What is a trench?

For the trench alternative, the railroad tracks will be lowered in an U-shaped box below Meadow Drive and Charleston Road. The new electrified railroad tracks will be built at the same location as the existing railroad tracks and will begin lowering south of Loma Verde Avenue, remain lowered under Meadow Drive and Charleston Road, and return to the existing elevation north of the San Antonio Station.

The roadways at Meadow Drive and Charleston Road will remain at their existing grade and have a similar configuration to what exists today with the addition of Class II buffered bike lanes on Charleston Road. This will require expanding the width of the road to maintain bike lanes through the overpass of the railroad.

By the numbers

- Railroad track is designed for 110 mph.
- Meadow Drive and Charleston Road are designed for 25 mph.
- Maximum grade on railroad is 2%, which exceeds Caltrain’s allowed maximum of 1%.
- Maximum grade on roadway is 8%.
- Travel lane widths are 10-12 feet.
- Bike lane widths are 5-6 feet.

Engineering Challenges

- A non-standard grade of 2% will be required on tracks. Caltrain’s maximum allowable grade is 1%.
- Lowering of the tracks will require diversion of Adobe and Barron creeks, resulting in the need for pump stations/siphons and numerous regulatory agency approvals.
- Pump stations will also be needed for dewatering because the trench will be below the ground water level.
- Increased long-term maintenance costs and risk of flooding due to pump stations.
- Major utility relocations are required for the lowered railroad.

Neighborhood Considerations

- Vertical clearance of Meadow Drive and Charleston Road over the railroad will be 24.5 feet.
- The railroad tracks will be approximately 30 feet below the existing street between Meadow Drive and Charleston Road. A high fence will be required along trench walls.
- With grade separations at Meadow Drive and Charleston Road the traffic at nearby intersections is expected to improve.
- During construction, Meadow Drive will be closed while the Charleston Road bridge is constructed and vice versa; right turn lanes on Alma Street at Meadow Drive and Charleston Road will be removed.

Cost Breakdown

<table>
<thead>
<tr>
<th>Item</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway &amp; Railroad Items</td>
<td>$462M to $548M</td>
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<tr>
<td>Structure Items</td>
<td>$10M to $13M</td>
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<tr>
<td>Right-of-way &amp; Utilities</td>
<td>$10M to $12M</td>
</tr>
<tr>
<td>Support Costs</td>
<td>$168M to $200M</td>
</tr>
<tr>
<td>Escalation to 2025</td>
<td>$150M to $177M</td>
</tr>
<tr>
<td>TOTAL PROJECT COSTS</td>
<td>$800M to $950M</td>
</tr>
</tbody>
</table>

For more information visit: https://connectingpaloalto.com
**Evaluation with City Council-Adopted Criteria**

- **Facilitate movement across the corridor for all modes of transportation**
  Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.

- **Reduce delay and congestion for vehicular traffic at rail crossings**
  With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted the rail crossing gates.

- **Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles**
  Pedestrians/cyclists will be separated from train traffic and bike lanes will be added Charleston Road.

- **Support continued rail operation and Caltrain service improvements**
  A temporary railroad track will be required and a crossover track located north of the San Antonio Caltrain Station will be relocated. With the pump stations, there will be potential risks to train operations due to flooding.

- **Finance with feasible funding sources**
  At a construction cost of $800-$950 million, additional funding sources will need to be secured.

**Concept Plan and Profile**

- **Reduce rail noise and vibration**
  Train horn noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. With the lowered track, train noise could reflect off walls and impact properties farther away; however, this can be mitigated.

- **Minimize visual changes along the corridor**
  Railroad tracks will be below grade. Landscaping options will be limited to bushes or plants with shallow roots in areas where ground anchors are required to the trench retaining walls.

- **Minimize right-of-way acquisition**
  Subsurface acquisitions will be required for the ground anchors for the trench retaining walls and right-of-way acquisitions will be required to construct pump stations.

- **Minimize disruption and duration of construction**
  Extended road closures at Meadow Drive and Charleston Road are required. Construction would last for approximately 6 years.

- **Facilitate movement across the corridor for all modes of transportation**
  Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.

- **Reduce delay and congestion for vehicular traffic at rail crossings**
  With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted the rail crossing gates.

- **Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles**
  Pedestrians/cyclists will be separated from train traffic and bike lanes will be added Charleston Road.

- **Support continued rail operation and Caltrain service improvements**
  A temporary railroad track will be required and a crossover track located north of the San Antonio Caltrain Station will be relocated. With the pump stations, there will be potential risks to train operations due to flooding.

- **Finance with feasible funding sources**
  At a construction cost of $800-$950 million, additional funding sources will need to be secured.

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For more information visit: https://connectingpaloalto.com
Meadow-Charleston Hybrid

What is a hybrid?
For the hybrid alternative, the railroad tracks will be raised above Meadow Drive and Charleston Road. The new electrified railroad tracks will be built at the same location as the existing railroad tracks and will begin rising near El Verano Avenue, remain raised above Meadow Drive and Charleston Road, and return to the existing elevation north of the Ferne Avenue. Between Park Boulevard and Alma Street, the roadways at Meadow Drive and Charleston Road will be lowered and will have a similar configuration that exists today, with the addition of Class II buffered bike lanes on Charleston Road. This will require expanding the width of the road to maintain bike lanes through the underpass of the railroad and to accommodate the new column supporting the railroad structure.

By the numbers
• Railroad track is designed for 110 mph.
• Meadow Drive and Charleston Road are designed for 25 mph.
• Maximum grade on railroad is 1%.
• Maximum grade on roadway is 8%.
• Travel lane widths are 10-12 feet.
• Bike lane widths are 5-6 feet.

Engineering Challenges
• A non-standard temporary vertical clearance of 12 feet will be required on tracks. Caltrain’s minimum allowable clearance is 15.5 feet.
• Lowering of the roadways will require a pump station.
• Increased long-term maintenance costs and risk of flooding due to pump stations.
• Major utility relocations will be required for the lowered roadways.

Cost Breakdown
<table>
<thead>
<tr>
<th>Item</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway &amp; Railroad Items</td>
<td>$92M to $115M</td>
</tr>
<tr>
<td>Structure Items</td>
<td>$13M to $20M</td>
</tr>
<tr>
<td>Right-of-way &amp; Utilities</td>
<td>$21M to $25M</td>
</tr>
<tr>
<td>Support Costs</td>
<td>$37M to $45M</td>
</tr>
<tr>
<td>Escalation to 2025</td>
<td>$37M to $45M</td>
</tr>
<tr>
<td>TOTAL PROJECT COSTS</td>
<td>$200M to $250M</td>
</tr>
</tbody>
</table>

Neighborhood Considerations
• Vertical clearance of Meadow Drive and Charleston Road under the railroad will be 15.5 feet.
• The railroad tracks will be approximately 15 feet above the existing street between Meadow Drive and Charleston Road.
• With grade separations at Meadow Drive and Charleston Road the traffic at nearby intersections is expected to improve.
• During construction, Alma Street, Meadow Drive, and Charleston Road will be reduced to two lanes, and right turn lanes on Alma Street at Meadow Drive and Charleston Road will be removed.

For more information visit: https://connectingpaloalto.com
Evaluation with City Council-Adopted Criteria

- Facilitate movement across the corridor for all modes of transportation
  Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.

- Reduce delay and congestion for vehicular traffic at rail crossings
  With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by gates coming down.

- Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles
  Pedestrians/cyclists will be separated from train traffic, and bike lanes will be added Charleston Road.

- Support continued rail operation and Caltrain service improvements
  A temporary railroad track will be required and a crossover track located north of the San Antonio Caltrain Station will be relocated.

- Finance with feasible funding sources
  At a construction cost of $200-$250 million, additional funding sources will need to be secured.

Reduce rail noise and vibration
Train horn noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. Train wheel noise could radiate out; however, this can be mitigated with a sound barrier.

Minimize visual changes along the corridor
Railroad tracks will be approximately 15 feet above grade. Landscaping with trees will be incorporated for screening where feasible.

Maintain access to neighborhoods, parks, and schools along the corridor while reducing regional traffic on neighborhood streets
No diversion of regional traffic with construction of grade separations.

Minimize right-of-way acquisition
No acquisition of private properties is required; however, driveway modifications will be required.

Minimize disruption and duration of construction
Extended lane reductions at Alma Street, Meadow Drive, and Charleston Road will be required. Construction would last for approximately 4 years.

Facilitate movement across the corridor for all modes of transportation
Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.

Reduce delay and congestion for vehicular traffic at rail crossings
With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by gates coming down.

Minimize visual changes along the corridor
Railroad tracks will be approximately 15 feet above grade. Landscaping with trees will be incorporated for screening where feasible.

Maintain access to neighborhoods, parks, and schools along the corridor while reducing regional traffic on neighborhood streets
No diversion of regional traffic with construction of grade separations.

Minimize right-of-way acquisition
No acquisition of private properties is required; however, driveway modifications will be required.

Minimize disruption and duration of construction
Extended lane reductions at Alma Street, Meadow Drive, and Charleston Road will be required. Construction would last for approximately 4 years.

Concept Plan and Profile

For more information visit: https://connectingpaloalto.com
What is a Viaduct?

For the viaduct alternative, the railroad tracks will be elevated on a structure over Meadow Drive and Charleston Road. The new electrified railroad tracks will be built between the existing railroad tracks and Alma Street (east side) and will begin rising north of Loma Verde Avenue, remain elevated over Meadow Drive and Charleston Road, and return to the existing elevation south of Ferne Avenue.

The roadways at Meadow Drive and Charleston Road will remain at their existing grade and have a similar configuration to what exists today, with the addition of Class II buffered bike lanes on Charleston Road. This addition will require expanding the width of the road to maintain bike lanes through the underpass of the railroad and to accommodate the new column supporting the railroad structure.

By the numbers

- Railroad track is designed for 110 mph.
- Meadow Drive and Charleston Road are designed for 25 mph.
- Maximum grade on railroad is 1.4%, which exceeds Caltrain’s allowed maximum of 1%.
- Maximum grade on roadway is 8%.
- Travel lane widths are 10-12 feet.
- Bike lane widths are 5-6 feet.

Engineering Challenges

- A design exception is required from Caltrain for non-standard grade of 1.4%.

Neighborhood Considerations

- Vertical clearance of the railroad over Meadow Drive and Charleston Road will be 15.5 feet.
- The railroad tracks will be approximately 20 feet above the existing street between Meadow Drive and Charleston Road.
- With grade separations at Meadow Drive and Charleston Road the traffic at nearby intersections is expected to improve.
- During construction, Meadow Drive and Charleston Road will be closed intermittently at night and on weekends.
- During construction, Alma Street will have narrow lanes for the portions north of Meadow Drive and south of Charleston Road.

Cost Breakdown

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway &amp; Railroad Items</td>
<td>$64M to $80M</td>
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<tr>
<td>Structure Items</td>
<td>$175M to $218M</td>
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<td>Right-of-way &amp; Utilities</td>
<td>$2M to $3M</td>
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<td>Support Costs</td>
<td>$84M to $106M</td>
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<tr>
<td>Escalation to 2025</td>
<td>$75M to $93M</td>
</tr>
<tr>
<td>TOTAL PROJECT COSTS</td>
<td>$400M to $500M</td>
</tr>
</tbody>
</table>

For more information visit: https://connectingpaloalto.com
Evaluation with City Council-Adopted Criteria

- **Facilitate movement across the corridor for all modes of transportation**
  Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.

- **Reduce delay and congestion for automobile traffic at rail crossings**
  With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by gates coming down.

- **Provide clear, safe routes for pedestrians and bicyclists crossing the rail corridor, separate from automobiles**
  Pedestrians/bicyclists will be separated from train traffic and bike lanes will be added to Charleston Road.

- **Support continued rail operation and Caltrain service improvements**
  New tracks can be built without a temporary railroad track, and a crossover track located north of the San Antonio Caltrain Station will be relocated.

- **Finance with feasible funding sources**
  At a construction cost of $400-$500 million, additional funding sources will need to be secured.

- **Reduce rail noise and vibration**
  Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. With the elevated track, train wheel noise could radiate out, which can be mitigated with a sound barrier.

- **Minimize visual changes along the corridor**
  Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible.

Concept Plan and Profile

- **Reduce delay and congestion for automobile traffic at rail crossings**
  With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by gates coming down.

- **Provision of clear, safe routes for pedestrians and bicyclists crossing the rail corridor, separate from automobiles**
  Pedestrians/bicyclists will be separated from train traffic and bike lanes will be added to Charleston Road.

- **Support continued rail operation and Caltrain service improvements**
  New tracks can be built without a temporary railroad track, and a crossover track located north of the San Antonio Caltrain Station will be relocated.

- **Finance with feasible funding sources**
  At a construction cost of $400-$500 million, additional funding sources will need to be secured.

- **Reduce rail noise and vibration**
  Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. With the elevated track, train wheel noise could radiate out, which can be mitigated with a sound barrier.

- **Minimize visual changes along the corridor**
  Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible.

- **Maintain access to neighborhoods, parks, and schools along the corridor while reducing regional traffic on neighborhood streets**
  No diversion of regional traffic with construction of a grade separations.

- **Minimize right-of-way acquisition**
  No acquisition of private properties is required.

- **Minimize disruption and duration of construction**
  The viaduct will have minimal road closures (nights/weekends only). Construction would last for approximately 2 years.
RAIL FACT SHEETS

Churchill Closure

What is a closure?
For the closure alternative, the railroad tracks will remain at their existing location and elevation. Churchill Avenue will become a T-intersection with Alma street on the east side and will end at Mariposa Avenue on the west side. A pedestrian/bike only undercrossing will be constructed. Two options are proposed: one crosses under the railroad tracks only and the other crosses under both the railroad tracks and Alma Street. Ramps and stairs in varying configurations will provide access to the undercrossing for pedestrians and cyclists.

There are several intersections improvements associated with the Churchill Avenue closure to mitigate the anticipated diversion in traffic. These improvements will include:

- Embarcadero Road/Alma Street: constructing a pedestrian/bike bridge over Embarcadero Road, widening Alma Street Bridge, adding a right turn lane from eastbound Embarcadero Road and left turn lane from southbound Alma Street, and installing a new signal at Embarcadero Road/Kinsley Avenue.
- El Camino Real/Embarcadero Road: optimizing signal timing and installing an additional westbound left turn lane and northbound right turn lane.
- Alma Street/Oregon Expressway: signalizing both on/off ramps with one controller.
- El Camino Real/Oregon Expressway-Page Mill Road: optimizing signal timing and installing a westbound right turn lane and northbound right turn lane from Oregon Expressway to El Camino Real Road.

For more information visit: https://connectingpaloalto.com
By the numbers
- Churchill Avenue is designed for 25 mph.
- Maximum grade on pedestrian/bike ramp is 5%.
- Pedestrian/bike ramp width is 8-10 feet.
- Travel lane widths are 10-12 feet.
- Bike lane widths are 5-6 feet.

Engineering Challenges
- Pedestrian/bike undercrossing will require a pump station.
- Relocation of pump house at Embarcadero Road will be required to widen Alma Street.
- Utility relocations will be required for pedestrian/bike undercrossing.

Cost Breakdown

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway &amp; Railroad Items</td>
<td>$26M to $33M</td>
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<tr>
<td>Structure Items</td>
<td>$6M to $8M</td>
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<td>Right-of-way &amp; Utilities</td>
<td>$6M to $8M</td>
</tr>
<tr>
<td>Support Costs</td>
<td>$6M to $8M</td>
</tr>
<tr>
<td>Escalation to 2025</td>
<td>$6M to $8M</td>
</tr>
<tr>
<td><strong>TOTAL PROJECT COSTS</strong></td>
<td><strong>$50M to $65M</strong></td>
</tr>
</tbody>
</table>

Neighborhood Considerations
- Vertical clearance of the pedestrian undercrossing will be 8-10 feet.
- The railroad tracks will remain at the existing grade at Churchill Avenue.
- Traffic mitigations will be implemented to maintain level of service for nearby intersections.
- During construction, Embarcadero Road, Alma Street, and Churchill Avenue will be closed intermittently at night and on weekends.

Evaluation with City Council-Adopted Criteria

- **Reduce rail noise and vibration**
  Train horn noise and warning bells will be eliminated with the removal of the at-grade crossings with roadway closure.

- **Minimize visual changes along the corridor**
  Railroad tracks remain at existing grade. Residual roadway areas from closure provide opportunities for landscaping.

- **Maintain access to neighborhoods, parks, and schools along the corridor, while reducing regional traffic on neighborhood streets**
  Diversion of regional traffic with Churchill Avenue closure will be mitigated.

- **Minimize right-of-way acquisition**
  No acquisition of private properties is required; however, there will be impacts to Palo Alto High School property and potentially Caltrain.

- **Minimize disruption and duration of construction**
  The closure will have minimal road closures (nights/weekends only). Construction would last approximately 1-2 years.

- **Minimize delay and congestion for vehicular traffic at rail crossings**
  With closure of Churchill Avenue, the traffic at nearby intersections will be impacted; however, this can be mitigated.

- **Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles**
  Pedestrians/cyclists will be separated from train traffic and vehicles.

- **Support continued rail operation and Caltrain service improvements**
  A temporary railroad track is not required.

- **Finance with feasible funding sources**
  At a construction cost of $50-$65 million, additional funding sources will need to be secured.

Churchill Avenue Underpass Concept - Option 2 - Looking East

Churchill Avenue Underpass Concept - Option 2 - Looking East

Churchill Avenue Underpass Concept - Option 2

Embarcadero Road and Kingsley Avenue Intersection - Looking Southwest

For more information visit: https://connectingpaloalto.com
What is a Viaduct?
For the viaduct alternative, the railroad tracks will be elevated on a structure over Churchill Avenue. The new electrified railroad tracks will be built at the same location as the existing railroad tracks and will begin rising near Homer Avenue, remain elevated over Churchill Avenue, and return to the existing track elevation near the California Avenue Station.

The roadway at Churchill Avenue will remain at its existing grade and have a similar configuration to what exists today. This will require expanding the width of the road through the underpass of the railroad to accommodate the new column supporting the railroad structure.

By the numbers
- Railroad track is designed for 110 mph.
- Churchill Avenue is designed for 25 mph.
- Maximum grade on railroad is 1.6%, which exceeds Caltrain's allowed maximum of 1%.
- Maximum grade on roadway is 8%.
- Travel lane widths are 10-12 feet.
- Bike lane widths are 5-6 feet.

Engineering Challenges
- A design exception is required from Caltrain for a non-standard grade of 1.6%.

Neighborhood Considerations
- Vertical clearance of the railroad over Churchill Avenue will be 15.5 feet.
- The railroad tracks will be approximately 20 feet above the existing street at Churchill Avenue.
- With grade separations at Churchill Avenue the traffic at nearby intersections is expected to improve.
- During construction, Alma Street and Churchill Avenue will be closed intermittently at night and on weekends.
- During construction, Alma Street will be reduced to two lanes and right turn lanes on Alma Street at Churchill Avenue will be removed.

Cost Breakdown
- Roadway & Railroad Items: $50M to $65M
- Structure Items: $128M to $170M
- Right-of-way & Utilities: $3M to $5M
- Support Costs: $63M to $85M
- Escalation to 2025: $56M to $75M
- TOTAL PROJECT COSTS: $300M to $400M

For more information visit: https://connectingpaloalto.com
**Evaluation with City Council-Adopted Criteria**

- **Facilitate movement across the corridor for all modes of transportation**
  Churchill Avenue will be grade separated from the railroad for all modes of transportation and will remain open.

- **Reduce rail noise and vibration**
  Train horn noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. Train wheel noise could radiate out; however, this can be mitigated with a sound barrier.

- **Minimize visual changes along the corridor**
  Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible.

- **Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles**
  Pedestrians/cyclists will be separated from train traffic.

- **Support continued rail operation and Caltrain service improvements**
  A temporary railroad track will be required. Stanford game day station will be eliminated.

- **Finance with feasible funding sources**
  At a construction cost of $300-$400 million, additional funding sources will need to be secured.

- **Reduce delay and congestion for vehicular traffic at rail crossings**
  With construction of the grade separation, the railroad crossing gates and warning lights at Churchill Avenue will be removed. Thus, the traffic will not be interrupted by the crossing gates.

- **Maintain access to neighborhoods, parks, and schools along the corridor while reducing regional traffic on neighborhood streets**
  No diversion of regional traffic with construction of a grade separation.

- **Minimize right-of-way acquisition**
  No acquisition of private properties is required.

- **Minimize disruption and duration of construction**
  Extended lane reductions at Alma Street will be required. Construction would last for approximately 2 years.

**Concept Plan and Profile**

- **Facilitate movement across the corridor for all modes of transportation**
  Churchill Avenue will be grade separated from the railroad for all modes of transportation and will remain open.

- **Reduce rail noise and vibration**
  Train horn noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. Train wheel noise could radiate out; however, this can be mitigated with a sound barrier.

- **Minimize visual changes along the corridor**
  Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible.

- **Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles**
  Pedestrians/cyclists will be separated from train traffic.

- **Support continued rail operation and Caltrain service improvements**
  A temporary railroad track will be required. Stanford game day station will be eliminated.

- **Finance with feasible funding sources**
  At a construction cost of $300-$400 million, additional funding sources will need to be secured.

**For more information visit:**  [https://connectingpaloalto.com](https://connectingpaloalto.com)
## Summary of Evaluation with City Council-Adopted Criteria

### Engineering Impacts

<table>
<thead>
<tr>
<th>Engineering Impacts</th>
<th>Meadow / Charleston</th>
<th>South Palo Alto Tunnel with Freight</th>
<th>South Palo Alto Tunnel without Freight</th>
<th>Churchill</th>
<th>Viaduct</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> Facilitate movement across the corridor for all modes of transportation</td>
<td>Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open.</td>
<td>Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open.</td>
<td>Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open.</td>
<td>Churchill Ave will be closed to vehicles at the railroad tracks.</td>
<td>Churchill Ave will be grade separated from the railroad for all modes and will remain open.</td>
</tr>
<tr>
<td><strong>B</strong> Reduce delay and congestion for vehicular traffic at rail crossings</td>
<td>With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Dr and Charleston Rd will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.</td>
<td>With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Dr and Charleston Rd will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.</td>
<td>With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Dr and Charleston Rd will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.</td>
<td>With construction of the grade separation, the railroad crossing gates and warning lights at Churchill Ave will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.</td>
<td>Pedestrians/cyclists will be separated from train traffic.</td>
</tr>
<tr>
<td><strong>C</strong> Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles</td>
<td>Pedestrians/cyclists will be separated from train traffic.</td>
<td>Pedestrians/cyclists will be separated from train traffic.</td>
<td>Pedestrians/cyclists will be separated from train traffic.</td>
<td>Pedestrians/cyclists will be separated from train traffic.</td>
<td>Pedestrians/cyclists will be separated from train traffic.</td>
</tr>
<tr>
<td><strong>D</strong> Support continued rail operations and Caltrain service improvements</td>
<td>A temporary railroad track will be required, and a crossover track located north of the San Antonio Caltrain Station will be relocated. With the pedestrian station, there will be potential risks to train operations from flooding.</td>
<td>New railroad tracks can be built without a temporary track, and a crossover track located north of the San Antonio Caltrain Station will be relocated.</td>
<td>A temporary railroad track will not be required.</td>
<td>A temporary railroad track will not be required.</td>
<td>Pedestrians/cyclists will be separated from train traffic and vehicles.</td>
</tr>
<tr>
<td><strong>E</strong> Finance with feasible funding sources</td>
<td>No acquisition of private properties is required; however, driveway modifications will be required.</td>
<td>No acquisition of private properties is required.</td>
<td>No acquisition of private properties will be required.</td>
<td>No acquisition of private properties is required; however, there will be impacts to Palo Alto High School property and potentially Caltrain.</td>
<td>No acquisition of private properties will be required.</td>
</tr>
<tr>
<td><strong>F</strong> Minimize right-of-way acquisition</td>
<td>Subsurface acquisitions will be required to grade the trench retaining walls and right-of-way acquisitions will be required to construct pump stations.</td>
<td>No diversion of regional traffic with construction of grade separations.</td>
<td>No diversion of regional traffic with construction of grade separations.</td>
<td>No diversion of regional traffic with construction of grade separations.</td>
<td>No diversion of regional traffic with construction of grade separations.</td>
</tr>
<tr>
<td><strong>G</strong> Reduce rail noise and vibration</td>
<td>Train noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. With the lowered track, train wheel noise could radiate out, which can be mitigated with a sound barrier.</td>
<td>Train noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. With the elevated track, train wheel noise could radiate out, which can be mitigated with a sound barrier.</td>
<td>Train noise and warning bells will be eliminated with the removal of the at-grade crossings with grade separations. With the elevated track, train wheel noise could radiate out, which can be mitigated with a sound barrier.</td>
<td>Train noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. With the lowered track, train wheel noise could radiate out, which can be mitigated.</td>
<td>Train noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. With the elevated track, train wheel noise could radiate out, which can be mitigated.</td>
</tr>
<tr>
<td><strong>H</strong> Maintain access to neighborhoods, parks, and schools along the corridor, while reducing regional traffic on neighborhood streets</td>
<td>No diversion of regional traffic with construction of grade separations.</td>
<td>No diversion of regional traffic with construction of grade separations.</td>
<td>No diversion of regional traffic with construction of grade separations.</td>
<td>Diversion of regional traffic with Churchill Ave closure will be mitigated.</td>
<td>No diversion of regional traffic with construction of grade separations.</td>
</tr>
<tr>
<td><strong>I</strong> Minimize visual changes along the corridor</td>
<td>Railroad tracks will be below grade.</td>
<td>Railroad tracks will be approximately 15 feet above grade.</td>
<td>Railroad tracks will be approximately 20 feet above grade.</td>
<td>Railroad tracks will remain at existing grade.</td>
<td>Railroad tracks will be approximately 20 feet above grade.</td>
</tr>
<tr>
<td><strong>J</strong> Minimize disruption and duration of construction</td>
<td>Extended road closures at Meadow Dr and Charleston Rd are required. Construction would last for approximately 6 years.</td>
<td>Extended road closures at Aloma St, Meadow Dr and Charleston Rd will be required. Construction would last for approximately 4 years.</td>
<td>The closure will have minimal road closures (nights/weekends only). Approximate construction duration is 1-2 years.</td>
<td>Extended road closures at Aloma St (one lane in each direction) will be required. Construction would last for approximately 3 years.</td>
<td>Extended road closures at Aloma St (one lane in each direction) will be required. Construction would last for approximately 3 years.</td>
</tr>
</tbody>
</table>

*Total Preliminary Construction Costs in 2018 dollars with escalation to 2035 (Subject to Change)*

<table>
<thead>
<tr>
<th>Order of Magnitude Cost</th>
<th>Meadow / Charleston</th>
<th>South Palo Alto Tunnel with Freight</th>
<th>South Palo Alto Tunnel without Freight</th>
<th>Churchill</th>
<th>Viaduct</th>
</tr>
</thead>
<tbody>
<tr>
<td>$800M to $950M*</td>
<td>$200M to $250M*</td>
<td>$400M to $500M*</td>
<td>$550M to $650M*</td>
<td>$300M to $400M*</td>
<td></td>
</tr>
</tbody>
</table>
## Summary of Engineering Challenges

<table>
<thead>
<tr>
<th>Engineering Impacts</th>
<th>Meadow / Charleston</th>
<th>Churchill</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L</strong> Creek/Drainage Impacts</td>
<td>• Requires diversion of Adobe and Barron creeks resulting in the need for pump stations.</td>
<td>• No significant creek or drainage impacts.</td>
</tr>
<tr>
<td></td>
<td>• Numerous regulatory agency approvals required for creek diversion.</td>
<td>• Pump station required for lowered pedestrian/bike way.</td>
</tr>
<tr>
<td></td>
<td>• Pump stations also required to dewater the trench.</td>
<td>• Increased risk of flooding with pump stations.</td>
</tr>
<tr>
<td></td>
<td>• Increased risk of flooding due to pump stations.</td>
<td>• Relocation of the pump house at Embarcadero Rd required to accommodate widening of Alma St.</td>
</tr>
<tr>
<td><strong>M</strong> Long-Term Maintenance</td>
<td>Increased maintenance costs due to:</td>
<td>Increased maintenance costs due to:</td>
</tr>
<tr>
<td></td>
<td>• Pump stations for creek diversion.</td>
<td>• Pump stations for undercrossing dewatering.</td>
</tr>
<tr>
<td></td>
<td>• Pump stations for trench dewatering.</td>
<td>• Potential utility relocations in Alma St and Churchill Ave for pedestrian/bike undercrossing.</td>
</tr>
<tr>
<td></td>
<td>• Below ground railroad alignment.</td>
<td>• Minimal impacts to utilities.</td>
</tr>
<tr>
<td><strong>N</strong> Utility Relocations</td>
<td>Major utility relocations for lowered railroad.</td>
<td>• Potential utility relocations in Alma St and Churchill Ave for pedestrian/bike undercrossing.</td>
</tr>
<tr>
<td></td>
<td>Major utility relocations for lowered roadways.</td>
<td>• Minor utility relocations for Embarcadero Rd/Alma St improvements.</td>
</tr>
<tr>
<td><strong>O</strong> Railroad Operations Impacts during Construction</td>
<td>Temporary track (i.e., shoofly) is required.</td>
<td>• No temporary track (i.e., shoofly) required, only single tracking during nights and weekends.</td>
</tr>
<tr>
<td></td>
<td>Temporary track (i.e., shoofly) required, but a bit shorter than the trench shoofly.</td>
<td>• Temporary track (i.e., shoofly) is required.</td>
</tr>
<tr>
<td><strong>P</strong> Local Street Circulation Impacts during Construction</td>
<td>Removal of right turn lanes on Alma St at Meadow Dr and Charleston Rd; however traffic will still be able to flow as needed despite lane reduction.</td>
<td>• Path along Palo Alto High School will temporarily be impacted during construction.</td>
</tr>
<tr>
<td></td>
<td>Removal of right turn lanes on Alma St at Meadow Dr and Charleston Rd; however, traffic will still be able to flow as needed despite lane reduction.</td>
<td>• Temporary night and weekend closures of lanes on Churchill Ave, Alma St and Embarcadero Rd.</td>
</tr>
<tr>
<td></td>
<td>Closes Meadow Dr while Charleston Rd roadway bridges are constructed and visa versa.</td>
<td>• Alma St, reduced to two lanes.</td>
</tr>
<tr>
<td><strong>Q</strong> Caltrain Design Exceptions Needed</td>
<td>2% grade on track required. Maximum allowed by Caltrain is 1%.</td>
<td>None required.</td>
</tr>
<tr>
<td></td>
<td>Temporary vertical clearance of 12 feet at undercrossing structures during construction. Minimum allowed by Caltrain is 15.5 feet.</td>
<td>1.6% grade on track required. Maximum allowed by Caltrain is 1%.</td>
</tr>
</tbody>
</table>