I-70 Traffic & Revenue Study

Cost Estimating Issue Task Force
Meeting February 25, 2014

I-70 Traffic & Revenue Study Agenda

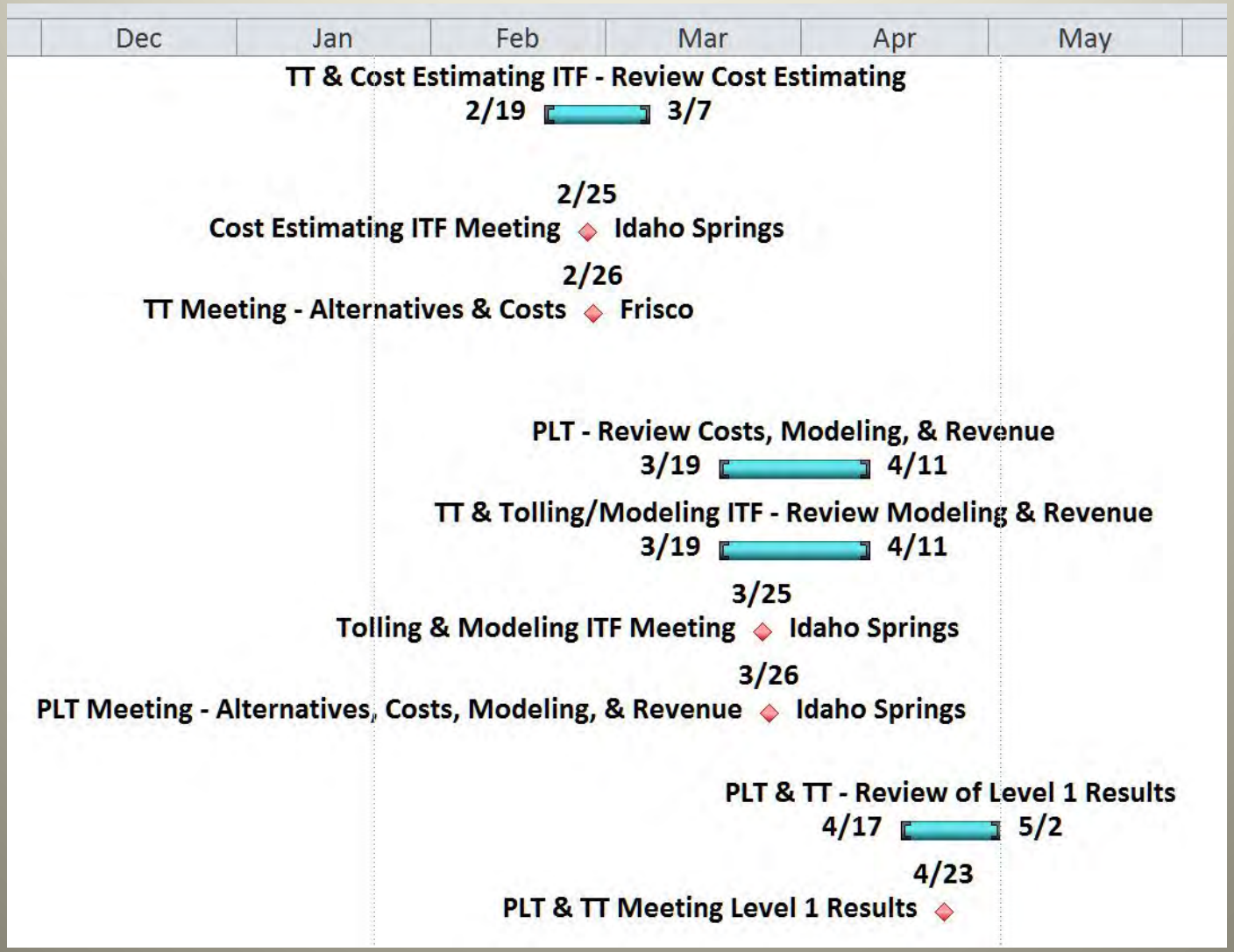
- Welcome & Introductions
- Overview of Level 1 Process
- Alternatives under Consideration
- Overview of Cost Estimating Process
- Review Alternative costs
- Small Group Sessions
- Review small group session comments & questions
- Schedule of Reviews & Future Level 1 Meetings
- Wrap Up & Adjourn

I-70 Traffic & Revenue Study Progress

- Detailed Alternatives
- Engineering
- Cost Estimating
- Modeling
- Issue Task Force Meetings
- CDOT Website
- Newsletter

I-70 Mountain Corridor
Context Sensitive Solutions Process

I-70 Mountain Corridor
Traffic & Revenue Study 3 – Month Look Ahead



I-70 Traffic & Revenue
13 Alternatives Under Consideration

- 2 Managed Lanes – 2 options
- 3 Managed Lanes – 3 options
- PEIS Minimum Improvements – 4 options
- PEIS Maximum Improvements – 2 options
- Permanent Peak Period Shoulder Lane
- Temporary Peak Period Shoulder Lane

Base Condition

Existing I-70 with EB Peak Period Shoulder Lane

Base Condition includes the existing highway infrastructure including the planned improvement of the EB peak period shoulder lane from Empire to Floyd Hill. The recently completed widening of the EB Twin Tunnel is part of the peak period shoulder lane project.

Roadway Information

Extent of Roadway Improvements	Empire to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by restriping existing pavement
Direction of Improvements	EB Only Direction
Design Speed	Match Existing
Trucks, Private Buses, BRT	Allowed in Peak Period Shoulder Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for EB Peak Period Shoulder Lane
Tunnels	Dynamic priced toll as part of the EB Peak Period Shoulder Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2014 (Assumes NEPA Cat-Ex)
Construction Duration	1 year
First Year Operation	2014 - WB Tunnel / 2015 - EB PPSL
Financial Period	50 years

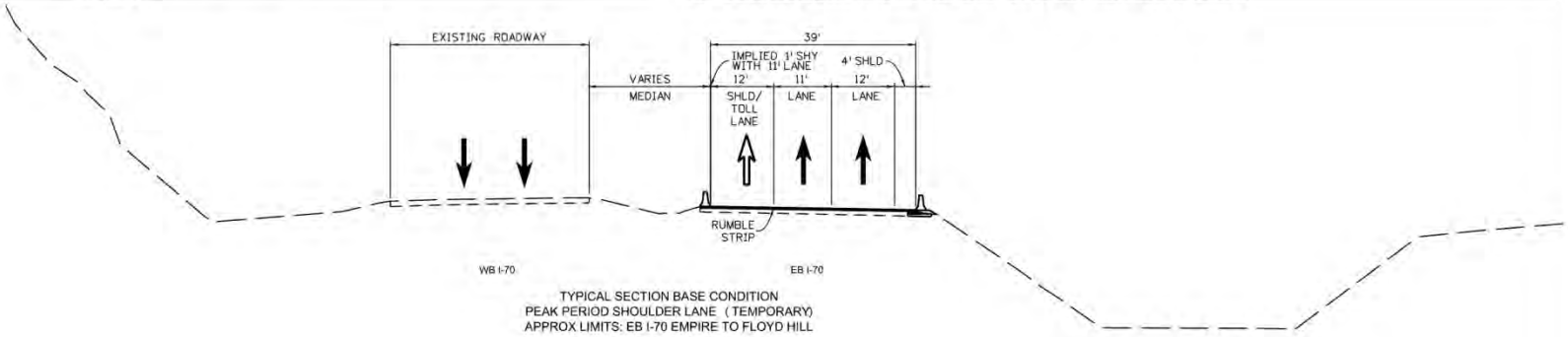
Transit Information

Termini	Glenwood Springs to Denver (CDOT Bus)
Special Infrastructure	N/A
Schedule	Fall 2014
Stations	6 CDOT Bus Stations - Glenwood Springs, Eagle, Vail, Frisco, Denver (2)
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	N/A

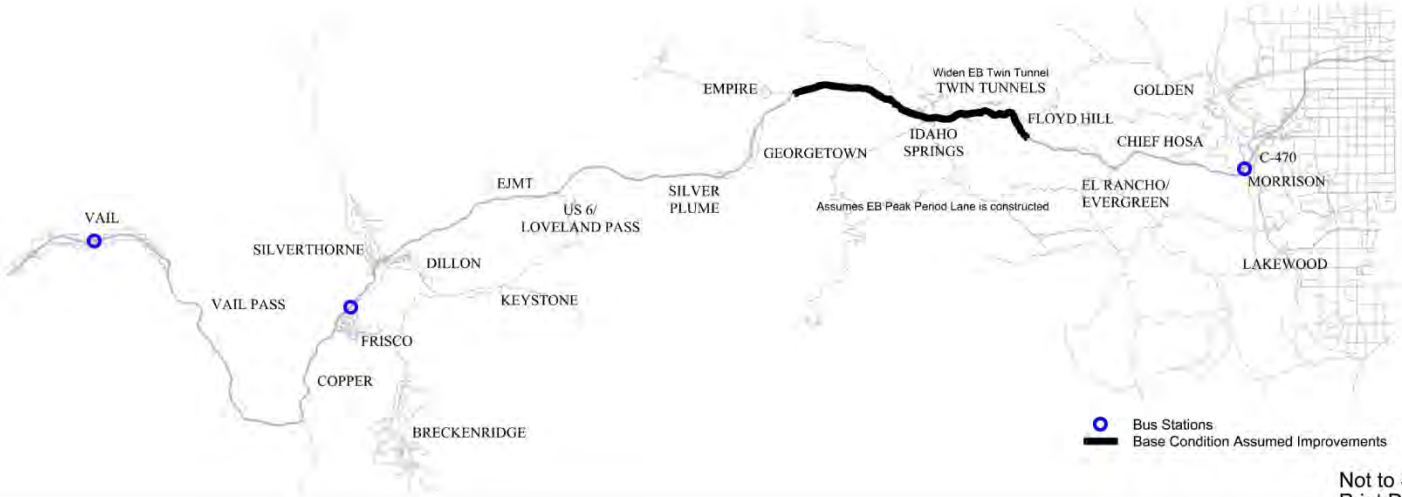
Special Structures

Special Structures	Existing EB Twin Tunnel Widening

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION BASE CONDITION
PEAK PERIOD SHOULDER LANE (TEMPORARY)
APPROX LIMITS: EB I-70 EMPIRE TO FLOYD HILL



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Alt01_Opt01

2 Tolled Reversible Managed Lanes

Reversible managed lanes designed at 65 mph. The reversible managed lanes are on a separate viaduct structure from East Idaho Springs to Floyd Hill in order to maintain 65 mph design speed. General purpose (GP) lanes designed at 55 mph except from East Idaho Springs to Floyd Hill, where existing design speeds & lanes will remain.

Roadway Information

Extent of Roadway Improvements	Silverthorne to C-470
General Purpose (GP) Lane Information	Align managed lanes with GP lanes except from E Idaho Springs to Floyd Hill
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph Managed Lanes, 55 mph GP lanes
Trucks, Private Buses, BRT	Allowed in Managed Lanes (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for Reversible Managed Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd bore
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA & Procurement)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

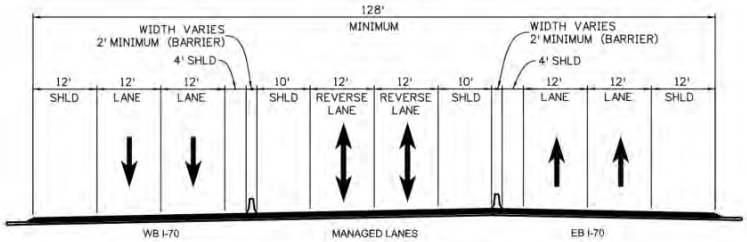
Transit Information

Termini	Vail to Denver
Special Infrastructure	Stations
Schedule	2019 - Limited Startup / 2023 - Full BRT Service
Stations	12 Total
Type	
CDOT Bus	N/A
BRT	Transit option for full 50 year concession
AGS	N/A

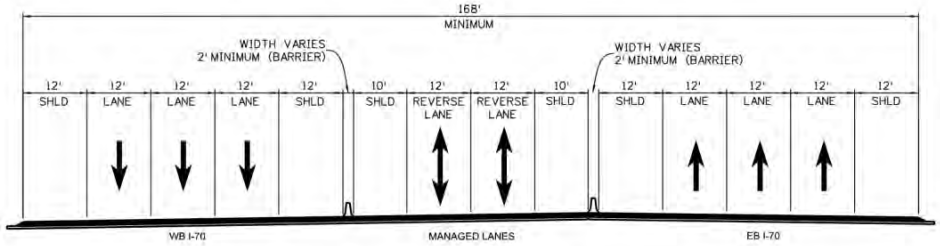
Special Structures

Special Structures	EJMT and Twin Tunnel 3rd Bores
	Managed Lanes on Viaduct from East Idaho Springs to Floyd Hill

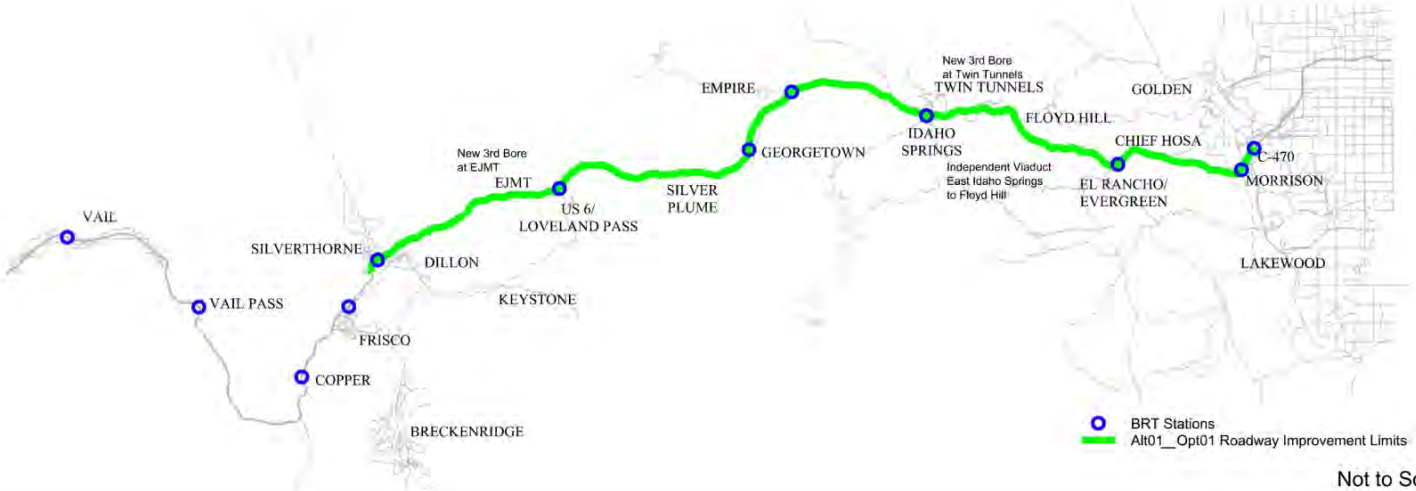
GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION ALT01
2 TOLLED REVERSIBLE MANAGED LANES
EXISTING 2 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: EJMT TO FLOYD HILL



TYPICAL SECTION ALT01
2 TOLLED REVERSIBLE MANAGED LANES
EXISTING 3 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: SILVERTHORNE TO EJMT, FLOYD HILL TO C-470



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Alt01_Opt02

2 Tolled Reversible Managed Lanes

Reversible managed lanes and I-70 designed at 65 mph. This option matches Alt01_Opt01 except from East Idaho Springs to Floyd Hill, where the reversible managed lanes and I-70 will be reconstructed to meet a 65 mph design speed.

Roadway Information

Extent of Roadway Improvements	Silverthorne to C-470
General Purpose (GP) Lane Information	Align managed lanes with GP lanes
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph - Managed Lanes & GP Lanes
Trucks, Private Buses, BRT	Allowed in Managed Lanes (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for Reversible Managed Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd bore
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA & Procurement)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

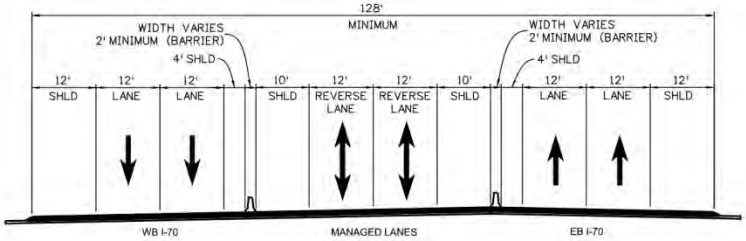
Transit Information

Termini	Vail to Denver
Special Infrastructure	Stations
Schedule	2019 - Limited Startup / 2023 - Full BRT Service
Stations	12 Total
Type	
CDOT Bus	N/A
BRT	Transit option for full 50 year concession
AGS	N/A

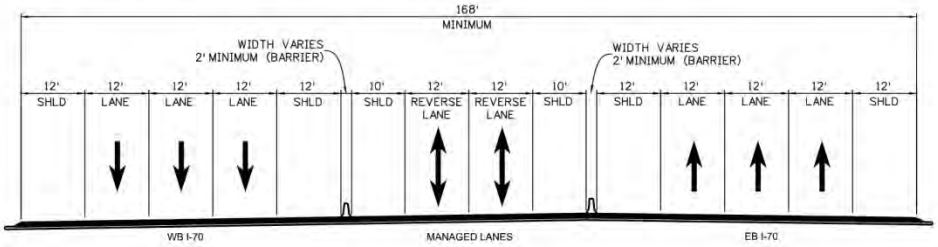
Special Structures

Special Structures	EJMT and Twin Tunnel 3rd Bores

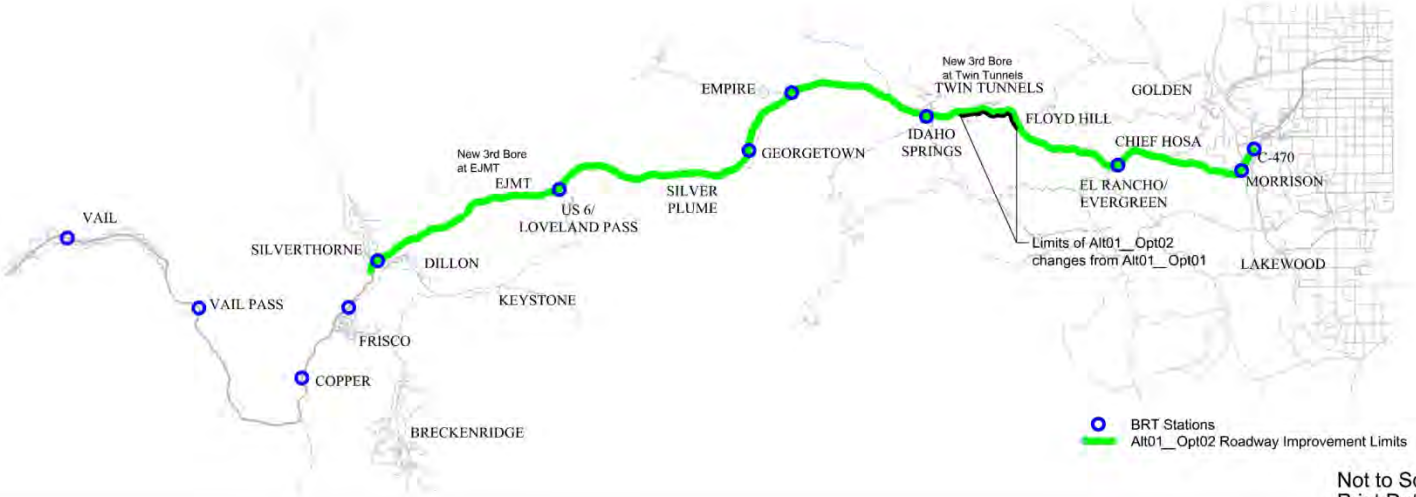
GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION ALT01
2 TOLLED REVERSIBLE MANAGED LANES
EXISTING 2 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: EJMT TO FLOYD HILL



TYPICAL SECTION ALT01
2 TOLLED REVERSIBLE MANAGED LANES
EXISTING 3 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: SILVERTHORNE TO EJMT, FLOYD HILL TO C-470



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Alt02_Opt01

3 Tolled Reversible Managed Lanes

Reversible managed lanes designed at 65 mph. The reversible managed lanes are on a separate viaduct structure from East Idaho Springs to Floyd Hill in order to maintain 65 mph design speed. General purpose (GP) lanes designed at 55 mph except from East Idaho Springs to Floyd Hill, where existing design speeds & lanes will remain.

Roadway Information

Extent of Roadway Improvements	Silverthorne to C-470
General Purpose (GP) Lane Information	Align managed lanes with GP lanes except from E Idaho Springs to Floyd Hill
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph Managed Lanes, 55 mph GP lanes
Trucks, Private Buses, BRT	Allowed in Managed Lanes (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for Reversible Managed Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd bore
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA & Procurement)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

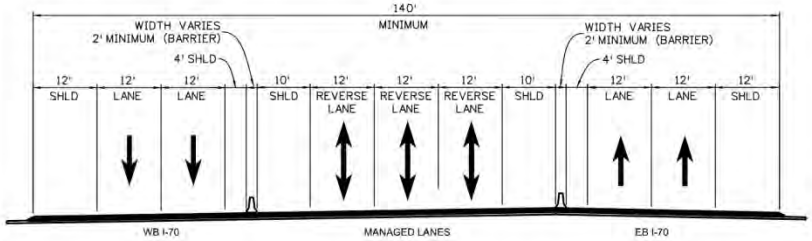
Transit Information

Termini	Vail to Denver
Special Infrastructure	Stations
Schedule	2019 - Limited Startup / 2023 - Full BRT Service
Stations	12 Total
Type	
CDOT Bus	N/A
BRT	Transit option for full 50 year concession
AGS	N/A

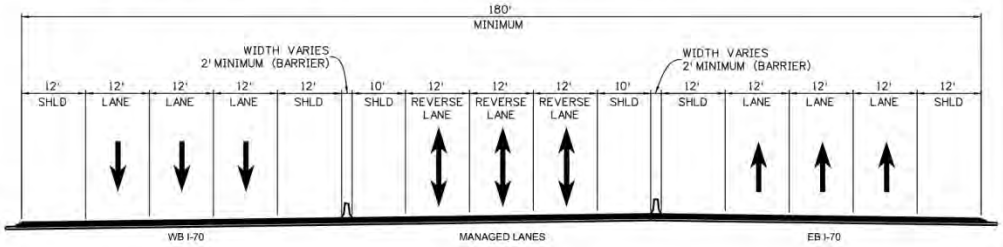
Special Structures

Special Structures	EJMT and Twin Tunnel 3rd Bores
	Managed Lanes on Viaduct from East Idaho Springs to Floyd Hill

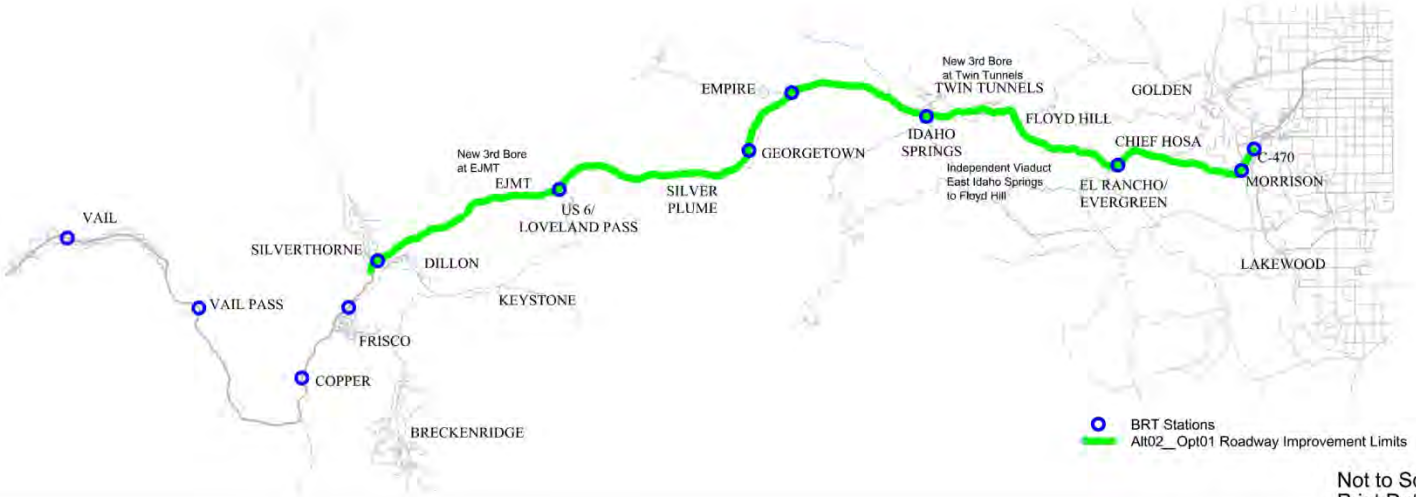
GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION ALT02
3 TOLLED REVERSIBLE MANAGED LANES
EXISTING 2 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: EJMT TO FLOYD HILL



TYPICAL SECTION ALT02
3 TOLLED REVERSIBLE MANAGED LANES
EXISTING 3 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: SILVERTHORNE TO EJMT, FLOYD HILL TO C-470



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Alt02_Opt02

3 Tolled Reversible Managed Lanes

Reversible managed lanes and I-70 designed at 65 mph. This option matches Alt02_Opt01 except from East Idaho Springs to Floyd Hill, where the reversible managed lanes and I-70 GP lanes will be reconstructed to meet a 65 mph design speed.

Roadway Information

Extent of Roadway Improvements	Silverthorne to C-470
General Purpose (GP) Lane Information	Align managed lanes with GP lanes
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph - Managed Lanes & GP Lanes
Trucks, Private Buses, BRT	Allowed in Managed Lanes (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for Reversible Managed Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd bore
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA & Procurement)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

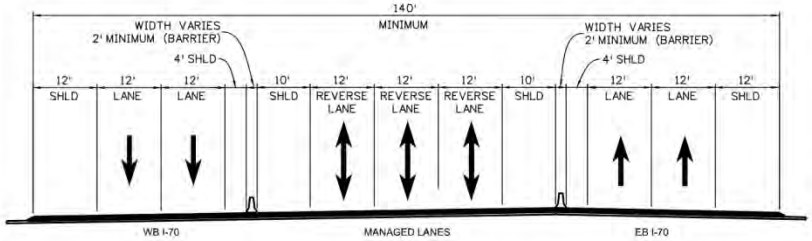
Transit Information

Termini	Vail to Denver
Special Infrastructure	Stations
Schedule	2019 - Limited Startup / 2023 - Full BRT Service
Stations	12 Total
Type	
CDOT Bus	N/A
BRT	Transit option for full 50 year concession
AGS	N/A

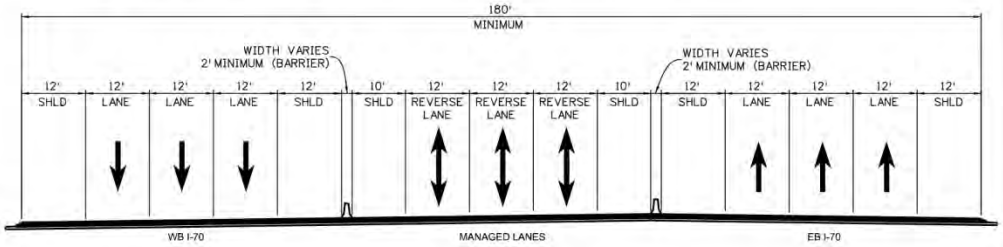
Special Structures

Special Structures	EJMT and Twin Tunnel 3rd Bores

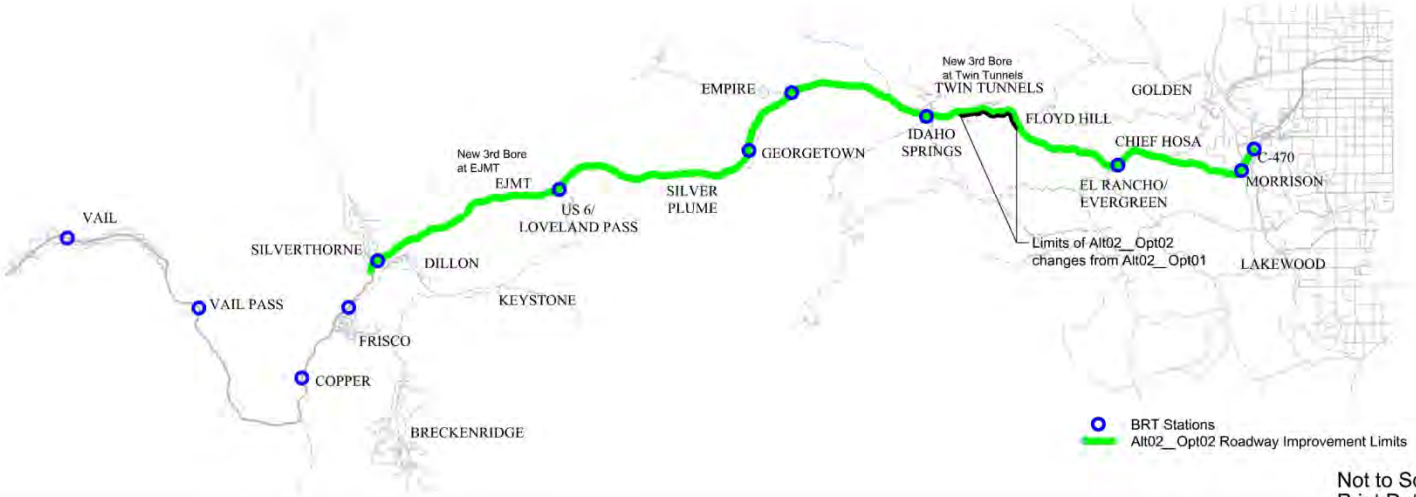
GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION ALT02
3 TOLLED REVERSIBLE MANAGED LANES
EXISTING 2 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: EJMT TO FLOYD HILL



TYPICAL SECTION ALT02
3 TOLLED REVERSIBLE MANAGED LANES
EXISTING 3 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: SILVERTHORNE TO EJMT, FLOYD HILL TO C-470



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Print Date: 1/16/2014

Alt02_Opt03

3 Tolled Reversible Managed Lanes

Reversible managed lanes designed at 65 mph. The reversible managed lanes are on a separate viaduct structure from West Idaho Springs to Floyd Hill to minimize impacts. General purpose (GP) lanes designed at 65 mph except from West Idaho Springs to Floyd Hill, where existing design speeds & lanes will remain. This option is similar to Alt02_Opt01, except viaduct extends to West Idaho Springs.

Roadway Information

Extent of Roadway Improvements	Silverthorne to C-470
General Purpose (GP) Lane Information	Align managed lanes with GP lanes except from W Idaho Springs to Floyd Hill
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph Managed Lanes, 55 mph GP lanes
Trucks, Private Buses, BRT	Allowed in Managed Lanes (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for Reversible Managed Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd bore
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA & Procurement)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

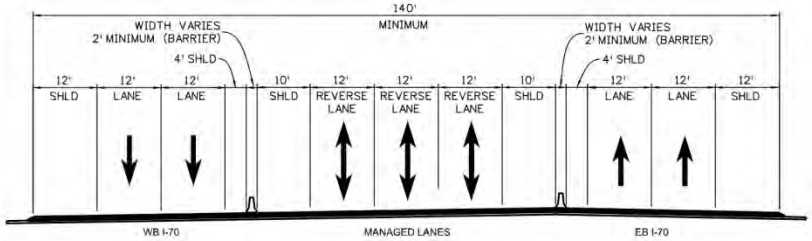
Transit Information

Termini	Vail to Denver
Special Infrastructure	Stations
Schedule	2019 - Limited Startup / 2023 - Full BRT Service
Stations	12 Total
Type	
CDOT Bus	N/A
BRT	Transit option for full 50 year concession
AGS	N/A

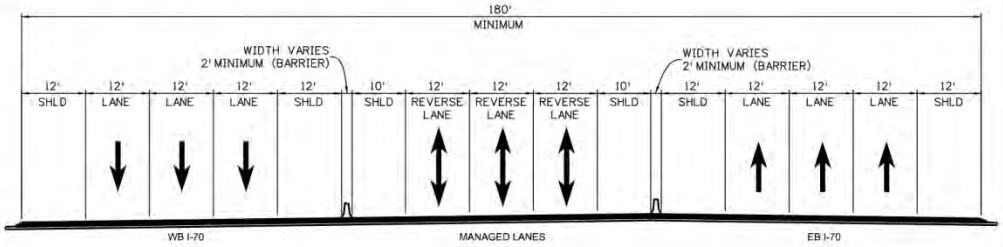
Special Structures

Special Structures	EJMT and Twin Tunnel 3rd Bores
	Managed Lanes on Viaduct from West Idaho Springs to Floyd Hill

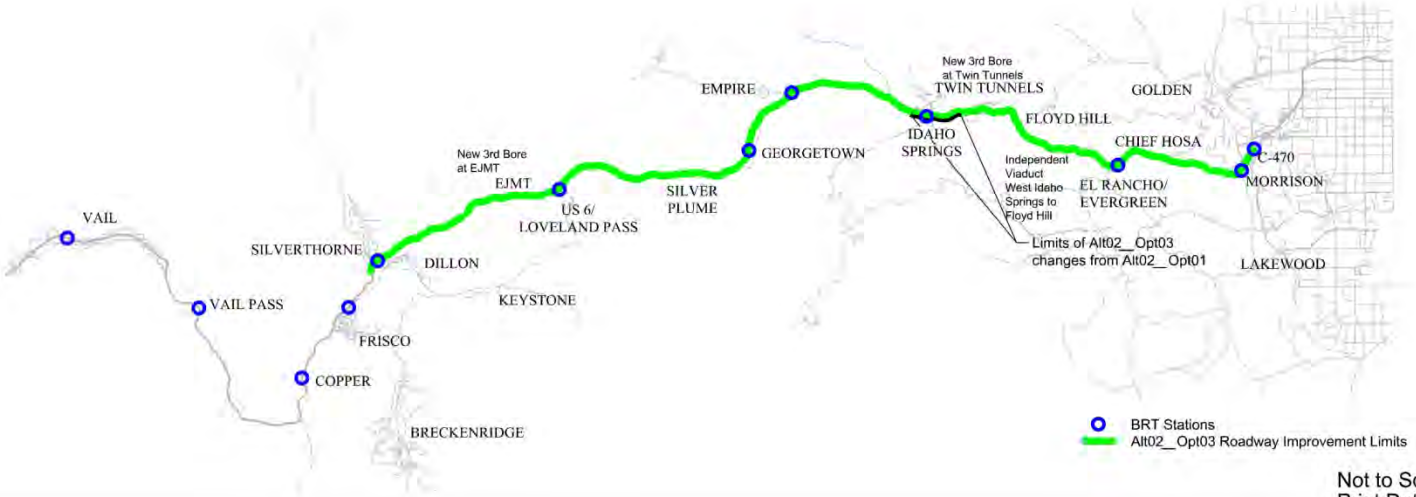
GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION ALT02
3 TOLLED REVERSIBLE MANAGED LANES
EXISTING 2 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: EJMT TO FLOYD HILL



TYPICAL SECTION ALT02
3 TOLLED REVERSIBLE MANAGED LANES
EXISTING 3 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: SILVERTHORNE TO EJMT, FLOYD HILL TO C-470



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Alt03_Opt01

Minimum Program per PEIS

Minimum program per PEIS with 55 mph design speed including a 3rd bore at EJMT. Minimum program is generally localized auxiliary lane improvements.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Auxiliary lanes added at localized areas between interchanges
Direction of Improvements	Both directions (EB and WB)
Design Speed	55 mph
Trucks, Private Buses, BRT	Allowed in GP Lanes and auxiliary lanes
Tolling	
Capacity Improvements	No toll for auxiliary lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2018 (Assumes 3 years NEPA)
Construction Duration	3 years
First Year Operation	2021
Financial Period	50 years

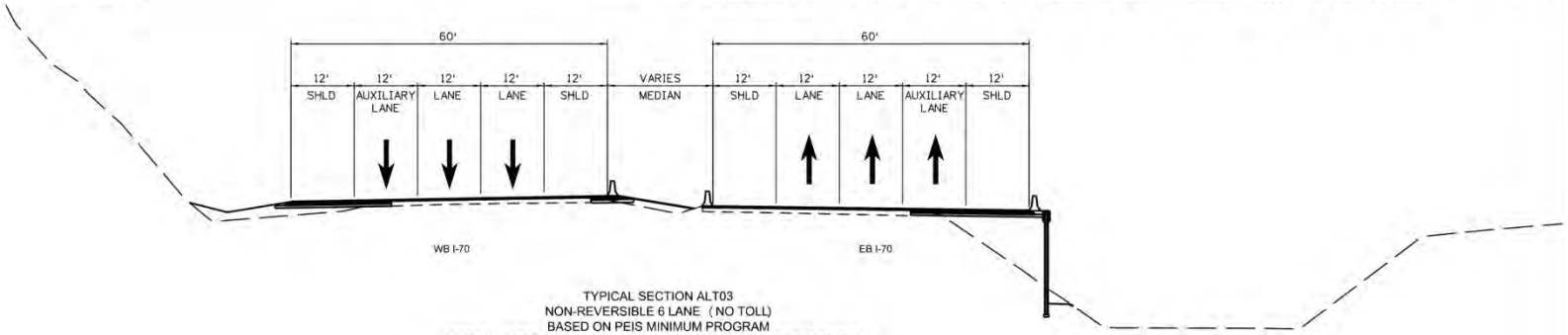
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System; None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

Special Structures

Special Structures	EJMT 3rd Bore

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT03
NON-REVERSIBLE 6 LANE (NO TOLL)
BASED ON PEIS MINIMUM PROGRAM
APPROX LIMITS: EJMT TO BAKERVILLE, IDAHO SPRINGS TO FLOYD HILL

Not to Scale
Print Date: 1/16/2014

Alt03_Opt02

Minimum Program per PEIS

Minimum program per PEIS with 65 mph design speed including a 3rd bore at EJMT. Minimum program is generally localized auxiliary lane improvements.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Auxiliary lanes added at localized areas between interchanges
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph
Trucks, Private Buses, BRT	Allowed in GP Lanes and auxiliary lanes
Tolling	
Capacity Improvements	No toll for auxiliary lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore, New & Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2018 (Assumes 3 years NEPA)
Construction Duration	3 years
First Year Operation	2021
Financial Period	50 years

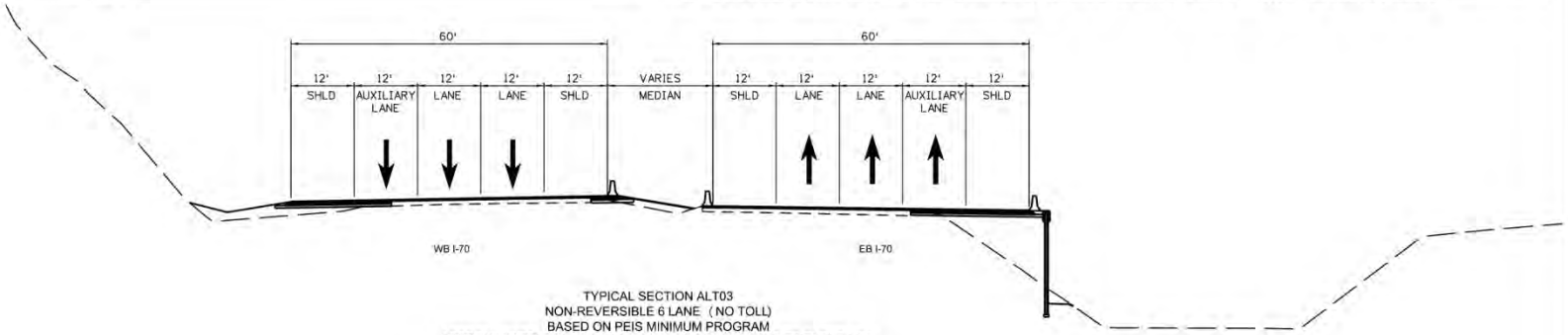
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System; None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

Special Structures

Special Structures	EJMT 3rd Bore
	New EB & WB Tunnel at Hidden Valley, New WB Tunnel near SH 6

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT03
NON-REVERSIBLE 6 LANE (NO TOLL)
BASED ON PEIS MINIMUM PROGRAM
APPROX LIMITS: EJMT TO BAKERVILLE, IDAHO SPRINGS TO FLOYD HILL

Not to Scale
Print Date: 1/16/2014

Alt03_Opt03

Minimum Program per PEIS

Minimum program per PEIS with 55 mph design speed without a 3rd bore at EJMT. Minimum program is generally localized auxiliary lane improvements. Option is similar to Alt03_Opt01 without 3rd Bore EJMT.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Auxiliary lanes added at localized areas between interchanges
Direction of Improvements	Both directions (EB and WB)
Design Speed	55 mph
Trucks, Private Buses, BRT	Allowed in GP Lanes and auxiliary lanes
Tolling	
Capacity Improvements	No toll for auxiliary lanes
Tunnels	Dynamic priced toll for Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2018 (Assumes 3 years NEPA)
Construction Duration	3 years
First Year Operation	2021
Financial Period	50 years

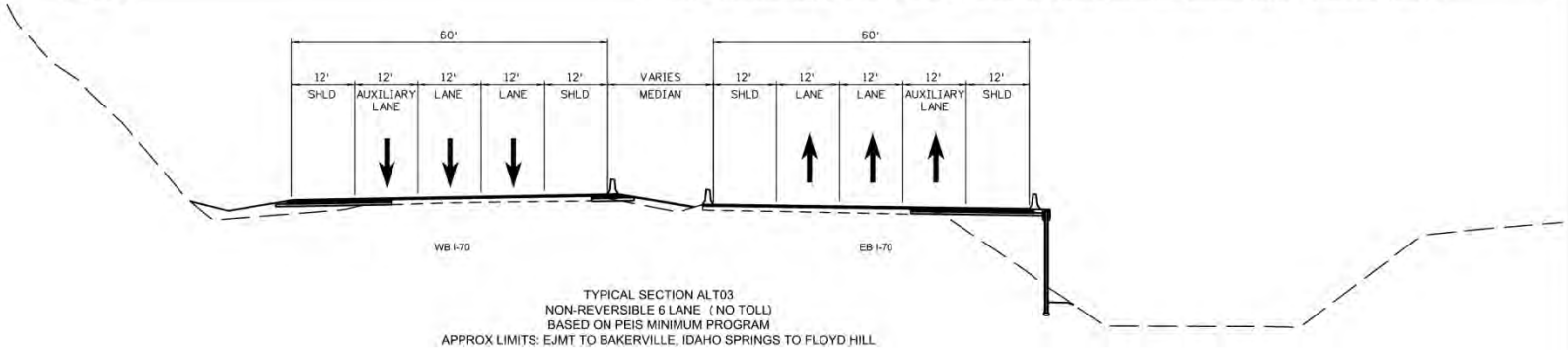
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System; None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

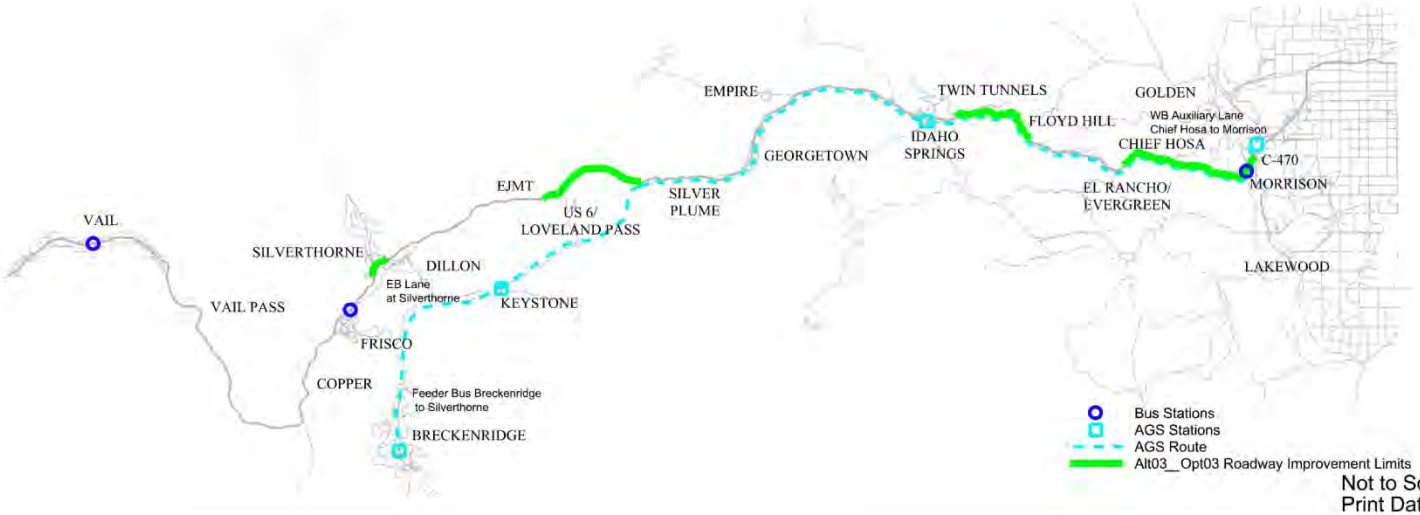
Special Structures

Special Structures	

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT03
NON-REVERSIBLE 6 LANE (NO TOLL)
BASED ON PEIS MINIMUM PROGRAM
APPROX LIMITS: EJMT TO BAKERVILLE, IDAHO SPRINGS TO FLOYD HILL



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Alt03_Opt04

Minimum Program per PEIS

Minimum program per PEIS with 65 mph design speed without a 3rd bore at EJMT. Minimum program is generally localized auxiliary lane improvements. Option is similar to Alt03_Opt02 without 3rd Bore EJMT.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Auxiliary lanes added at localized areas between interchanges
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph
Trucks, Private Buses, BRT	Allowed in GP Lanes and auxiliary lanes
Tolling	
Capacity Improvements	No toll for auxiliary lanes
Tunnels	Dynamic priced toll for New & Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2018 (Assumes 3 years NEPA)
Construction Duration	3 years
First Year Operation	2021
Financial Period	50 years

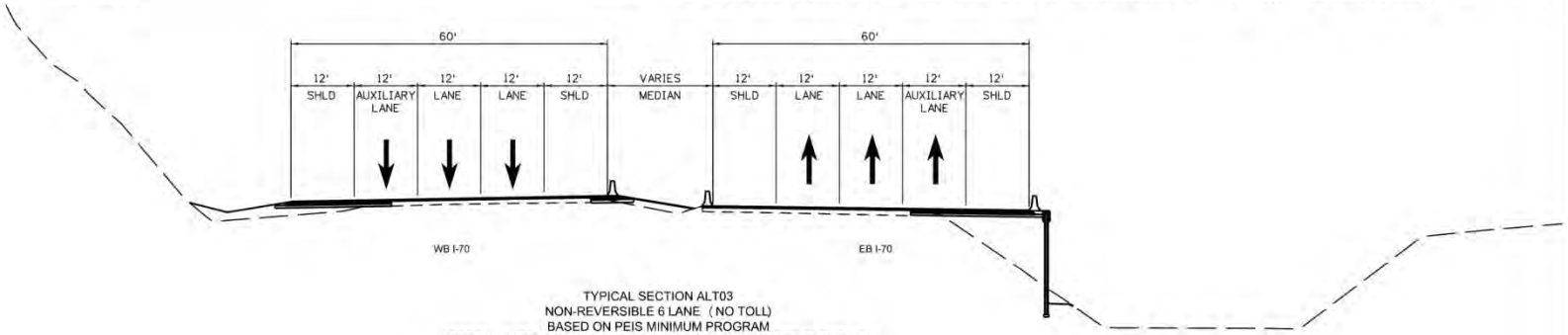
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System; None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

Special Structures

Special Structures	New EB & WB Tunnel at Hidden Valley, New WB Tunnel near SH 6

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT03
NON-REVERSIBLE 6 LANE (NO TOLL)
BASED ON PEIS MINIMUM PROGRAM
APPROX LIMITS: EJMT TO BAKERVILLE, IDAHO SPRINGS TO FLOYD HILL

Not to Scale
Print Date: 1/16/2014

Alt04_Opt01

Maximum Program per PEIS

Maximum program per PEIS with 55 mph design speed including a 3rd bore at EJMT. Maximum program includes one additional non-reversible tolled lane (EB & WB) between EJMT and Floyd Hill.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by widening existing (Non-reversible)
Direction of Improvements	Both directions (EB and WB)
Design Speed	55 mph
Trucks, Private Buses, BRT	Allowed in Toll Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for 3rd toll lane
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2018 (Assumes 3 years NEPA)
Construction Duration	4 years
First Year Operation	2022
Financial Period	50 years

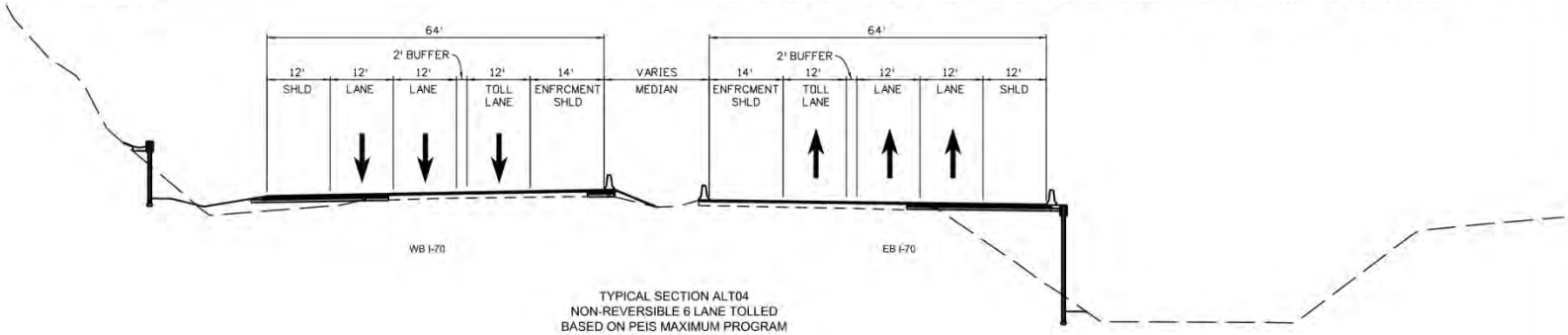
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System; None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

Special Structures

Special Structures	EJMT 3rd Bore

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT04
NON-REVERSIBLE 6 LANE TOLLED
BASED ON PEIS MAXIMUM PROGRAM
APPROX LIMITS: EJMT TO FLOYD HILL

Not to Scale
Print Date: 1/16/2014

Alt04_Opt02

Maximum Program per PEIS

Maximum program per PEIS with 65 mph design speed including a 3rd bore at EJMT. Maximum program includes one additional non-reversible tolled lane (EB & WB) between EJMT and Floyd Hill.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by widening existing
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph
Trucks, Private Buses, BRT	Allowed in Toll Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for 3rd toll lane
Tunnels	Dynamic priced toll for EJMT 3rd Bore and New & Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2018 (Assumes 3 years NEPA)
Construction Duration	4 years
First Year Operation	2022
Financial Period	50 years

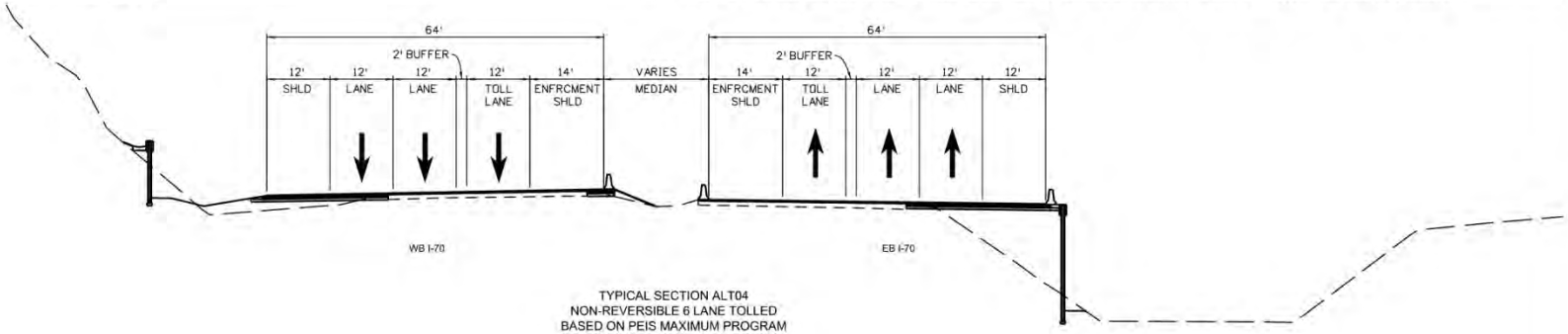
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System; None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

Special Structures

Special Structures	EJMT 3rd Bore
	New EB & WB Tunnel at Hidden Valley, New WB Tunnel near SH 6

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT04
NON-REVERSIBLE 6 LANE TOLLED
BASED ON PEIS MAXIMUM PROGRAM
APPROX LIMITS: EJMT TO FLOYD HILL

Not to Scale
Print Date: 1/16/2014

Alt05_Opt01

Permanent Peak Period Shoulder Lane

Widen the existing roadway to accommodate one additional left side managed lane (EB & WB) for use during peak times, during non-peak times operates as a standard shoulder. Provide full width shoulder on right side.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by widening existing
Direction of Improvements	Both directions (EB and WB)
Design Speed	Match Existing
Trucks, Private Buses, BRT	Allowed in Peak Period Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for EB & WB Peak Period Shoulder Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

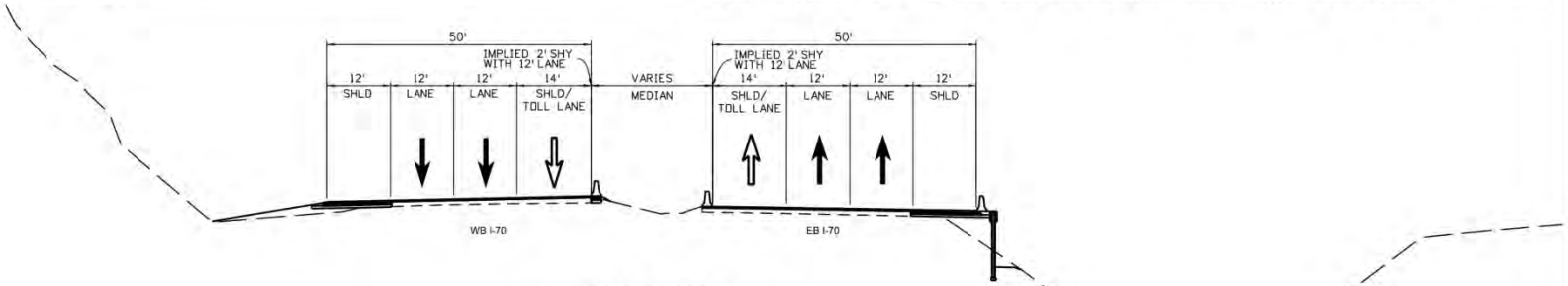
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System; None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

Special Structures

Special Structures	EJMT 3rd Bore

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT05
PEAK PERIOD SHOULDER LANE (PERMANENT)
APPROX LIMITS: EJMT TO FLOYD HILL

Not to Scale
Print Date: 1/16/2014

Alt06_Opt01

Temporary Peak Period Shoulder Lane

Using the existing roadway, accommodate one additional WB left side managed lane for use during peak times; during non-peak times operates as a standard shoulder. No twelve foot wide shoulders are available during peak periods. During non-peak periods, twelve foot breakdown shoulder is on left side instead of right. Construction of WB peak period lane from Empire to Floyd Hill only. (This alternative assumes EB direction peak period lane from Empire to Floyd Hill is constructed.)

Roadway Information

Extent of Roadway Improvements	Empire to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by restriping existing
Direction of Improvements	WB Only Direction
Design Speed	Match Existing
Trucks, Private Buses, BRT	Allowed in Peak Period Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for EB & WB Peak Period Shoulder Lanes
Tunnels	Dynamic priced toll for Twin Tunnels 3rd Lanes
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2016 (Assumes 1.5 years NEPA)
Construction Duration	3 years
First Year Operation	2019
Financial Period	50 years

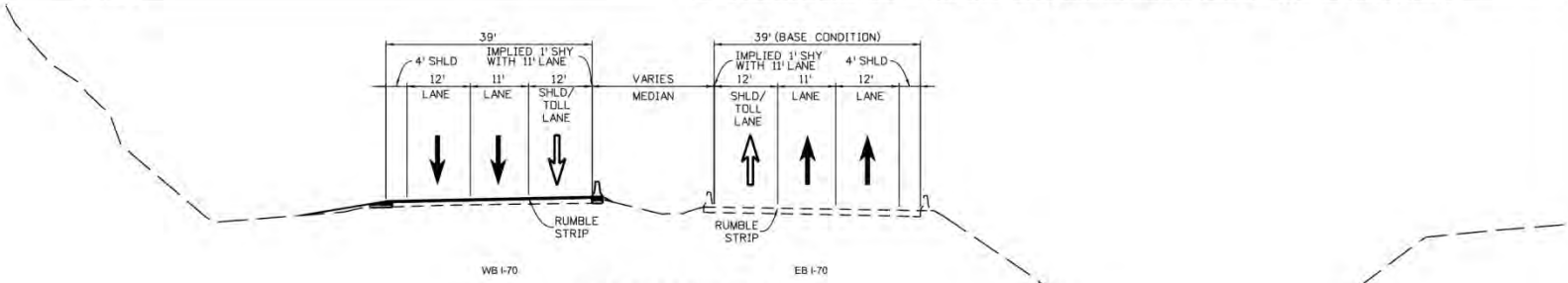
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System; None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

Special Structures

Special Structures	

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



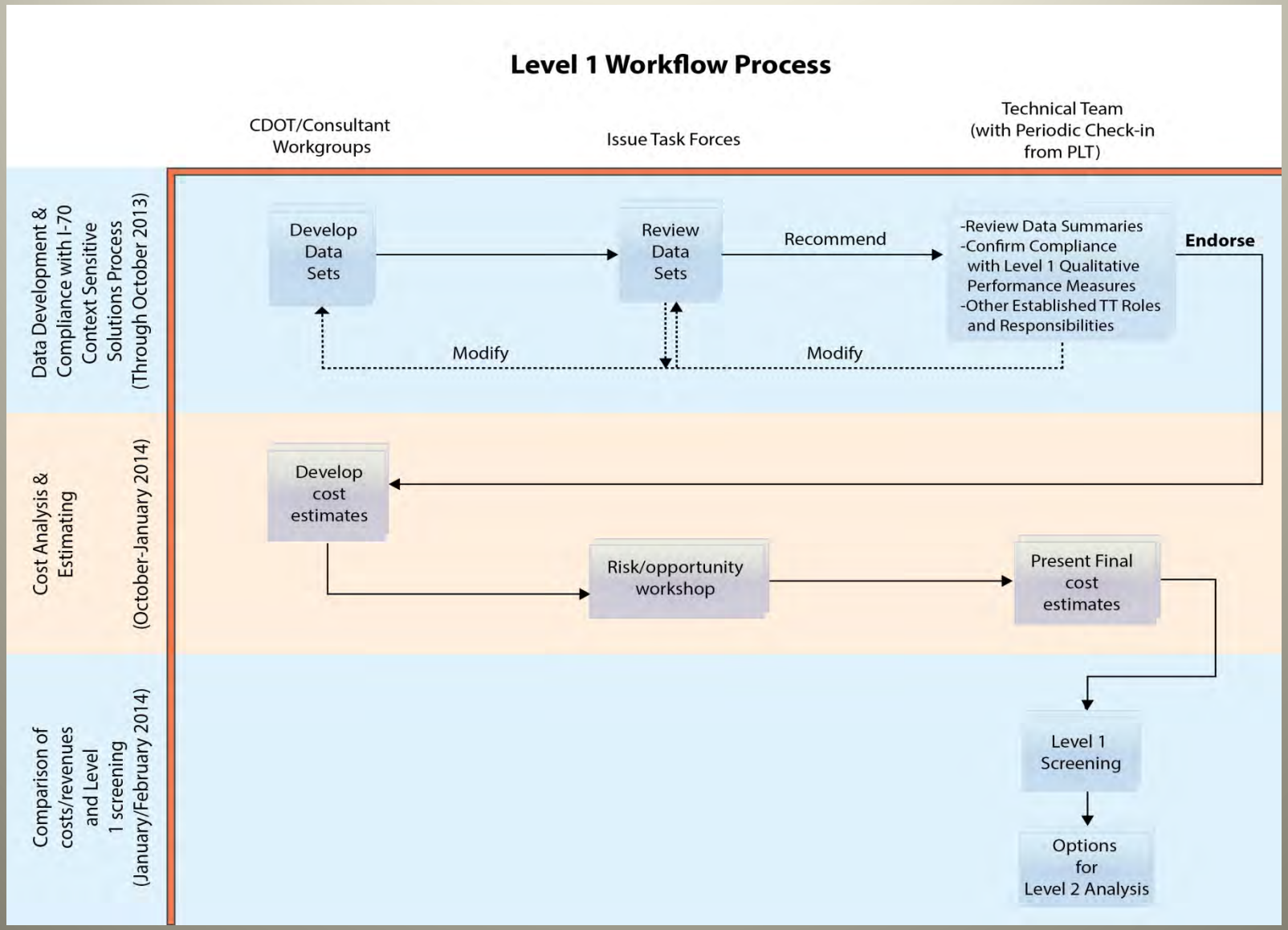
TYPICAL SECTION ALT06_OPT01
PEAK PERIOD SHOULDER LANE (TEMPORARY)
APPROX LIMITS: WB I-70 EMPIRE TO FLOYD HILL

Not to Scale
Print Date: 1/16/2014

I-70 Traffic & Revenue Study

Process for
Cost Estimating
of
Alternatives

Level 1 Workflow Process



I-70 Traffic & Revenue Study

Process for
Base Cost Estimate
of
Alternatives

Base Cost Estimating

- **General Concepts for Capital Costs**
  - Roadway & Structures, Tunnels, & Transit
  - Schematic Engineering to produce quantities for known items
  - Varied resources for deriving unit costs for known items (CDOT)
  - Allowance for Unallocated Items (known items but not quantifiable)
  - Allowance for CSS factor on capital costs 15%
  - Advanced Guideway System costs directly from DRAFT 2014 AGS Study

Base Cost Estimating

- **General Concepts for Preconstruction & Administration**
  - NEPA costs derived through similar projects
  - Design percentages applied to capital costs
  - Design percentages include both Design Engineer & CDOT costs
  - Allowance for CSS factor on design costs 19%
  - Construction Engineering percentages applied to capital costs
  - Advanced Guideway System costs directly from DRAFT 2014 AGS Study

Base Cost Estimating

- **General Concepts for Operations & Maintenance**
  - Varied resources for deriving unit costs for known items (CDOT)
  - CDOT Maintenance Staff provided unit costs for maintenance items
  - O&M costs were included to carry out the CDOT I-70 Clear Creek Corridor Sediment Control Action Plan (September 2013)
  - Advanced Guideway System costs directly from DRAFT 2014 AGS Study

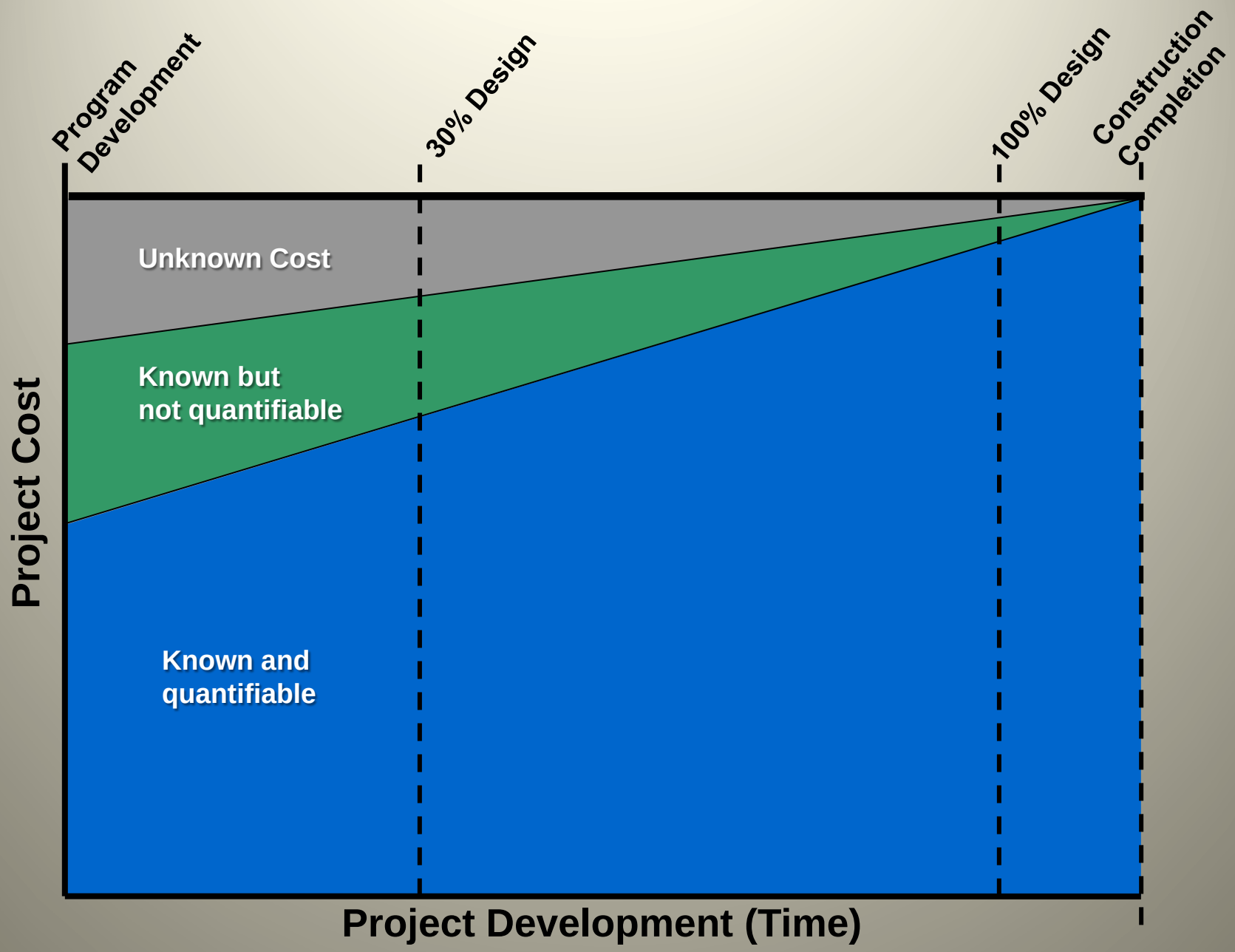
I-70 Traffic & Revenue Study

Process for Validating Base Cost Estimate of Alternatives

Project Cost and Schedule Uncertainty

The ultimate cost and schedule of a project cannot be predicted with 100% certainty, because:

- Plans can be affected by a number of variables:
  - Technical
  - Policy (regulatory and political)
  - Stakeholders
- During project development, information on these variables is typically limited


Program Development
30% Design
100% Design
Construction Completion
Unknown Cost
Known but not quantifiable
Known and quantifiable
Project Cost
Project Development (Time)

Transportation Risk and Uncertainty Estimating (TRUE)

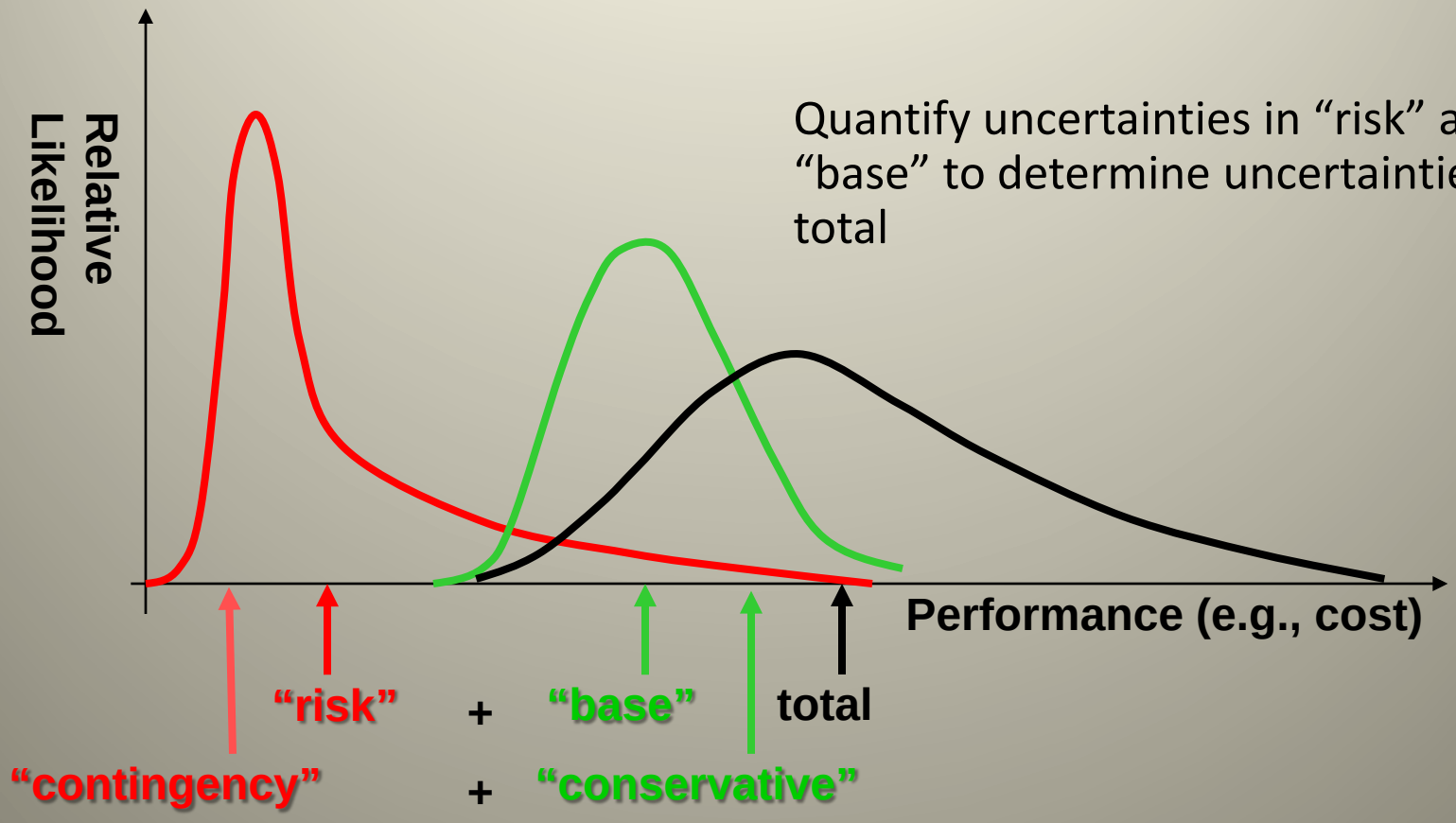
- Quantify uncertainty in cost:
  - o Sequence project activities

    (at Level 2 update)
  - o “Base” activity costs
  - o Risks, Opportunities, and other uncertainties
- Prioritize critical risks

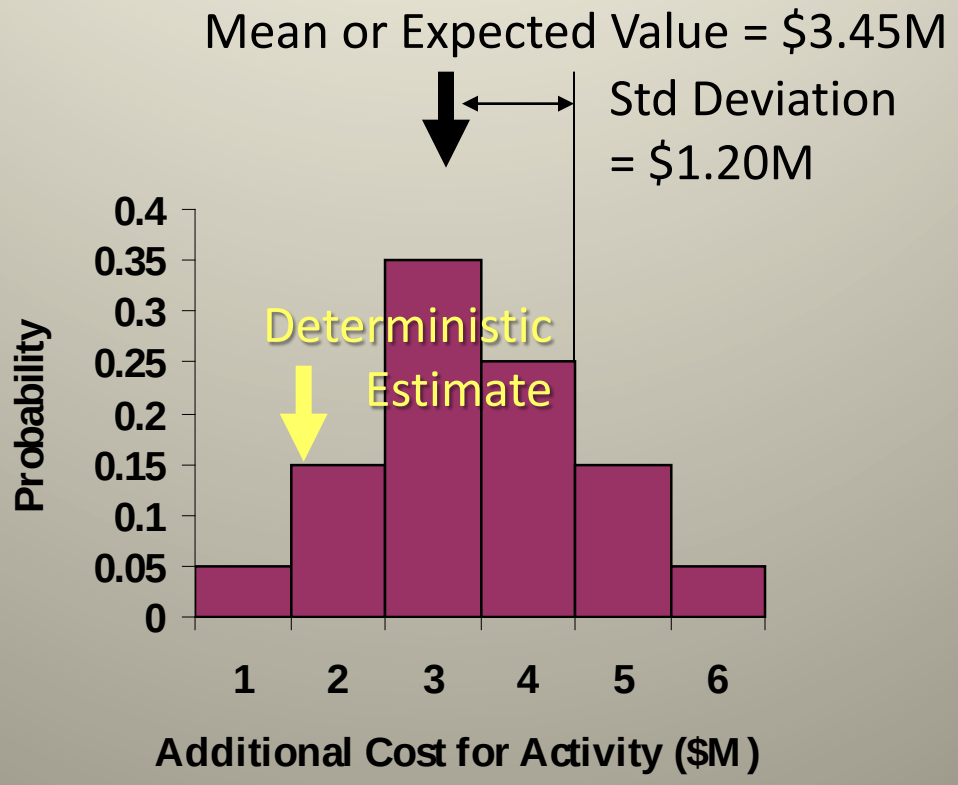
Total = Base + Risk

Replace “contingency” (top-down) with calculated “risk” and “opportunity” (bottom-up)

Quantify uncertainties in “risk” and “base” to determine uncertainties in total



Describing Uncertainty



TRUE Approach

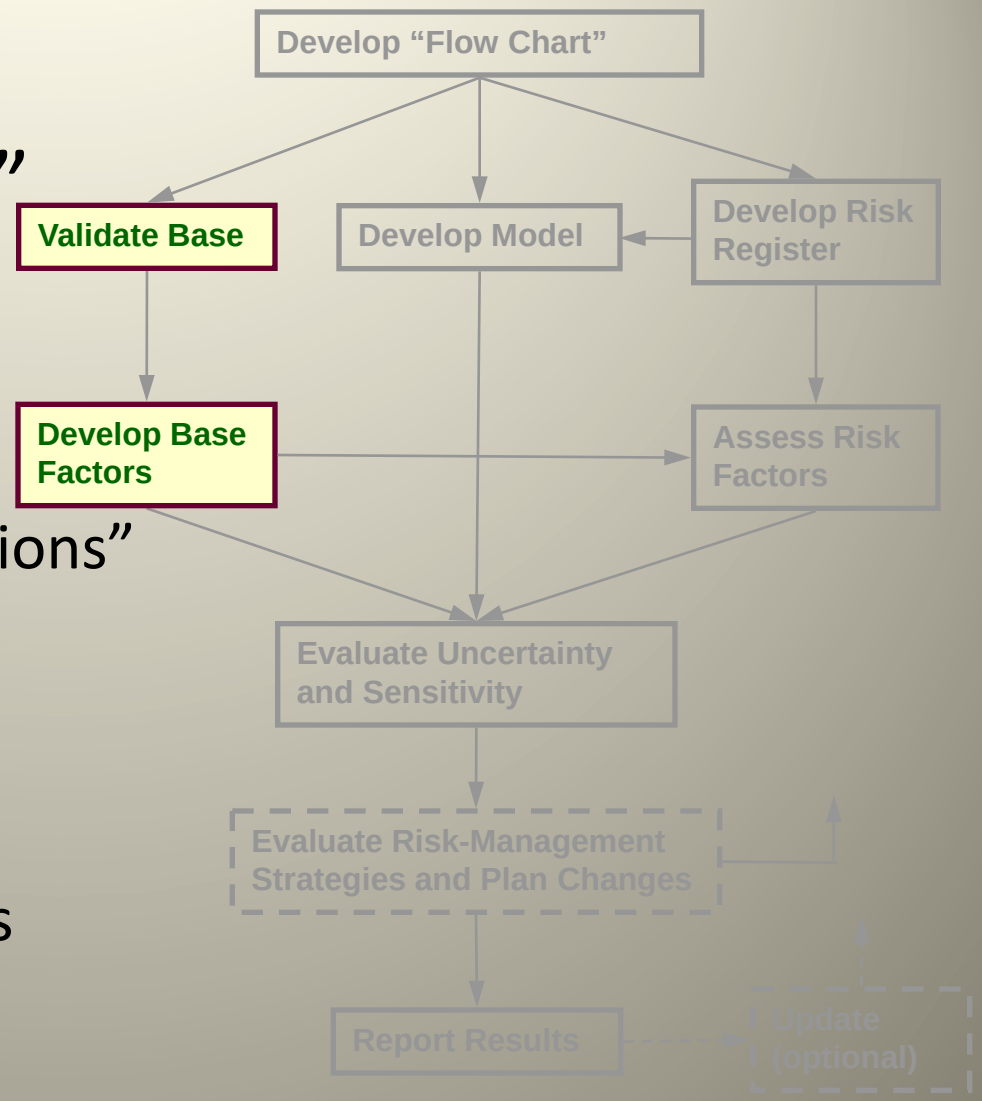
Comprehensive look at the project

- Employ a collaborative, team approach
  - Focus on key issues
    - Quantify uncertainty
      - Apply risk-mgt. Strategies (level2)
        - Document and Update

TRUE (Risk-Based) vs. Traditional

Traditional	Risk-Based
Estimate is a Single Value with unknown confidence	Estimate is a Distribution that expresses confidence
Based on arbitrary set of assumptions	Considers uncertainty in key assumptions
Risk and Uncertainty are modeled as lumped “contingency”	Risk and Uncertainty are evaluated explicitly by source / type
Risk Management is ad-hoc	Risk Management is formal and explicit, because significant risks (and opportunities) are quantified
Relies on judgment from experience plus data – consensus hard to achieve	Relies on judgment from experience plus data – consensus easier to achieve

Develop “Base Cost ”



- Project “within assumptions”
- Estimate = Scope
- Validate Costs
- Develop *unbiased* values

PROJECT TEAM OWNS THE ESTIMATE

Actions…

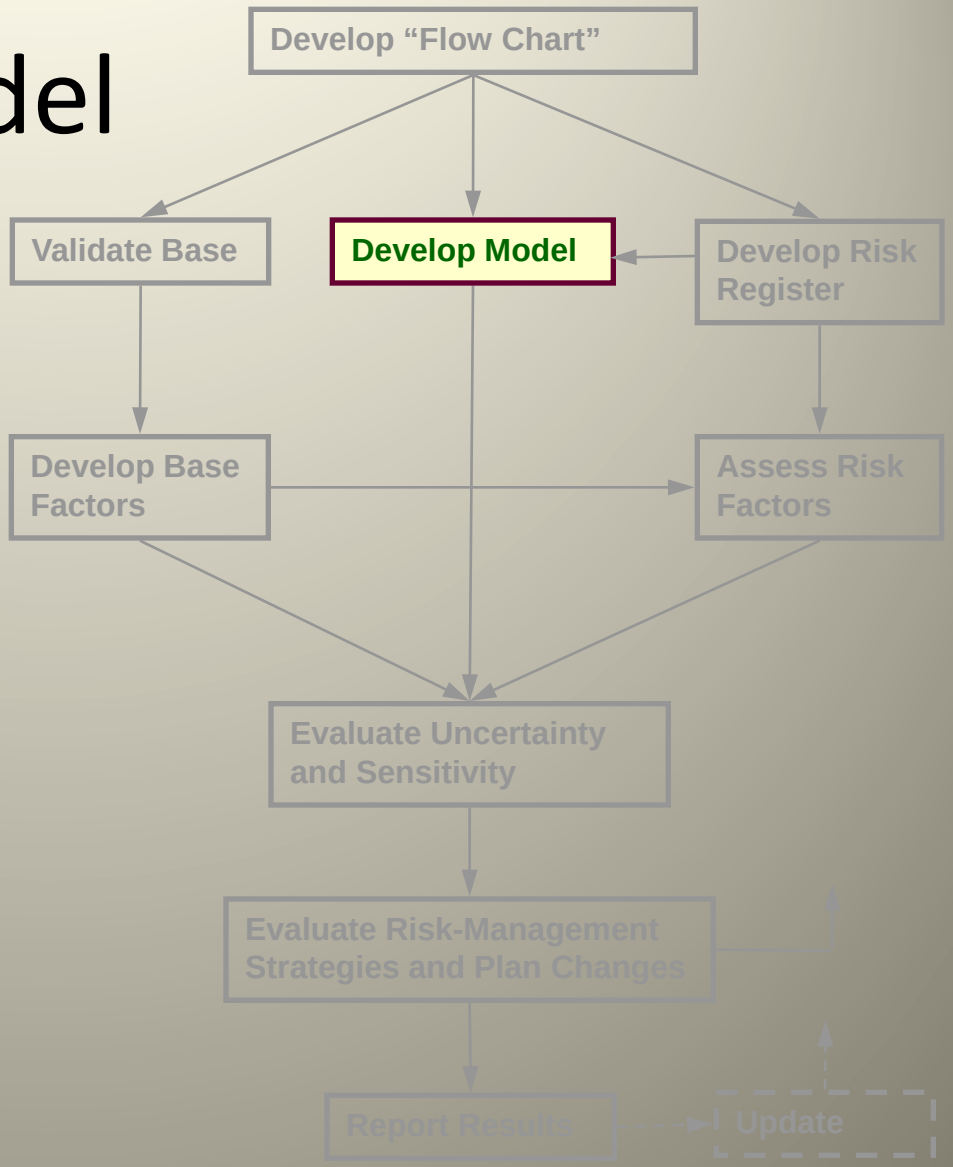
- Remove contingency (explicit and ‘buried’)
  - Exception for CSS Factor
- Replace with “risk” and “opportunity” events
- Identify conservatism (e.g. unit prices)
- Document assumptions

Risk-factor assessments…

- Are based on data, if available (objective analysis)
- Are based on assessments from experienced Subject Matter Experts
- Can combine data and judgment

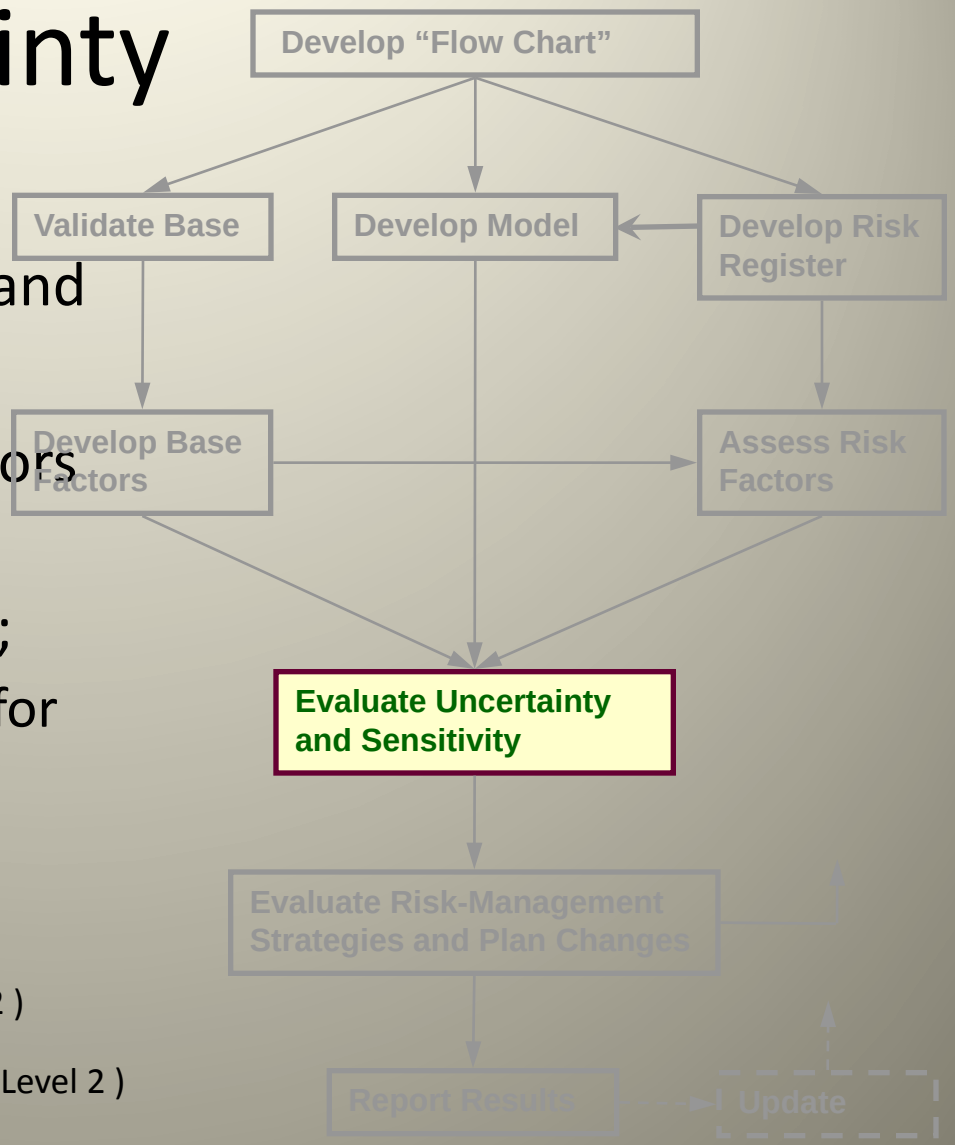
Uncertainty Model

- Inputs: base cost, and risk register (flow chart in Level 2)
- Statistical Model
- Software used is Crystal Ball™
- Predictive analysis tool
- Monte Carlo simulation calculates thousands of scenarios



Evaluate Uncertainty

- Identify, quantify, and prioritize critical activities and risks
- Combine base and risk factors
- Simulate results of interest;
  - Probability distributions for total project cost
  - Probability of meeting milestones (for Level 2)
  - Component costs (for Level 2)
  - Cash flow uncertainty (for Level 2)



SAMPLE ESTIMATING SPREADSHEET

Resource	Description	Project Totals	At Risk Cost Range $			Risk Probability Percentages (%)			Weighted Percentages		
			L	ML	H	L	ML	H			
Contractor	Mobilization	$ 367,500	$ 300,000	$ 367,500	$ 400,000	30%	75%	80%	16.2%	40.5%	43.2%
Contractor	Excavation & Backfill	$ 592,800	$ 450,000	$ 592,800	$ 592,880	85%	50%	20%	54.8%	32.3%	12.9%
Contractor	Intersections	$ 210,000	$ 180,000	$ 210,000	$ 240,000	30%	75%	60%	18.2%	45.5%	36.4%
Contractor	Structures	$ 14,624,584	$ 12,000,000	$ 14,624,584	$ 19,000,000	20%	60%	75%	12.9%	38.7%	48.4%
Contractor	Retaining Walls	$ 4,875,000	$ 4,000,000	$ 4,875,000	$ 5,000,000	70%	80%	70%	31.8%	36.4%	31.8%
Contractor	Pavements	$ 1,474,697	$ 800,000	$ 1,474,697	$ 1,800,000	15%	50%	20%	17.6%	58.8%	23.5%
Contractor	Signing & Striping	$ 40,000	$ 30,000	$ 40,000	$ 100,000	75%	60%	80%	34.9%	27.9%	37.2%
Contractor	Erosion Control	$ 68,321	$ 50,000	$ 68,321	$ 80,000	40%	70%	50%	25.0%	43.8%	31.3%
Contractor	Surveying	$ 20,000	$ 20,000	$ 20,000	$ 40,000	50%	50%	50%	33.3%	33.3%	33.3%
Contractor	Rock Staining	$ 42,000	$ 25,000	$ 42,000	$ 50,000	50%	50%	70%	29.4%	29.4%	41.2%

TRUE Workshop Team

Project Director
Steve Smith

Benjamin Acimovic
Ralph Trapani
Workshop Leaders

Brad Doyle & Joe Kracum
Facilitation Leaders

Uncertainty Model
Hans Hoppe

Subject Matter Experts

Structures
Dave Kosmiski
John Braaksma
Julia Barker

Roadway
Randy Jensen
Sara Richardson
Carl Rogers
Scott Thomas

Transit
David Krutsinger
Phil Hoffman
Jen Babbington

Mitigation
Melinda Urban
Wendy Wallach
Paul Nikolai

Construction
Mitch Fowler
Dennis Curtin

Tunnels
Matt Greer
Doug Slakey
Greg Fischer
Peggy Ganse

TRUE Summary

TRUE quantifies uncertainties considering

- Integration of costs for each T&R alternative
- “Base” project assumptions
- Risk and Opportunity
- Inflation

TRUE

- Provides a defensible approach to estimating
- Provides the basis for future Risk Management, Value Engineering and Project / Program Strategic Planning
- Promotes internal project communication and understanding

I-70 Traffic & Revenue Study
Level 1 Cost Estimating of Alternatives

- Capital Costs
- Design & Construction Engineering
- CSS Factors
- Distribution of Costs - 80% Certainty

Managed Lanes Alternatives w/ BRT

- **Alternative 1 – Two Managed Lanes. BRT.**
  - Option 1 $ 4,116 - $ 4,330
  - Option 2 $ 4,494 - $ 4,733

- **Alternative 2 – Three Managed Lanes. BRT.**
  - Option 1 $ 5,084 - $ 5,351
  - Option 2 $ 5,339 - $ 5,623
  - Option 3 $ 5,156 - $ 5,418

Costs in 2014 millions.

PEIS Alternatives

- **Alternative 3 – Minimum Program w/ AGS**
  - Option 1 $ 1,948 - $ 2,096 Plus AGS $6,802
  - Option 2 $ 2,300 - $ 2,458 Plus AGS $6,802
  - Option 3 $ 526 - $ 563 Plus AGS $6,802
  - Option 4 $ 886 - $ 943 Plus AGS $6,802

- **Alternative 4 – Maximum Program w/ AGS**
  - Option 1 $ 2,625 - $ 2,800 Plus AGS $6,802
  - Option 2 $ 3,028 - $ 3,218 Plus AGS $6,802

Costs in 2014 millions.

Peak Period Shoulder Lanes

- **Alternative 5 – Permanent Shoulder w/ AGS**
  - Option 1 $ 1,937 - $ 2,054 Plus AGS $6,802

- **Alternative 6 – Temporary Shoulder w/ AGS**
  - Option 1 $ 100 - $ 108 Plus AGS $6,802

Costs in 2014 millions.

I-70 Traffic & Revenue Study
Level 1 Cost Estimating of Alternatives

- Operations & Maintenance <u>Costs per year</u>
  - Roadway & Structures
  - Tunnels
  - Bus Rapid Transit
  - Advanced Guideway System

Managed Lanes Alternatives w/ BRT Operations & Maintenance Costs

- **Alternative 1 – Two Managed Lanes. BRT.**
  - Opt 1 $ 19.8 lanes $ 29.9 BRT $49.7 total
  - Opt 2 $ 19.9 lanes $ 29.9 BRT $49.8 total

- **Alternative 2 – Three Managed Lanes. BRT.**
  - Opt 1 $ 24.0 lanes $ 29.9 BRT $53.9 total
  - Opt 2 $ 24.2 lanes $ 29.9 BRT $54.1 total
  - Opt 3 $ 24.2 lanes $ 29.9 BRT $54.1 total

Costs in 2014 millions per year.

PEIS Alternatives

- **Alternative 3 – Minimum Program w/ AGS**
  - Opt 1 $ 10.6 lanes $ 59.3 AGS $69.9 total
  - Opt 2 $ 10.9 lanes $ 59.3 AGS $70.2 total
  - Opt 3 $ 5.4 lanes $ 59.3 AGS $64.7 total
  - Opt 4 $ 5.6 lanes $ 59.3 AGS $64.9 total

- **Alternative 4 – Maximum Program w/ AGS**
  - Opt 1 $ 14.2 lanes $ 59.3 AGS $73.5 total
  - Opt 2 $ 14.4 lanes $ 59.3 AGS $73.7 total

Costs in 2014 millions per year.

Peak Period Shoulder Lanes

- **Alternative 5 – Permanent Shoulder w/ AGS**
  - Opt 1 $ 13.8 lanes $ 59.3 AGS $73.1 total

- **Alternative 6 – Temporary Shoulder w/ AGS**
  - Opt 1 $ 3.4 lanes $ 59.3 AGS $62.7 total

Costs in 2014 millions per year.

I-70 Traffic & Revenue Study
Alternatives & Cost Estimating Group Sessions

- Could we create a better alternative by mixing and matching elements of different alternatives?
- What constitutes a good cost estimate?
- Any Questions or Clarifications?

Could we create a better alternative by mixing and matching elements of different alternatives?

-
-

What constitutes a good cost estimate?

-
-

Questions & Clarifications?

-
-

Future Meetings

- 25 Mar Tolling & Modeling ITF Meeting
- 26 Mar PLT Meeting on Costs & Modeling
- 23 Apr PLT / TT Meeting on Level 1 Results

Information Review Periods

- 7 Mar Cost Estimating review comments due
- 19 Mar Distribution of Modeling Information to TT & PLT
- 11 Apr TT & PLT Comments due on Costs & Modeling
- 23 Apr PLT / TT Meeting on Level 1 Results

Wrap up & Action Items Review

-

Thank You