Valley Line is planned to connect with the East Line near Grossmont Center in La Mesa for a total of 11.8 miles (19.8 km).

Connection with other rail lines
Will connect to North-South (Blue) LRT Line and Coast Express Rail at the Old Town Transit Center; future proposed LRT extension near I-5 and I-15.

Route Length
6.1 miles (9.7 km) between Old Town and I-15.

ACCESS
Stations
Seven stations, with two future stations.

Bus Connections
Buses will serve designated stations; times coordinated at major transfer points. Fashion Valley Transit Center was relocated adjacent to the LRT station.

Parking
Park-and-ride facilities will be located at Morena/Linda Vista, Fashion Valley Transit Center and Qualcomm Stadium stations.

Fare Collection
Self-service, barrier-free, system, roving fare inspectors to check riders for proof of payment.

Bicycle
Racks and lockers to be provided at stations.

ADA
As required by Americans With Disabilities Act (ADA), uniform station design features such as: tactile strips and directional bars to assist visually impaired riders; wheelchair lifts provided on all light rail vehicles (LRVs); elevators at two stations.

OPERATIONS
Patronage
Approximately 5,500 to 9,000 daily riders are projected in the first year for this segment, with a capacity to accommodate 103,000 daily riders for special events.

Vehicles
Electrically propelled, articulated light rail transit vehicles, wheelchair-accessible; in trains of up to four cars.

Average Speed
25-30 mph

Maximum Speed
55 mph

Frequency
15-minute service during the day; 30-minute service at night.

Operating Agency
Operation by San Diego Trolley, Inc., a subsidiary owned by MTDG

Service Area
Provides direct service to existing and future major trip generators along the alignment including:
- Morena/Linda Vista
- Riverwalk (Future)
- Fashion Valley Transit Center
- Hazard Center
- Mission Valley Center
- Rio Vista
- Mission City (Future)
- San Diego Qualcomm Stadium
- Mission San Diego

ESTIMATED COST
Total project cost was $223 million.

$36.6 M/mile

FINANCIAL PROGRAM
Developer Agreements
Several agreements with developers for right-of-way dedication, at-grade track construction and station construction.

Funding
TransNet (local public transit sales tax) revenues, and state grants.

ENVIRONMENTAL CONSIDERATIONS
Forty percent of extension on structures to minimize traffic and flooding impacts; river channel improvements; addition of 25+ acres of wildlife corridor previously non-existent; quality of existing habitat enhanced.

July 1999
### MTS Statistics for the San Diego Metropolitan Area (FY 2000)

**Performance Statistics**

<table>
<thead>
<tr>
<th>Service</th>
<th>Operating Cost Per Revenue Mile</th>
<th>Total Pass. Per Revenue Mile</th>
<th>Subsidy Per Total Pass.</th>
<th>Farebox Recovery</th>
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<tr>
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<td>4.05</td>
<td>$0.39</td>
<td>65.13%</td>
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<tr>
<td>Fixed-Route Bus</td>
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<tr>
<td>General Public Demand Responsive Service</td>
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<td>0.36</td>
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<td>ADA Complementary Paratransit Service</td>
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<td>0.10</td>
<td>15.42</td>
<td>15.60</td>
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<td>Area-Wide Weighted Average</td>
<td>$4.20</td>
<td>2.70</td>
<td>$0.86</td>
<td>44.88%</td>
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</table>
San Diego Trolley O&M Financials

SAN DIEGO TROLLEY, INC.

Operated by: San Diego Trolley, Inc., a publicly owned corporation (MTDB subsidiary).

Service: Two regional light rail transit (LRT) routes, serving a total of 46.8 one-way route miles.

FY 00 Revenue Car Miles: 7,090,499
FY 00 Passengers: 28,743,326
FY 00 Operating Budget: $32,154,689
FY 00 Fare Revenue: $20,940,891

$ 4.53 per Vehicle-Mile
Freeways Data
About 14% of cars are carpool. If average number of passengers in carpool is 3, the average number of people per car is $(0.86 \times 1 + 0.14 \times 3) = 1.28$.
Average cost is $11M/lane-mile, with a low of $3M and a high of $84M/lane-mile. The average is calculated using the total cost / the total added lane-miles.
Urban Maglev Costing Breakdown
Primary Alignment Deployment

Site-Specific / Detail Engineering

Commissioning

Construction

<table>
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<th>Task</th>
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<td>Construction</td>
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<tr>
<td>Commissioning</td>
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Urban Maglev

GENERAL ATOMICS
Site-Specific/Detail Engineering

Urban Maglev

- Vehicle
- Magnet / Levitation Systems
- Maintenance Yard / Equipment
- Energy Supply Systems
- Project Integration
- Right-of-Way / Corridor
- Civil Structures
- Guideway Structure
- Operation / Command / Control Sys

<table>
<thead>
<tr>
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<tr>
<td>12000</td>
<td>Magnet / Levitation Systems</td>
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<tr>
<td>13000</td>
<td>Maintenance Yard / Equipment</td>
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<td>14000</td>
<td>Energy Supply Systems</td>
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<td>15000</td>
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<td>17000</td>
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<td>18000</td>
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<tr>
<td>19000</td>
<td>Project Integration</td>
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Commissioning

- Safety Planning
- FMEA
- Test Planning
- Component Acceptance Test
- Project Integration
- Energy
- Training
- System Acceptance Test

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<tr>
<td>36000</td>
<td>Training</td>
<td>20%</td>
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<tr>
<td>37000</td>
<td>Energy</td>
<td>13%</td>
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<tr>
<td>38000</td>
<td>Project Integration</td>
<td>20%</td>
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</table>
O & M Costs

- Annual O & M Cost per Vehicle-Mile for Primary Alignment: $3.67