

Summary of Evaluation with City Council-Adopted Criteria

Evaluation Criteria		Meadow / Charleston					Churchill	
		Trench	Hybrid	Viaduct	South Palo Alto Tunnel Passenger and Freight	South Palo Alto Tunnel with At-Grade Freight	Closure	Viaduct
A	Facilitate movement across the corridor for all modes of transportation	Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open.	Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open.	Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open. Viaduct provides opportunities for additional crossings for all modes.	Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open	Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open	Churchill Ave will be closed to vehicles at the railroad tracks.	Churchill Avenue will be grade separated from the railroad for all modes and will remain open. Viaduct provides opportunities for additional crossings for all modes.
B	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 Dr and Charleston Rd will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.	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.	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 gates coming down.	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.	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 railroad crossing gates.	With closure of Churchill Ave, the traffic at nearby intersections will be impacted; however, this can be mitigated.	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.
C	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 to Charleston Rd.	Pedestrians/cyclists will be separated from train traffic and bike lanes will be added to Charleston Rd.	Pedestrians/cyclists will be separated from train traffic and bike lanes will be added to Charleston Rd.	Pedestrians/cyclists will be separated from train traffic.	Pedestrians/cyclists will be separated from passenger train traffic only.	Pedestrians/cyclists will be separated from train traffic and vehicles.	Pedestrians/cyclists will be separated from train traffic.
D	Support continued rail operations 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 from flooding.	A temporary railroad track will be required, and a crossover track located north of the San Antonio Caltrain Station will be relocated.	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.	A temporary railroad track will be required at the boring pit areas to the north and south. A siding track will be relocated north of the California Avenue Caltrain Station. Due to the pump stations, there will be potential risks to train operations due to flooding.	A temporary railroad track will be required at the boring pit areas to the north and south. A siding track will be relocated north of the California Avenue Caltrain Station. Due to the pump stations, there will be potential risks to train operations due to flooding.	A temporary railroad track will not be required.	A temporary railroad track will be required. Stanford game day station will be eliminated due to grade issues.
E	Finance with feasible funding sources	The trench will require greater levels of local funding in the form of fees, taxes or special assessments, the feasibility of which are still being studied in the context of overall citywide infrastructure funding needs.	The hybrid would require lower levels of local funding, with a substantial portion of capital costs covered by Regional, State and Federal sources.	The viaduct would require substantial local funding resources more than the hybrid alternative, but less than the trench alternative.	The tunnel will require the greatest levels of local funding in the form of fees, taxes or special assessments, the feasibility of which are still being studied in the context of overall citywide infrastructure funding needs.	The tunnel will require the greatest levels of local funding in the form of fees, taxes or special assessments, the feasibility of which are still being studied in the context of overall citywide infrastructure funding needs. However, this alternative would not be eligible for grade separation funding as the at-grade crossing for freight would remain.	The closure would require lower levels of local funding, with a substantial portion of capital costs covered by Regional, State and Federal sources.	The viaduct would require substantial local funding resources significantly above the closure alternative.
F	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.	No acquisition of private properties is required; however, driveway modifications will be required.	No acquisition of private properties is required.	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.	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.	No acquisition of private properties is required; however, there will be impacts to Palo Alto High School property and potentially Caltrain. There also may be some parking loss on the east side of Churchill Ave for the pedestrian/bike undercrossing (Option 2 only).	No acquisition of private properties will be required.
G	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. Utilizing electric engines instead of diesel engines will also reduce noise. With the lowered track, train noise could reflect off walls and impact properties farther away, which can be mitigated.	Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing electric engines instead of diesel engines will also reduce noise. With the elevated track, train wheel noise could radiate out, which can be mitigated with a sound barrier.	Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing electric engines instead of diesel engines will also reduce noise. With the elevated track, train wheel noise could radiate out, which can be mitigated with a sound barrier.	Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing electric engines instead of diesel engines will also reduce noise. In the trench section, train noise could reflect off walls and impact properties farther away, which can be mitigated. In the tunnel section, train wheel noise will be contained.	Train horn noise and warning bells will remain for the at-grade crossings to accommodate the freight trains. Utilizing electric engines instead of diesel engines will also reduce noise. In the trench section, train noise could reflect off walls and impact properties farther away, which can be mitigated. In the tunnel section, train wheel noise will be contained.	Train horn noise and warning bells will be eliminated with the removal of the at-grade crossings with roadway closure. Utilizing electric engines instead of diesel engines will also reduce noise.	Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing electric engines instead of diesel engines will also reduce noise. With the elevated track, train wheel noise could radiate out, which can be mitigated.
H	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.	No diversion of regional traffic with construction of grade separations.	No diversion of regional traffic with construction of grade separations.	No diversion of regional traffic with construction of grade separations.	Diversion of regional traffic with the permanent lane reduction on Alma Street will impact residential streets.	Diversion of regional traffic with Churchill Ave closure will be mitigated.	No diversion of regional traffic with construction of a grade separations.
I	Minimize visual changes along the corridor	Railroad tracks will be below grade with high fencing at grade. Landscaping options will be limited to plants with shallow roots in areas where tiebacks are required for the trench retaining walls.	Railroad tracks will be approximately 15 feet above grade. Landscaping with trees will be incorporated for screening where feasible.	Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible.	Railroad tracks will be below grade with high fencing at grade in the trench section. Landscaping options will be limited to plants with shallow roots in areas where ground anchors are required for the trench section.	Passenger tracks will be below grade and freight tracks will be at-grade with high fencing. Landscaping options will be limited to plants with shallow roots in areas where ground anchors are required for the trench section.	Railroad tracks remain at existing grade. Residual roadway areas from closure provide opportunities for landscaping.	Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible.
J	Minimize disruption and duration of construction	Extended road closures at Meadow Dr and Charleston Rd are required. Construction would last for approximately 6 years.	Extended lane reductions at Alma St, Meadow Dr, and Charleston Rd will be required. Construction would last for approximately 4 years.	The viaduct will have minimal road closures (nights/weekends only). Construction would last for approximately 2 years.	Extended lane reductions on Alma Street are required. Construction would last for approximately 6 years.	Extended lane reductions on Alma Street are required. Construction would last for approximately 6 years.	The closure will have minimal road closures (nights/weekends only). Construction would last for approximately 2 years.	Extended lane reductions at Alma St (one lane in each direction) will be required. Construction would last for approximately 2 years.
Order of Magnitude Cost		\$800M to 950M*	\$200M to \$250M*	\$400M to 500M*	\$1,218M to \$1,827M*	\$1,173M to \$1,759M*	\$50M to \$65M*	\$300M to \$400M*

* Total Preliminary Construction Costs in 2018 dollars with escalation to 2025 (Subject to Change).

Summary of Engineering Challenges

Engineering Challenges		Meadow / Charleston					Churchill	
		Trench	Hybrid	Viaduct	South Palo Alto Tunnel Passenger and Freight	South Palo Alto Tunnel with At-Grade Freight	Closure	Viaduct
L	Creek/Drainage Impacts	<ul style="list-style-type: none"> Requires diversion of Adobe and Barron creeks resulting in the need for pump stations. Numerous regulatory agency approvals required for creek diversion. Pump stations also required to dewater the trench. Increased risk of flooding due to pump stations. 	<ul style="list-style-type: none"> Pump stations required for lowered roadways. Increased risk of flooding due to pump stations. 	<ul style="list-style-type: none"> No significant creek or drainage impacts. 	<ul style="list-style-type: none"> Requires diversion of Adobe and Matadero creeks resulting in the need for pump stations. Numerous regulatory agency approvals required for creek diversion. Pump stations also required to dewater the trench and tunnel. Increased risk of flooding due to pump stations. 	<ul style="list-style-type: none"> Requires diversion of Adobe and Matadero creeks resulting in the need for pump stations. Numerous regulatory agency approvals required for creek diversion. Pump stations also required to dewater the trench and tunnel. Increased risk of flooding due to pump stations. 	<ul style="list-style-type: none"> Pump station required for lowered pedestrian/bike way. Increased risk of flooding with pump stations. Relocation of the pump house at Embarcadero Rd required to accommodate widening of Alma St. 	<ul style="list-style-type: none"> No significant creek or drainage impacts.
M	Long-Term Maintenance	<p>Increased maintenance costs due to:</p> <ul style="list-style-type: none"> Pump stations for creek diversions. Pump stations for trench dewatering. Below ground railroad alignment. 	<p>Increased maintenance costs due to:</p> <ul style="list-style-type: none"> Pump stations for trench dewatering. Above ground railroad alignment with embankments and undercrossing structures. 	<p>Increased maintenance costs due to:</p> <ul style="list-style-type: none"> Above ground railroad alignment with embankments and viaduct structures. 	<p>Increased maintenance costs due to:</p> <ul style="list-style-type: none"> Pump stations for creek diversions Pump stations for trench dewatering Below ground railroad alignment. 	<p>Increased maintenance costs due to:</p> <ul style="list-style-type: none"> Pump stations for creek diversions Pump stations for trench dewatering Below ground railroad alignment as well as at-grade railroad alignment 	<p>Increased maintenance costs due to:</p> <ul style="list-style-type: none"> Pump stations for undercrossing dewatering. 	<p>Increased maintenance costs due to:</p> <ul style="list-style-type: none"> Above ground railroad alignment with embankments and viaduct structures.
N	Utility Relocations	<ul style="list-style-type: none"> Major utility relocations for lowered railroad. 	<ul style="list-style-type: none"> Major utility relocations for lowered roadways. 	<ul style="list-style-type: none"> No major utility relocations. 	<ul style="list-style-type: none"> Major utility relocations for lowered railroad. 	<ul style="list-style-type: none"> Major utility relocations for lowered railroad. 	<ul style="list-style-type: none"> Potential utility relocations in Alma St and Churchill Ave for pedestrian/bike undercrossing. Minor utility relocations for Embarcadero Rd/Alma St improvements. 	<ul style="list-style-type: none"> Minimal impacts to utilities.
O	Railroad Operations Impacts during Construction	<ul style="list-style-type: none"> Temporary track (i.e., shoofly) is required. 	<ul style="list-style-type: none"> Temporary track (i.e., shoofly) is required, but a bit shorter than the trench shoofly. 	<ul style="list-style-type: none"> No temporary track (i.e., shoofly) required. 	<ul style="list-style-type: none"> Temporary track (shoofly) is required. 	<ul style="list-style-type: none"> Temporary track (shoofly) is required. 	<ul style="list-style-type: none"> No temporary track (i.e., shoofly) required, only single tracking during nights and weekends. 	<ul style="list-style-type: none"> Temporary track (i.e., shoofly) is required.
P	Local Street Circulation Impacts during Construction	<ul style="list-style-type: none"> 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. Closes Meadow Dr while Charleston Rd roadway bridges are constructed and visa versa. 	<ul style="list-style-type: none"> 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. Alma St, Charleston Rd, and Meadow Dr reduced to 2 lanes. 	<ul style="list-style-type: none"> Reduced lane widths on Alma St, north of Meadow Dr and south of Charleston Rd. Possible night time closures of Meadow Dr and Charleston Rd. 	<ul style="list-style-type: none"> Alma Street will be reduced to one lane in each direction from south of Oregon Expressway to Ventura Avenue. From Charleston Road to Ferne Avenue, there will be only one southbound lane on Alma Street. 	<ul style="list-style-type: none"> Alma Street will be reduced to one lane in each direction from south of Oregon Expressway to Ventura Avenue. 	<ul style="list-style-type: none"> Path along Palo Alto High School will temporarily be impacted during construction. Temporary night and weekend closures of lanes on Churchill Ave, Alma St and Embarcadero Rd. 	<ul style="list-style-type: none"> Alma St, reduced to two lanes. Removal of right turn lanes on Alma St at Churchill Ave; however, traffic will still be able to flow as needed despite lane reduction. Temporary night and weekend closures of lanes on Alma St and Churchill Ave.
Q	Caltrain Design Exceptions Needed	2% grade on track required. Maximum grade allowed by Caltrain is 1%.	Temporary vertical clearance of 12 feet at undercrossing structures during construction. Minimum vertical clearance allowed by Caltrain is 15.5 feet.	1.4% grade on track required. Maximum grade allowed by Caltrain is 1%.	2% grade on track required. Maximum grade allowed by Caltrain is 1%.	2% grade on track required. Maximum grade allowed by Caltrain is 1%.	None required.	1.6% grade on track required. Maximum grade allowed by Caltrain is 1%.