Technical Memorandum #6 – Feasibility-Level Cost Estimating Methodology

Introduction

This document outlines the methodology for determining feasibility-level capital costs for the investment options developed in the Illinois High-Speed Rail Feasibility Study. The following elements define this methodology:

1. Cost Units – Infrastructure elements that will be quantified and priced
2. Unit Quantities – Total amount of infrastructure elements to be quantified
3. Unit Prices –Dollar value assigned to quantified cost units

This document outlines how each of these elements will be executed in the Federal Railroad Administration's (FRA's) Standard Cost Category (SCC) format which are defined below.

Capital Cost Methodology

The capital costs for this feasibility study will describe and quantify the infrastructure elements and multiply the unit quantities by the unit price to arrive at a total cost. This process will be repeated for all potentially feasible route options from Chicago to East St. Louis. Quandel identified twelve route options from Chicago to East St. Louis as potentially feasible. All route options include terminal stations in Chicago and East St. Louis, Illinois as well as an intermediate station in Springfield, Illinois. Beyond these stations, the potentially feasible routes include intermediate stations at larger metropolitan areas within Illinois and utilize a variety of right-of-way options between city pairs (e.g., along the interstate/existing railroad, adjacent to the interstate, and new greenfield construction). The full route development process is described in Technical Memorandum #2 – Route Options Development.

Cost Sources

The Cost Units define how the capital costs are quantified and priced. Quandel has developed similar estimates for other high-speed rail feasibility studies (Colorado Interregional Connectivity Study or ICS (2017 data)) as well as other conventional steel-wheel/steel-rail intercity passenger service planning and design projects throughout the Midwest, including the Northern Lights Express project (2023 data). In addition to Quandel's library of data, the California High-Speed Rail (CAHSR) project (2024 data), that is currently under design and construction, provides data for cost estimates from public reports.

All costs are converted into Illinois region-specific numbers as described below and inflated to base year 2025 dollars accordingly.

FRA Standard Cost Categories

The FRA SCC is used for FRA-funded railroad projects to be consistent with reporting and estimating requirements for capital costs. Due to the structured nature of SCC, it is easy to compare estimates between capital-intensive projects as well as assess the evolution of an individual project's capital costs categorically over time. FRA's SCC is broken into 10 categories as follows[1]:

- 10 Track Structures and Track
- 20 Stations, Terminals, Intermodal
- 30 Support Facilities: Yards, Shops, Administrative Buildings
- 40 Sitework, Right of Way, Land, Existing Improvements
- 50 Communications & Signaling
- 60 Electric Traction
- 70 Vehicles
- 80 Professional Services
- 90 Unallocated Contingency
- 100 Finance Charges

Unit Cost Determination

Quandel focused on comparing CAHSR track cost category (FRA SCC 10) with the previous Colorado ICS project to confirm if the Colorado project's unit costs were a close approximation for the ILHSR cost estimate. By inflating select CAHSR unit costs with closest descriptions to 2025$ and adjusting for Colorado prices using ENR's City Cost Index ratio between San Francisco and Denver for construction costs, it was determined that the Colorado ICS project unit costs came within 20% above or below CAHSR unit costs. This provided a conservative rationale to adopt the Colorado ICS unit costs for ILHSR. Table 1 shows a cost comparison of several track elements for the CASHR project and the Colorado ICS project.

[1] (Federal Railroad Administration, 2016)

FRA SCC	Description	Unit	Days/Year	CAHSR Inflated to 2025$ using ENR with city adjustment to Denver (thousands)	Colorado inflated to 2025$ using ENR (thousands)	Difference between Colorado and CAHSR (%)
10.07.01	Cut & Cover Box – 2 Track/ 1 Box (	Route Mile	365	$198,176	$201,850	-2.0%
10.08.01	Retained Cut, Trench – 2 Track (10' Avg, Exc Depth)	Route Mile	365	$52,129	$53,473	-2.5%
10.08.02	Retained Cut, Trench – 2 Track (20' Avg. Exc Depth)	Route Mile	365	$109,680	$130,679	-19.1%
10.08.03	Retained Fill Walls Both Sides – 2 Tracks (10' Avg. Wall Ht)	Route Mile	365	$11,163	$13,345	-19.5%

Table 1- Unit Cost Comparisons between CAHSR and Colorado ICS

In addition, several unit cost items are taken from the Northern Lights Express (NLX) project, a project that proposes reinstating passenger rail service between Minneapolis, MN and Duluth, MN. Those unit costs were adjusted to 2025$. A unit cost for land acquisition was utilized from the Chicago to Quad Cities Passenger Rail project preliminary engineering capital cost estimate.

Unit Cost Descriptions

10 – Track Structures and Track

10.01 Track Structure: Viaduct

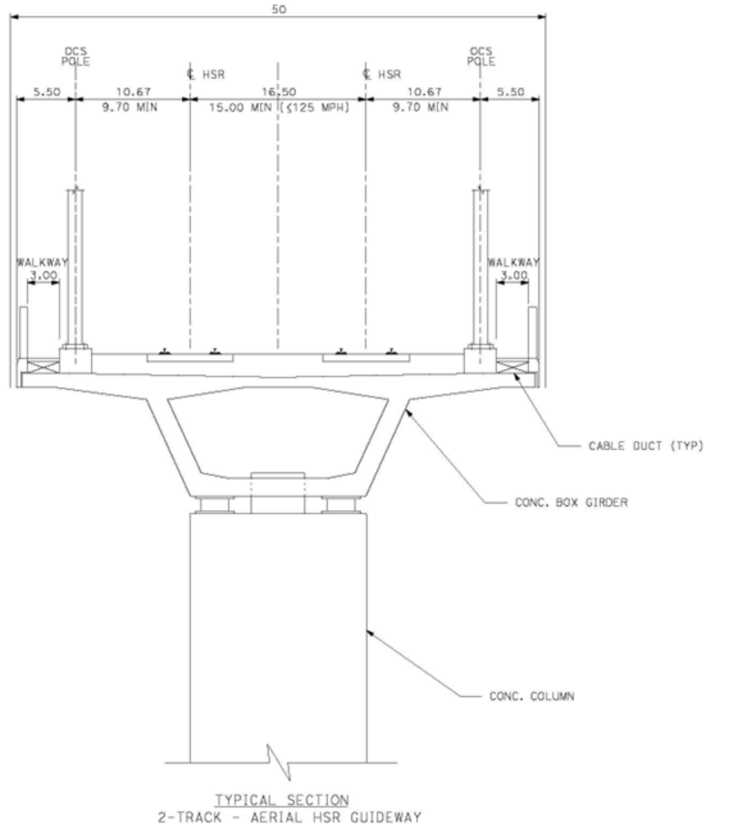
10.01.01 – Elevated Structure + Direct Fixation – 2 Track (30' Avg. Pier Ht)

10.01.02 – Elevated Structure + Direct Fixation – 2 Track (60' Avg. Pier Ht)

10.01.03 – Elevated Structure Straddle + Direct Fixation – 2 Track (30' Avg. Pier Ht)

A viaduct was priced out where insufficient median space restricted at-grade double track construction particularly near city centers.

- A typical track section for elevated structures is displayed below. Structures at least 30 feet in height were deemed necessary through all urban areas and for crossing over at-grade roadways, railroads, rivers, and other immobile objects and terrain running semi-parallel to the alignment. Structures 60 feet in height are assumed only in areas in which the alignment must pass over elevated structures for existing roadways and railroads. Another type of elevated structure, straddle structures, are assumed when entering a highway median from outside the highway right-of-way and when crossing over a major interstate highway. The unit cost for elevated structures from the Colorado project does not include cost for track and so was merged with another line item called double track direct fixation and inflated accordingly, from the NLX project.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.02 Track Structure: Major Bridge

<u>10.02.01 – High Level Structure, major river crossing</u>

The cost of a high-level structure at a major river crossing was compared with an undergrade double track high level bridge (50 feet) and the higher of the two (the latter) was used. The cost breakdown is described under 10.03.08 below.

10.03 Track Structure: Undergrade Bridges

10.03.01 - Four Lane Urban Expressway

10.03.02 – Four Lane Rural Expressway

10.03.03 – Two Lane Highway

10.03.04 – Rail

10.03.05 – Rail-Rail Flyovers

10.03.06 – Minor River

10.03.07 – Major River

10.03.08 – Double Track High (50') Level Bridge

This cost item was used with a linear measurement taken of the existing movable railroad bridge connecting to Joliet. Connecting into Joliet station, a high-level double track bridge over the existing CSX railroad bridge would be required. Inflating the cost numbers from 2022$ to 2025$, the cost of erecting such a bridge is $31,000 per lineal foot.

10.03.09 – Rehab for Passenger Speeds

10.03.10 – Bridge Rehab for 90 mph

The Canadian National Gilman Subdivision bridge as shown in the photos below currently runs CN freight traffic with very little frequency. It would serve as one potential route into Springfield across Lake Springfield. Currently, it is a steel through-plate girder bridge with 100-foot-long piers. In addition, it has six spans at 320 feet and is 12 feet high. It was originally built in 1897 and strengthened in subsequent years. There is no walkway present, and it does not provide road access.

Figure 1 - Side view of Gilman Sub CN Bridge near Toronto, IL

Figure 2 - Front view of Gilman Sub CN Bridge near Toronto, IL

To accommodate high-speed trains on this bridge, the current bridge would need to be raised and replaced with ballast deck. The estimated cost for this rehabilitation is $30 million in 2025$.

10.03.11 – Convert open deck bridge to ballast deck (single track)

10.03.12 – Convert open deck bridge to ballast deck (double track)

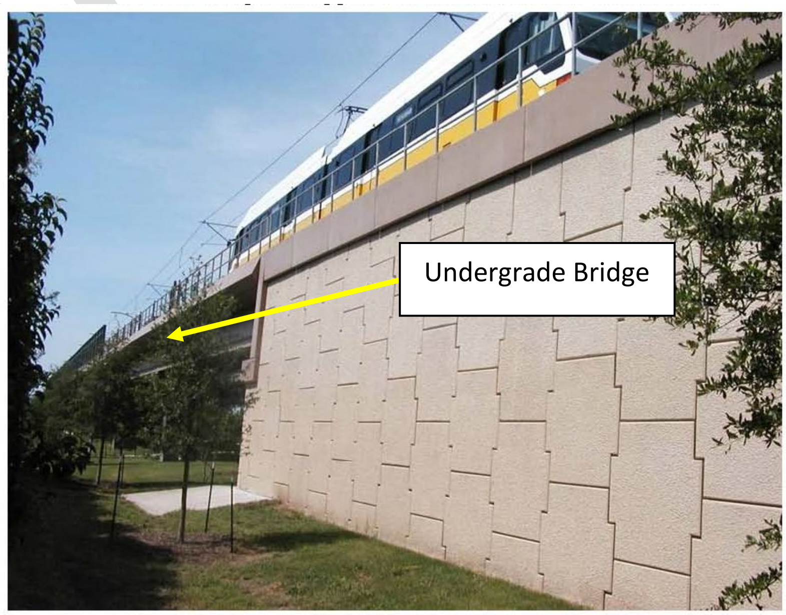
10.03.13 – Single Track on Flyover/Elevated Structure

10.03.14 – Ballasted Deck Replacement Bridge

10.03.15 – Land Bridges

<u>10.03.17 – Undergrade Bridge (Double Track)</u>

- Roadways, railroads, and rivers that the alignment crosses perpendicularly are addressed with an undergrade bridge structure. An exhibit is shown to the right. The unit cost associated with an undergrade bridge includes a provision for new abutments, necessary grading and earth retention system to control the embankment at the abutments, new piers, and the placement of a new 200 foot-long and 44-foot-wide superstructure at undergrade bridge locations. The unit cost for undergrade bridges does not include cost for track.



Source: Reinforced Earth Company

10.07 Track Structure: Tunnel

10.07.01 – Cut & Cover – 2 Track/1Box (40' Avg. Exc. Depth)

10.08 Track Structure: Retaining walls and systems

10.08.01 – Retained Cut, Trench – 2 Track (10' Avg. Exc. Depth)

10.08.02 – Retained Cut, Trench – 2 Track (20' Avg. Exc. Depth)

10.08.03 – Retained Fill, Walls Both Sides – 2 Tracks (10' Avg Wall Ht.)

10.08.04 – Retained Fill, Walls Both Sides – 2 Tracks (20' Avg. Wall Ht.)

10.08.05 – Retained Fill, Walls Both Sides – 2 Tracks (30' Avg. Wall Ht.)

10.09 Track New Construction: Conventional Ballasted

<u>10.09.01 – Single Track New Construction on Existing Roadbed</u>

High-Speed Rail (HSR) on Existing Roadbed addresses the installation of a new track on an existing roadbed within an existing railroad right-of-way where track(s) has been removed. If there is an existing track present in the right-of-way, the new track will be built at an appropriate distance from it, generally using the same track centers as had been used before the historic second track had been removed. The track center spacing is typically 14 feet. If there is no track in place, the new track will generally be centered in the right of way per the operating railroads typical track section. The work consists of leveling the roadbed, maintaining existing drainage, and placing a 6-inch ballast pad prior to track construction. HSR Track will be constructed on this base and the remaining 6-inch required ballast will be installed to allow final alignment and surfacing of the new track.

<u>10.09.02 – Single Track New Construction on New Roadbed</u>

Single Track New Construction on New Roadbed is similar to the above but requires subgrade preparation and the placement of 12 inches of compacted sub ballast before a ballast pad or new track can be constructed.

<u>10.09.03 – Single Track New Construction on New Roadbed and New Embankment</u>

This line item is to be used for median at-grade alignments and is a repeat of the above with clearance of way for preparing the subgrade, establishing drainage patterns, maintaining existing drainage, and placing 12 inches sub ballast. The HSR track will be constructed on this base, and the embankment will be at minimum 15 feet.

<u>10.09.04 - Double Track New Construction on New Roadbed and New Embankment</u>

A typical section of new track construction on new embankment is shown below. The unit cost associated with this typical section includes costs for construction of a 5-foot embankment, ballast, ties, and a double track. This item is assumed for new sections of track that are constructed in the vicinity of existing passenger/freight track or adjacent county roads. Where the new track is adjacent to existing track, a retained fill section may be necessary. Where the at-grade double track is constructed adjacent to a county road, a horizontal clearance of 2000 feet is advisable to allow for traffic movement under the embanked double track. A contingency to inflate this cost item for a 15-foot embankment will be added.

10.09.05 – Single Track New Construction on Double Trackbed Embankment

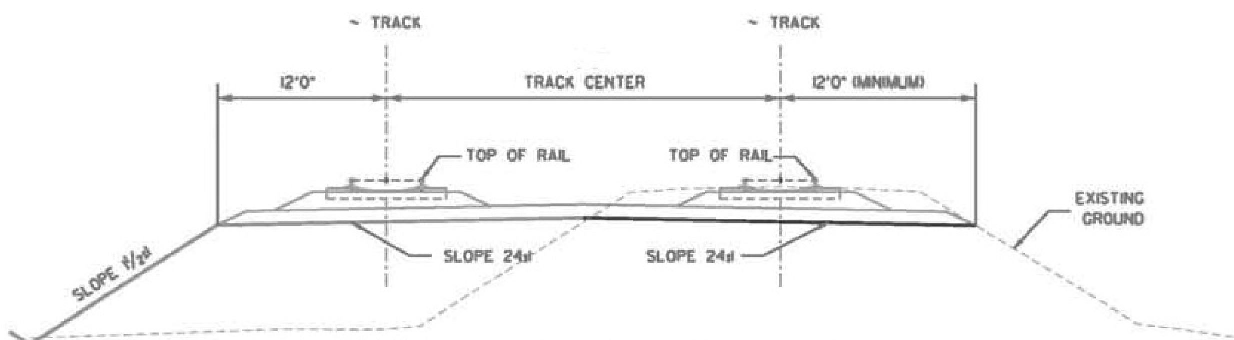
This line item takes the difference of the following items namely “Double Track New Construction on New Embankment” and “Double Track New Construction on Prepared Subgrade” to get the cost of the double track embankment only (without the track component costs). Then, the line item above denoted “Single Track New Construction on Existing Roadbed” is added to the difference tabulated before to arrive at this final cost item. This line item is to be used in greenfield/median-adjacent alignments.

10.09.06 – 10-Mile-Long Passenger Siding

This work consists of site clearing the full width of additional right-of-way required for the siding, generally 50 feet in width, preparing the roadbed, and maintaining existing drainage, and placing 12 inches of sub-ballast. HSR Track will then be constructed on this base. A #33 turnout will be installed at each end of a passenger siding.

10.09.07 - Double Track New Construction on Prepared Subgrade

Typical cross sections for this item are shown below. The unit cost associated with double track new construction on prepared subgrade includes ballast, ties, and a double track. This unit cost does not include costs for a 15-foot embankment. It is assumed that this type of track construction will occur in locations where a subgrade has already been prepared, such as on a retained cut or fill section.



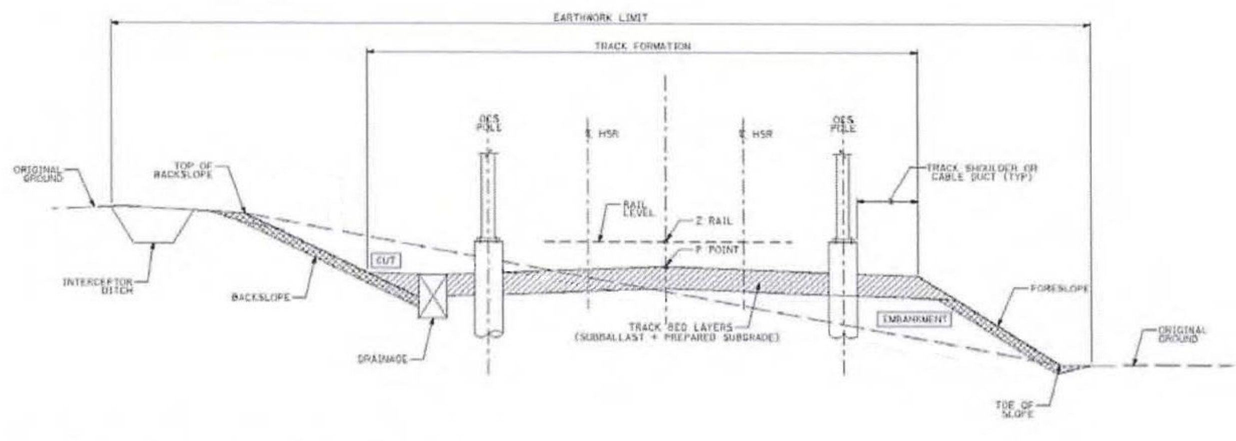
DOUBLE TRACK "FILL" SECTION

Source: Midwest Regional Rail Initiative - Cost Estimating Methodology for High-Speed Rail on Shared Right-of-Way

10.09.08 – Double Track New Construction on New Embankment

10.09.09 - Double Track New Construction on Cut/Fill Section (retaining walls as needed)

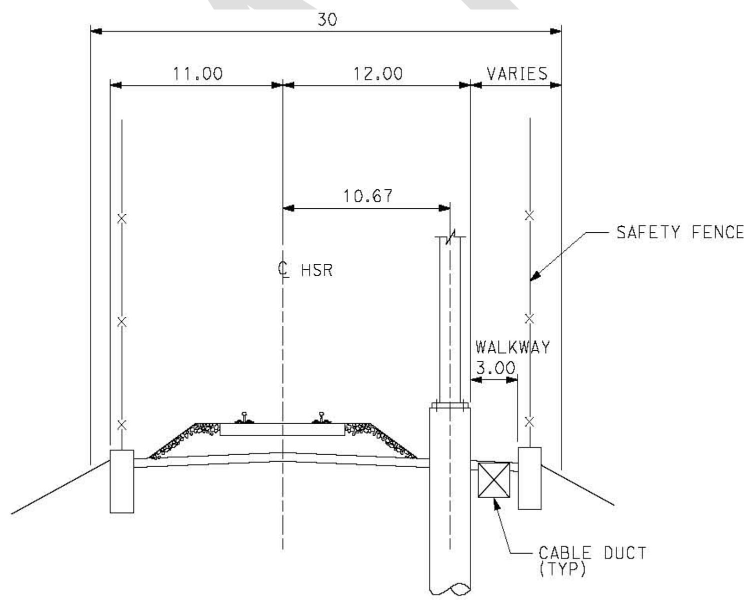
The typical cross section for this item of work is shown below. The unit cost associated with new track construction on cut or fill sections include earthwork costs, retaining walls (if needed), ballast, ties, and a double track. This type of track construction is assumed for sections of track that will be constructed adjacent to highway embankments or other areas that are not level ground and not adjacent to existing passenger/freight track.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.09.10 - Single Track New Construction on Prepared Subgrade

Costs for single track new construction on prepared subgrade include ballast, ties, and a single track. This item does not include costs for 15-foot embankment. It is assumed that this type of track construction will occur in locations where a subgrade has already been prepared, such as on a retained cut or fill section.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.09.11 - Single Track New Construction on New Embankment

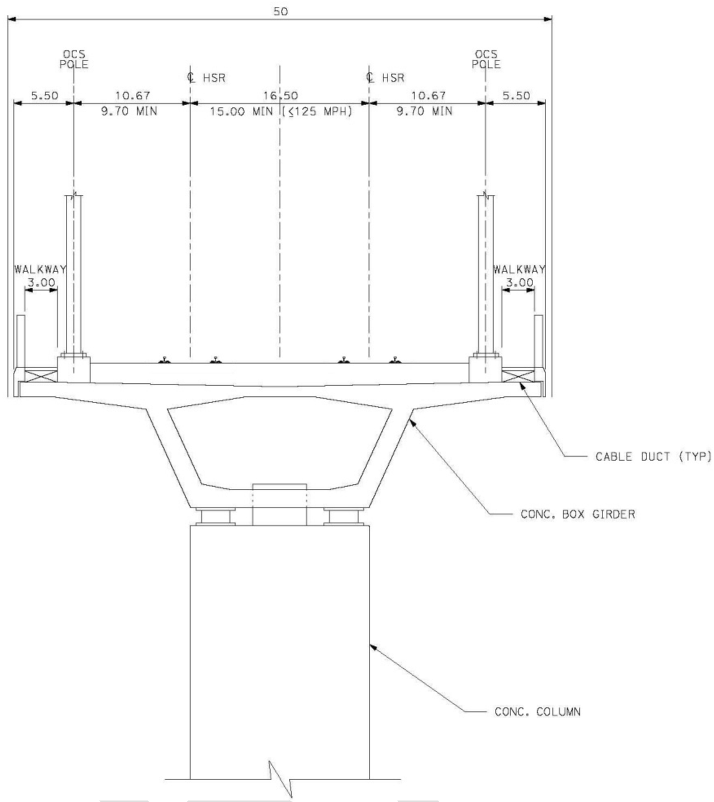
This line item will account for single track components on a 15-foot embankment within the median. In addition, it will include site clearance, drainage considerations, preparing the subgrade, and placing 12 inches of sub-ballast upon which the High-Speed Track would be constructed.

10.10 Track New Construction: Non-Ballasted

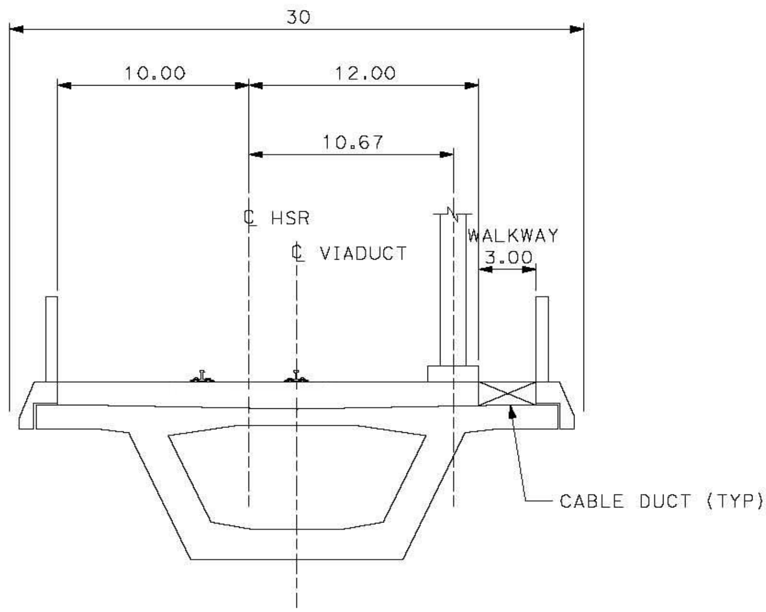
10.10.01 - Double Track New Construction with Direct Fixation

10.10.02 – Single Track New Construction with Direct Fixation

Direct fixation of track occurs on all elevated structures. Typical cross sections are shown below. The unit cost for this item includes track and other materials to anchor the track to the structure. The cost of the structure itself is not included.



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21



Source: CHSTP Technical Memorandum – Typical Cross Sections for 15% Design TM 1.1.21

10.14 Track: Special trackwork (switches, turnouts, insulated joints)

10.14.01 - #33 High Speed Turnout

10.14.02 - #24 High Speed Turnout

10.14.03 - #33 Crossover

10.14.04 - #24 Crossover

10.14.05 – Dedicated HSR on Rock Island

This line item is informed from Metra's recent Rock Island District 3rd Mainline cost estimate spanning from 18th Street to 74th Street. This mainline would allow Amtrak to operate at 79 mph into Chicago. The breakdown provided by Metra is shown in Table 2:

Item #	Project Element	Cost ($M)
1	3rd Mainline Track 17th to 74th	696.2
2	47th St. Yard Expansion	212.1
3	Signal, Station and Track Upgrades South of Gresham	212.6
	Subtotal (with 17% Professional services)	1120.9
4	ROW, Land, Existing Improvements	20.8
5	Unallocated contingency (10%)	114.2
	Total	**1,255.9**

Table 2 – Metra's Rock Island District 3rd Mainline Cost Estimate

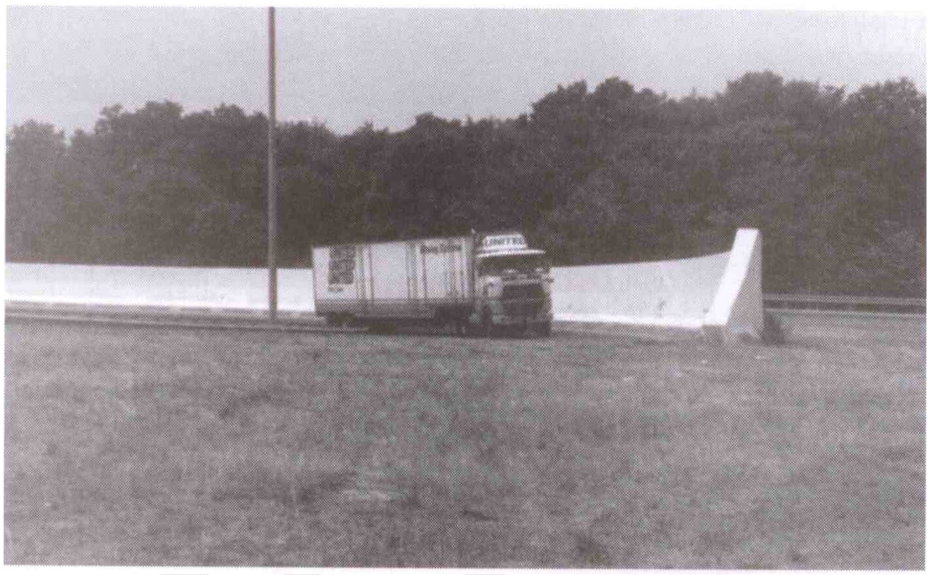
The "Dedicated HSR on Rock Island" was calculated by taking item 1 and item 4 in the above table

($696.2 million + $20.8 million) and dividing by the total proposed mileage for the 3rd mainline (6.775 miles) to arrive at $105.83 million/mile in 2025$. This per mile cost is inclusive of ROW acquisitions and land improvements required for the dedicated HSR track in Chicago urban.

10.18 Other Linear Structures Including Fencing, Sound Walls

10.18.01 – Highway Barrier Type 6

These barriers are only included where the alignment runs inside a highway median at or below grade and a horizontal curve exists. The unit cost for this item of work includes the complete installation of the item. Highway Barrier Type 6 reinforced concrete barriers meeting the requirements of NCHRP Report 350 Test Level 6.



Source: *Roadside Design Guide 2002,* American Association of state Highway and Transportation Officials, Washington, D.C. Used by permission. Documents may be purchased from the AASHTO bookstore at 1-800-231-3475 or https://bookstore.transportation.org

10.18.02 – Highway Barrier Type 5

These barriers are only included where the alignment runs inside a highway median at or below grade and on tangent track. The unit cost for this item of work includes the complete installation of the item. Highway Barrier Type 5 are reinforced concrete barriers meeting the requirements of NCHRP Report 350 Test Level 5.

Source: *A Guide to Standardized Highway Barrier Hardware, Online Hardware Guide*, AASHTO-AGS-ARTBA Joint Committee, Subcommittee on New Highway Materials, Task Force 13 Report - http://aashtotf13.tamu.edu/Guide/nameindex.html

<u>10.18.03 – Fencing, 6 ft Chain Link (both sides)</u>

Six-foot chain link fencing will be installed in rural areas along alignments that use existing rail right-of-way. The unit cost for this item includes the cost of a 6-foot chain link fence and installation of the fence. This line item is for the greenfield alignments only.

<u>10.18.04 – Fencing, 10 ft Chain Link (both sides)</u>

Fencing will be installed on top of highway barriers when present (type 5 and 6). The unit cost for this item includes the cost of a 10-foot chain link fence and installation of the fence. Fencing will be installed on both sides of the track. This line item is for the highway median/median adjacent alignments only.

20 Stations, Terminals, and Intermodal

<u>20.01 Terminal Station Buildings: Intercity Passenger Rail Only</u>

Terminal stations are in city centers where passengers are accommodated through other modal connections. These stations will be used for cross-platform transfer and are assumed in East St. Louis (at the Metrolink's Riverfront Station) and Chicago, as end points of the proposed high-speed corridor. The station cost is based on station size, configuration and general location. These costs are assumed to be rough approximations as station costs are expected to vary widely based on location.

The unit cost for this item takes the average of California High Speed Rail's 2024 Capital Cost Basis of Estimate Report[2]. The terminal station cost after adjusting for 2025$ is $1.25 billion.

<u>20.02: Intermediate Station Buildings: Intercity Passenger Rail Only</u>

Intermediate stations are located in between terminal station locations and in suburban areas where a

2 https://hsr.ca.gov/wp-content/uploads/2024/05/2024_Business_Plan_Basis_of_Estimate-FINAL.pdf

network of interstate highways and intermodal connections exists to ensure passengers have access to the stations. These stations are assumed in Springfield (around the I-72/I-55 junction), Decatur station (around the I-72/US HWY 51 junction), Bloomington station (around the I-55/I-74 junction), Champaign station (around the I-72/I-57 junction), Joliet station (around the Joliet Central Station) and University Park station (around the existing University Park Metra Electric District station). The cost would include passenger platform, inspection platform, tracks and special tracks through stations, substructure supporting tracks and platform outside of main line track envelope. The cost would also include circulation, lighting, security measures and all auxiliary spaces including intermodal connection areas. Space would also be provided within the station for ticket sales, passenger information, station administration, baggage handling, and commercial space for newsstands, small restaurants etc.

The intermediate station cost is inspired by taking the average of California High Speed Rail's 2024 Capital Cost Basis of Estimate Report[3]. The intermediate station cost after adjusting for 2025$ is $279.9 million.

30 Support Facilities: Yards, Shops, Admin. Buildings

30.01 Light Maintenance Facility

30.01.01 – Layover Facility

Two layover facilities are assumed for the high-speed corridor, one on the north side (south of Chicago) and one on the south side (near East St. Louis) of the system. A layover facility has the capability of providing daily servicing and inspection and will provide cleaning and replenishing of provisions for the daily service requirements. It is assumed that the layover facilities will each require 5 acres of land. Additionally, electrical hookups, waste disposal, and potable water facilities are needed to service the passenger coaches.[4] The unit cost for this item is taken from the Colorado ICS cost estimate with appropriate inflation and adjustment to arrive at $31 million per layover facility in 2025$.

30.02 Heavy Maintenance Facility

30.02.01 – Maintenance Facility (electrified track)

One maintenance facility is assumed near East St. Louis. A maintenance facility will house daily servicing and inspection facilities, preventive maintenance and corrective maintenance shops for coaches and locomotives, material storage, health and welfare facilities, and a storage yard. If the maintenance facility is a hub facility, it may also support heavy repair and high-level preventive maintenance work for the entire fleet.[5] It is assumed that a facility will require 40 acres of land. The unit cost for this item is taken from the Colorado ICS cost estimate with appropriate inflation and adjustment to arrive at $593 million per maintenance facility in 2025$.

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[3] https://hsr.ca.gov/communications-outreach/reports/business-plans/2024-business-plan/

[4] Midwest Regional Rail Initiative Phase 7 – Technical Report: Operating Equipment Configurations and Performance Standards - LTK Engineering Services, 2010

[5] Midwest Regional Rail Initiative Phase 7 – Technical Report: Operating Equipment Configurations and Performance Standards - LTK Engineering Services, 2010

40 Sitework, Right of Way, Land, Existing Improvements

40.07 Purchase or Lease of Real Estate

40.07.01 – Land Acquisition Rural

The amount of land acquisition required is calculated assuming that rail acquisition will require a 100-foot width of right-of-way. Land acquisition is assumed to be rural in areas outside of large population areas such as East St. Louis, Springfield, Bloomington, Decatur, Champaign, Kankakee, and Chicago. The portions of the alignment that run closely to I-55/I-72, I-74 and I-57 are considered to be on IDOT property and do not require acquisition costs. All township lines and other greenfield routes are considered rural acquisitions.

The unit cost for rural land acquisition includes the purchase of land and/or easement rights, relocation assistance, and demolition costs. It was estimated off a Chicago-Quad Cities preliminary engineering estimate for the Iowa Interstate where a new passenger rail alignment was established between Silvis to Rock Island. Adjusted for 2025, the rural land acquisition cost is $0.52/sq ft.

40.07.02 – Land Acquisition Urban

Urban land acquisition is calculated assuming that rail acquisition will require a 60-foot width of right-of-way, except in areas where the alignment is being constructed adjacent to an existing railroad. A 100-foot right-of-way is assumed at these locations. The portions of the alignment that are located in the highway median are assumed to be IDOT property and do not require acquisition costs. All property within the Chicago, Joliet, Champaign, Bloomington, Springfield, Decatur, Morton and East St. Louis area is considered to be urban. City limits for this item begin and end where residential property becomes noticeably dense.

Since land acquisition costs per square foot would vary up and down the state (i.e. different in Springfield than urban Chicago), an allocated contingency approach is taken instead of computing a blended per square foot land acquisition cost for urban land purchase, easements, relocation and demolition etc. An allocated contingency of 40% is established for this section.

40.08 Highway/pedestrian overpass/grade separations

40.08.01 – Highway Bridge Over High-Speed Rail

Overhead highway bridges were assumed to be reconstructed at all locations where the railroad alignment travels under existing highway bridges. Bridges are assumed to span over 2 railroad tracks and have the width of an average 4 lane roadway structure. Work includes removing the existing structure, re-using the existing embankment cones to accommodate an end-anchored single-span bridge, installing geo-composite wall drains and adding traffic control, and contingency factors at the end of the total. The unit cost breakdown is shown in Table 3 and closely mimics recent IDOT bid tabs for full bridge replacement. As an example, the IL-40 bridge over I-80 was replaced in 2025 for $9.9 million. Another comparable is the replacement of existing Michigan City Road Bridge over I-94 Bishop Ford Expressway including new retaining walls, high mast lighting, and modifications to I-94 for $12 million. The cost item for this work is within reasonable bounds and comes out to $9.65 million per bridge in 2025$. This estimate is close to the inflated Colorado ICS cost of constructing a highway bridge over high-speed rail.

Pay Item	Quantity	Unit	Unit Price	Total (2025$)
Porous Granular Embankment	292	Cu Yd	$100	$29,200
Structure Excavation	1612	Cu Yd	$50	$80,600
Protective Coat	1958	Sq Yd	$5	$9,790
Elastomeric Bearing Assembly Type I	40	EA	$2000	$80,000
Concrete Structure	1166	Cu Yd	$1000	$1,166,000
Concrete Superstructure	550	Cu Yd	$2500	$1,375,000
Furnishing & Erecting Structural Steel	554400	Pound	$4.50	$2,494,800
Stud Shear Connectors	2406	EA	$10	$24,060
Reinforcement Bars, Epoxy Coated	220000	Pound	$2	$440,000
Concrete Piles	5134	Linear Ft	$125	$641,750
Name Plates	2	EA	$2000	$4000
Tie Down Device	20	EA	$20,000	$400,000
Slope wall 4''	401	Sq Yd	$150	$60,150
Geocomposite Wall Drain	1466	Sq Yd	$50	$73,300
Screen Panels	18	EA	$1000	$18,000
Rubbed Finish	5260	Sq Ft	$5	$26,300
Removing Existing Structure	1	L Sum	$500,000	$500,000
Subtotal				$7,422,950
Traffic Control (Est. 20%)				$1,485,000
Contingencies (Est. 10%)				$743,000
Final Estimate				**$9,650,950**

Table 3 – Single Span Bridge Overpass over I-55 Cost

40.08.02 – Highway Lane Shift

The highway lane shift line item is composed of replacing all highway lanes on one side of the corridor to widen the median. This may mean taking advantage of the frontage road medians to push the highway corridor towards the frontage roads to make room in the median where required width for at-grade double track is currently not available. This line item is anticipated to be used closer to metropolitan areas where interstate median requires minor expansion to accommodate at-grade track. As a median is widened, the highway lane shift cost item would also include cost for replacing slip ramps to overhead corridors (assuming a height of 25 feet above interstate) at interchanges.

A detailed breakdown for highway lane shift where insufficient median space is available is provided as follows if at-grade track is being proposed in the median. This cost item is also used for highway reconstruction wherever train meets occur and would be added to the elevated track cost if the median space and the adjacent development limit construction of piers for the elevated track structure.

Line Item	Cost (2025$)
Slip ramp structure (2 ramps per interchange) plus incidental modifications	$120 million/5 miles between successive interchanges = $24 million/mile
Roadway shift (3 through-lanes on one side)	$8 million + ($2 million/through-lane x 3) = $14 million/mile
Additional shift of ramps	$2 million + $1.6 million RT shoulder past gore + $0.8 million LT shoulder past gore = $4.4 million/mile
TOTAL	**$42.4 million/mile**

Table 4 – Highway Lane Shift Cost Breakdown

In addition, if there is insufficient median space for at-grade double track, and one side of the highway is reconstructed rather than elevating the high-speed tracks over the interchange, the cost of reconstruction per mile of the highway would be one-fourth of constructing a double track structure that is 60 feet high (Level 2) over the interchange. This cost differential has been factored in the capital cost estimate where applicable and the reasonable option is to elevate over the interchange in such a situation. The total cost for this line item is $42.4 million per mile of highway lane shift required in 2025$.

<u>40.08.03 – Rail – Overhead</u>

The work required to modify existing overhead railroad bridge passing over the proposed HSR alignment is captured in this line item which will include structural improvements without causing clearance hurdles or other problems in relation to the proposed HSR alignment. The unit cost for this line item is captured from the NLX cost estimate and after adjustment, amounts to $15.5 million per overhead railroad bridge in 2025$.

<u>40.08.04 – Grade Separate Crossroads</u>

The crossroads intersecting the proposed HSR alignment need to be reprofiled either under or over the proposed alignment. To do this, a cost comparison was undertaken for both overpass and underpass scenarios, and it was determined that due to drainage implications in the underpass scenario, an overpass option will be priced in for this line item only. The assumptions include:

- 2 Lane rural highway
- Bridge over Railroad
- Clearance over Railroad of 23 feet
- Bridge beam height = 48 inches
- Bridge deck thickness = 12 inches
- New tracks over existing ground = 12 inches
- Top of road = 29 feet over existing ground
- Bridge length = 74 feet
- Design speed = 60 mph
- Miscellaneous & Incidental Costs = 25% add-on

The breakdown shown in Table 5 is to be used as a multiplier with total number of grade separated crossroads along a greenfield alignment to arrive at total cost of grade separated crossroads per greenfield segment. The unit cost for a grade separated crossroad is $10.9 million in 2025$.

Line Item	Cost (2025$)
Bridge Cost	$1,304,250
Pavement Cost (IDOT weighted avg)	$766,700
Borrow Earthwork Cost (IDOT weighted avg)	$6,654,120
Subtotal	$8,725,070
Misc & Incidental (25%)	$2,181,268
Total Cost/grade separated crossroad	**$10,906,338**

Table 5 – Grade Separated Crossroad Cost

50 Communications & Signaling

50.01 Wayside Signaling

50.01.01 - Train Control (ETCS L2), Wayside Protection System, Fiber Optic Backbone

This pay item includes Automatic Train Control (ATC), Wayside Protection System, and Communications (w/Fiber Optic Backbone). This item is assumed to be for a double track section installed over the entire length of the corridor. The unit cost for train control includes the wayside, on-board, and central control software and hardware for the overall signaling system. The unit cost for the Wayside Protection System includes systems/equipment to monitor and/or detect obstacles that may be placed or fall onto the track, intrusion, flooding, wind, seismic activity, and equipment failures. The unit cost for a fiber optic backbone includes systems/equipment to operate a communication system along the corridor.[6] It is adjusted from the Colorado ICS project and inflated to amount to $6.34 million per route mile in 2025$.

60 Electric Traction

60.01- Traction Power Supply – Substation

60.01.01 – Traction Power Supply

The unit cost for Traction Power Supply includes the cost of the substations including site preparation, foundations, cable trenches, fencing, and electrical equipment. It does not include the cost of transmission lines from the local utility source to the substations. Those costs are included in operating and maintenance costs as "energy costs"[7].

Substation sites to be placed at 30-mile intervals along the HSR right-of-way. To prevent stalling of trains at phase breaks, substations and switching stations should not be within 2 miles of the nearest end of railways station or wayside crossover[8].

The unit cost for this item is applied per route mile of track and was taken from the Colorado ICS project. After inflation to 2025$, the per mile cost is $8.26 million per route mile.

[6] California High-Speed Train Program EIR/EIS – Capital Cost: Definition of Cost Elements
[7] California High-Speed Train Program EIR/EIS – Capital Cost: Definition of Cost Elements
[8] (Traction Power Facilities General Standardization Requirements TM3.1.1.3)

60.02 – Traction power distribution: Catenary and third rail

60.02.01- Traction Power Distribution – Catenary

The unit cost comes from the Final Electrification Report done by the firm HDR, for North American Class I Railroad Networks. It assessed 139,000 track miles and developed a cost breakdown as follows[9]:

Conceptual Capital Cost Category	Cost (with Contingency) (All Class I Routes) (2024$)
Overhead Contact System	$510 billion
Traction Power Systems	$150 billion
Electric Utility Interconnection Costs	$130 billion
Right-of-Way Modifications and Third-Party Protection	$20 billion
Total per mile cost	**$810 billion/ 139,000 miles =** **$5.83 million/mile**

Table 6 – Conceptual Infrastructure Capital Cost – Final Electrification Report (2024$)

The unit cost for this item is applied per route mile of track and after inflation in 2025$ is $5.94 million per mile.

70 Vehicles

This section includes cost of trainset acquisition of a Tier 3-compliant trainset. It is assumed that two hot spare trainsets and two running in maintenance trainsets would be required. For 32 trains to operate a day and based on stringline calculations, a total of eight trainsets would need to be acquired exclusive of spares. The study assumes that these trainsets can be maintained under a specific Technical Support and Spare Supply Agreement (TSSSA) with additional support from vendor sites within the United States[10]. The cost breakdown is listed in Table 7 and Table 8.

Total Trainsets per Operation	Spares & Maintenance	Total Trainsets Required
8	4	12

Table 7 –Trainsets for 32 Round Trip Service Plan

Total Trainsets Required	Cost per Trainset (2025$)	Total Cost for Rolling Stock (2025$)
12	$137,500,000	$1,650,000,000

Table 8 –Rolling Stock Total Cost

The per trainset cost after adjusted for inflation is denoted in Table 8 at $137.5 million in 2025$. Accounting for total trainsets required with the assumption of two spares and two running in maintenance, the total cost for rolling stock is $1.65 billion in 2025$.

[9] (Study of Catenary Electrification of the North American Class I Railroad Network, 2025)
[10] (Alstom to provide Amtrak with its new generation of high-speed train, 2016)

80 Professional Services

The project elements included in the Professional Services category are environmental planning, design engineering, program management, construction management and inspection, engineering services during construction, insurance, and testing and commissioning. Field and construction management services and testing and commissioning of various project elements are also required. Professional services and other soft costs required to develop the project have been estimated as a percentage of the estimated construction cost and are included in the overall cost estimates as a separate line item. These costs include, as a percentage of construction cost:

- Environmental Planning 3%
- Design Engineering 10%
- Insurance 2%
- Legal 2%
- Program Management 4%
- Construction Management 6%
- Engineering services during construction 2%
- Testing and Commissioning 2%
- Noise Mitigation 1%
- Hazardous waste 1%
- Erosion control 1%

Professional Services fees total 34%.

Allocated and Unallocated Contingency

Contingency costs are added as an overall percentage of the total construction cost. Contingencies are an allowance added to the estimate of costs to account for items and conditions that cannot be realistically anticipated. FRA identified “rules of thumb” for cost contingencies in their Capital Cost Estimating Guidance from 2016[11]. These rules of thumb are presented in Figure 3.

[11] 160830 FRA RPD Capital Cost Estimating Guidance.pdf

Cost Contingencies – Rules of Thumb

Milestones	Allocated	Unallocated	Total
Completion of Planning/Concept Design (15% Design)	25-35%	10-20%	35-55%
Completion of PE (30 – 60% Design)	20-30%	7-15%	27-45%
Completion of Final Design (preparing documents for bidding) Ready to procure / bid construction in DBB At partially bid: *For work already bid* *For work ready to bid* *For work not yet ready*	15-20% *10%* *15%* *25%*	5-10%	20-30%
Start of Construction	10-15%	3-7%	13-22%
At 20% Construction Complete	7-10%	5%	12-15%
At 50% Construction Complete	5-7%	2-5%	7-12%

Figure 3 - FRA Cost Contingencies "Rules of Thumb"

Allocated contingency is applied to each cost category. Unallocated contingency is applied to the total of cost categories 10-70. Allocated and unallocated contingencies are shown in Table 9.

Category	Allocated Contingency	Unallocated Contingency
10 TRACK STRUCTURES & TRACK	40%	20%
20 STATIONS, TERMINALS AND INTERMODAL	40%	20%
30 SUPPORT FACILITIES, YARDS, SHOPS, ADMIN BLDGS	40%	20%
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS	40%	20%
50 COMMUNICATIONS & SIGNALING	40%	20%
60 ELECTRIC TRACTION	40%	20%
70 VEHICLES	40%	0%
80 PROFESSIONAL SERVICES	0%	0%

Table 9 – FRA Cost Categories and Contingencies

Overall, allocated contingency is equal to 19% of the total capital cost and unallocated contingency is equal to 13% of the total capital cost, for a total of 32% contingency applied to the project capital costs. The contingency for this feasibility level will be reduced as the project advances into more detailed engineering and conceptual uncertainties are investigated and resolved.

Summary

Feasibility-level capital costs were developed using FRA's SCC framework to ensure a consistent comparison across all route alternatives. Estimates were based on quantified infrastructure elements, including guideway, structures, stations, electrification, signaling, maintenance facilities, right-of-way, and rolling stock, with costs developed by applying representative unit prices to each route's infrastructure quantities.

Unit costs were derived from Quandel's experience on comparable rail projects and supplemented with data from the California High-Speed Rail program, the Colorado ICS, the NLX project, and other industry sources. All costs were adjusted to 2025 dollars and reflect feasibility-level estimates intended to compare alternatives rather than establish project budgets.

Feasibility-level costs are presented in Technical Memorandum #7 – Investment Options Analysis.